

A Review of Fuzzy Based Expert System in Agriculture

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Abstract

Agriculture in India has a very significant history. Today, India ranked second worldwide in terms of farm output. Over the year agriculture has contributed towards India's GDP but is narrowly declining with the country's economic growth due lack of initiatives. Over the years there have been various advancements and experiments done in this field. One such is Fuzzy expert systems which are being used in agriculture for various activities i.e soil preparation, seed selection, pesticide management, water scheduling, weed management etc, with an objective to get better results and good yield out of crops. An fuzzy expert system is a collection of membership functions and rules that are used to reason about data. Unlike conventional expert systems, which are mainly symbolic reasoning engines, fuzzy expert systems are oriented toward numerical processing. In this paper we will be discussing role of fuzzy expert system and various experiments and research applied in field of agriculture.

Keywords: Fuzzy Expert system, Agriculture, Fertilizer, Fuzzy logic..

Introduction

An expert system is a computer program that uses artificial intelligence in emulating the decision-making ability of a human expert. Expert systems are designed with purpose to solve complex problems by reasoning about knowledge, represented primarily as if-then rules rather than through conventional procedural code. The first expert systems were created in the 1970s and then proliferated in the 1980s. Expert systems were among the first truly successful forms of AI software[20].

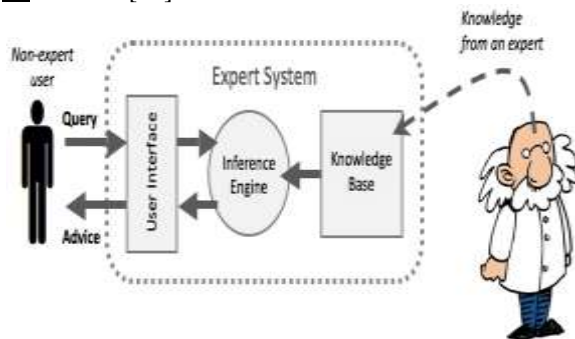


Fig 1 Expert Systems [19]

An expert system basically consists of three parts:

- A knowledge base A knowledge base is rules about the system's domain area. The knowledge

base is gathered and collected from information, facts provided by human experts.

- An inference engine - An inference engine basically evaluates and interprets the facts of the knowledge base in order to provide an result. It acts like a search engine, examining the knowledge base contents for data that would match the input user's query.
- A user interface - This is the system that would allow a user to put query to the expert system, and will receive advice.

Information knowledge and facts for a knowledge base will be acquired from human experts through interviews and observations. This acquired knowledge is then usually represented in the form of "if-then" rules

Expert system applications

This Expert system over the years has been used in various research area and have been very beneficial and useful with their results. Some of areas of application are Medical Field: Firstly medical information already fed to knowledge base. The symptoms of the patient are used as the query, and the expert system output is a diagnose of the patient's illness.

Gaming Field: Like in a chess game against a computer where the knowledge base are pre fed strategies and moves, the player's moves will be used as the query, and the output will be the computer's response move.

Recognition: In this field it helps to recognize and identify things like animals, plants, rocks, as knowledge base contains characteristics of things in its knowledge base. The unknown thing detail will be query and output would be recognition. There are lot of areas where expert system is being used [19].

PROS of expert system

- **Availability** Expert system can be easily available on any computer hardware.
- **Information Cost** The cost of providing expertise advice per user is greatly reduced.
- **Reliability** Expert system provides reliable outputs as knowledge base contains expert advice unless a mistake is done from expert in providing data.
- **Responsive.** There is time we require fast or real-time response for some applications, an expert system may respond faster than a human expert.

CONS of expert system

- **Adaptability** Expert system cannot easily adapt to new data that is unexpected or unknown to its knowledge base.
- **Difficulty** It can be difficult to use if non expert makes mistake while he using system and resulting advice would be false.
- **Hardware** These systems have no common sense like a human which may be able to identify or notice errors which computer hardware may not.

Application field of expert systems in agriculture

In the following we will we discuss various expert system and there approach and will broadly classify them accordingly their application area in agriculture.

Water Irrigation expert systems

- “A fuzzy controller (FC) has been implemented for monitored drip irrigation duration to reduce water using as variables soil moisture degree and air temperature in greenhouse” [1]. In this work soil moisture was measured using electronic circuits and a user interface using LABVIEW was developed for acquiring this data and monitoring drip irrigation system. Thus, this research developed a system which would acquire current amount of moisture contents in

soil and accordingly required amount of water is fed to crop so that it helps to irrigate at right time.

