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ADVISE GIVING EXPERT SYSTEM BY USING ARTIFICIAL BEE COLONY OPTIMIZATION ALGORITHM

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Abstract- The presently developed paper deals with the concepts of expert systems and machine learning Algorithms in the field of Artificial Intelligence. This expert system follows the tactic of task-based specification and it is independent in case of problem solving. Second thing is that, the machine learning technique is used to find the good optimal solution. This paper mainly focuses on the investigations on the diseases and treatment to the diseases which were affected to the chilli plants by using the mechanism of Rule based system and Artificial Bee Colony (ABC) algorithm. The rules in the database is process by the rule based system which is generally used in expert system and if the required rules are not present in the database, then the system goes to the Machine learning algorithm technique used expert system. Thus by applying machine learning techniques, this resulting to best global optimized solution for recognizing the diseases in chilli plants.
Keywords- Expert System, Advisory System, Rule Based System, Artificial Bee colony Algorithm.

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Introduction

Artificial Intelligence (AI) is a branch of computer science, which focuses on the development of computer systems to simulate the processes of problem solving and duplicate human brain functions. According to Elaine Rich (1983), "Artificial intelligence is the study of how to make computers do things at which, at moment, people are better". This simple, but expressive, statement captures the real meaning of the detection. Artificial intelligence comprises hardware and software systems and techniques that attempt to emulate human mental and physical processes. The mental processes emulated include thinking, reasoning, decision making, data storage and retrieval, problem-solving and learning. To design an expert system, one needs a knowledge engineer, an individual who studies how human experts make decisions and translates the rules into terms that a computer can understand.

Related Work

In 1965 the AI researcher Edward Feigenbaum and the geneticist Joshua Lederberg, both of Stanford University, began work on Heuristic Dendral, the high-performance program that was the model for much of the ensuing work in the area of expert systems. The program's task was chemical analysis. Some of the expert systems which have been created are-

- Dendral- This ES identifies the molecular structure of unknown compounds.
- Mycin- This ES developed by Stanford University. This expert system provides assistance to physicians in the diagnosis and treatment of meningitis and bacterial infections.
- Prospector- This system used successfully to locate deposits of several minerals, including copper and uranium developed by SRI International.
- Altrex- This system helps diagnose engine troubles of certain models of Toyota cars developed by their research lab.
- Predicate- This system developed by Digital Equipment Corporation for use by Land Lease, Australia.

Expert System

As per given in the introduction section an expert system is a computer program dedicated to solving problems and giving advice within a specialized area of knowledge and information. A very well performance giving system can match the performance of a human specialist. Expert systems have application in virtually every field of knowledge. An expert system is software that uses a knowledge base of human expertise for problem solving, or to clarify uncertainties where normally one or more human experts would need to be consulted for giving best. The decision areas expert systems are typically applied to include configuration, diagnosis, interpretation, instruction, monitoring, planning, prognosis, remedy and control. The basic components of an expert system are a "knowledge base" or KB and an "inference engine". The information in the KB is obtained by interviewing people who are expert in the area in question.

Types of Expert System

There are many different types of expert systems. The following list describes the various types.

Diagnosis- Diagnosis types of expert systems are used to recommend remedies to illnesses, trouble-shoot electronic or mechanical problems or as debugging tools.

Repair-Expert systems that define repair strategies are also very common. As well as diagnosing the problem they can suggest a plan for the repair of the item.

Instruction-Instructional expert systems have been used for individualized training or instruction in a particular field.

Interpretation- Interpretive expert systems have the ability to analyses data to determine its significance or usefulness.

Prediction- Predictive expert systems are used as a method to “guess” at the possible outcomes of observed situations, usually providing a probability factor. This is used often in weather forecasting.

Design and Planning-This allows experts to quickly develop solutions that save time. These systems do not replace experts but act as a tool by performing tasks such as costing, building design, material ordering and magazine design.

Monitoring and Control- In certain applications expert systems can be designed to monitor operations and control certain functions.

Classification/Identification- These systems help to classify the goals in the system by the identification of various features For example various types of animals are classified according to attributes such as habitat, feeding information, color, breeding information, relative size etc.

Expert System Architecture

An expert system is, typically, composed of two major components, the Knowledge-base and the Expert System Shell. The Knowledge-base is a collection of rules encoded as metadata in a file system, or more often in a relational database.

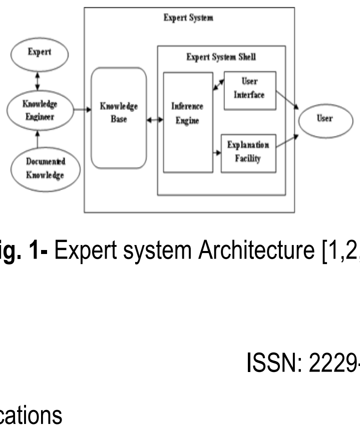


Fig. 1- Expert system Architecture [1,2,23]

The As is shown in Figure 1, expert system architecture distinctly separates knowledge and processing procedures in the knowledge base and inference engine, respectively [1,2,23]. Explicit knowledge is context specific and is easily captured and codified [2].

In expert systems, the inference engine organizes and controls the steps taken to solve the problem. It uses rule-based reasoning to navigate through the rules, which are stored in the knowledge base [1]. Once the inference engine determines a solution to the problem, it is presented to the user through the user interface. In addition, explanation facilities in expert systems trace the line of reasoning used by the inference engine to help end-users assess the credibility of the decision made by the system [12]. Often the decisions made by expert systems are based on incomplete information about the situation at hand.

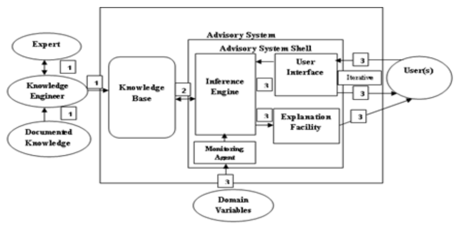
Advisory System

Both advisory systems and expert systems provide expertise to support decision making in a many of domains. Expert systems are used to solve problems in well defined, narrowly focused problem domains, whereas advisory systems are designed to support decision making in more unstructured situations which have no single correct answer. The decision-making process that occurs when users utilize advisory systems is similar to that which is used for the judge-advisory model developed in the organizational behavior literature [21,22].

Advisory System Architecture

Advisory system differ from expert systems in that classical expert systems can solve a problem and deliver a solution, while advisory system are designed to help and complement the human’s problem-solving process [11,18]. Let’s go towards the changes in advisory system from expert systems includes giving the final decision back to the user and utilizing the case-based reasoning methodology in the inference engine [11]. In contrast to the rule-based reasoning used in traditional expert systems, which uses Boolean logic, case-based reasoning accommodates for uncertainty by using algorithms to compare the current situation to previous ones and assigns probabilities to the different alternatives [24]. Once probabilities have been assigned, the advisory system interface engine is then able to evaluate the alternatives. Fig. 2 illustrates the iterative support of advisory systems in the decision-making process; this functionality contrasts expert systems which only provided a final answer with supportive justification. The three main processes of advisory systems are knowledge acquisition, cognition and interface.

Process 1- Knowledge Acquisition



1-Knowledge Acquisition, 2-Cognition, 3-Interface

Fig. 2- Proposed advisory systems architecture, adapted from [19,11