- Another fuzzy based expert system for irrigation that was developed using Mamedani controller and was built using Matlab software. This developed fuzzy logic controller can effectively estimate amount of water uptake of plants in distinct depth using the reliable irrigation model, evapo-transpiration functions, environmental conditions of greenhouse, soil type, type of plant and another factors affecting the irrigation of greenhouse [13].

Climate control expert system

This control system was implemented using fuzzy logic which would regulate various climatic parameters under greenhouse by making of the LabVIEW software, by cooling and heating for ensuring required range of temperature and humidity range. Graphics user interfaces were developed, under LabVIEW software, for real time monitoring of greenhouse system [8].

Fertilizer management expert system

This system was developed for fertilizer recommendation purpose that used validated fertilizer adjustment equations (generated by AICRP on soil test crop response correlation and Geographic information system)[8]. This system took index values of nitrogen(N), phosphorous(P) and potassium(K) and calculated correspondingly equivalent of soil nutrients values of N,P and K required .

Pest Control and Diagnosis expert Systems

- In this expert system named FuzzyXPest, basic approach was to forecast the pest activity level by which we will be able determine the damages done by pests. FuzzyXPest is proposed to provide information to farmers and researchers through the internet using fuzzy expert system. This system has been verified by Malaysia Agriculture Research & development Institute, Malaysia [3].
- SOYBUG, an expert system was developed to advise Florida farmers on control of four important insect pests of soybeans: velvet bean caterpillar, stink bug, corn earworm, and soybean looper [7]. SOYBUG system basically implements various rules and knowledge that are based on crop study and economics. This expert system accordingly input

query recommends pesticides and its application rates required.

- SOYPEST, expert system was developed with pest management approach to help solve pest related problems of farmers by providing diagnosis of pest and its corrective measures. Objective of SOYPEST is to provide IPM decision support to the farmers through the internet. This has been used for the crops grown in different regions of India [6].
- This is another pest diagnosis expert system named CALEX developed in Egypt used extensively for cotton crop. CALEX is user friendly computer program that simulates human problem solving behavior. Growers can use this system to help manage crop production or predicts the effects of any one decision on subsequent events [11]. This expert system was advantageous for cotton producers as CALEX contained plant and pest simulation model for the purpose of pest diagnosis.
- Web based fuzzy expert system [18] was developed for the purpose of controlling the insect pests found in groundnut. This expert system is able to identify various observable symptoms, secondly identify actual insect pest then recommend various control measures and recommendations as per knowledge base. The system is divided into mainly two parts. The first part is used to identify the externally observable symptoms on crop as well as on insect and the second part is used to identify the actual problem(s) and recommend appropriate control measure.
- This disease management expert system provides remedial measures for disease management of Ragi food crop of Karnataka state of India. The introduction section consists of contributions of expert systems in agriculture. The second section explains the process in Integrated Disease Management (IDM). The third section is about knowledge engineering process which consists of knowledge acquisition and knowledge representation. The fourth section is about the application of fuzzy logic in IDM. The fifth section briefs about defuzzification of IDM. Expert system - a branch of Artificial Intelligence is a collection of programs which has the ability to reason, justify and answer the queries in a particular domain as a human expert would do. It can be applied to various fields [12].

- Here a disease diagnostic system was developed particularly for oilseeds like soybean, groundnut rapeseeds etc which will help to increase the ability of the cultivators/extension workers researchers in decision making.[14]. Above system is basically a web-based intelligent disease diagnosis system (WIDDS) using the fuzzy logic approach, thus this system will help in diagnosis approach in agriculture.
- This is an image based paddy disease diagnostic expert system which would use the fuzzy based knowledge[16]. Here in this system three types of methods are used. Three types of methods are used for used in this system developing membership rules, membership exemplification, direct rating reverse rating are used for implementation purpose.

Conclusion

Over the years agriculture has seen various changes, with expert system coming up with needful technological methods. Expert systems now are proving a better option over traditional systems. Expert system is a technological way to deliver agricultural knowledge from books, research papers, thesis etc to actual implementation level i.e. at Farmer levels. Including fuzzy logic in expert system to handle imprecise information agriculture field is been useful and have shown good results. So in proposed research we would develop such a expert system which will guide agriculturists to take decision for fertilizer management and would be beneficial for not only farmers but also to environment.

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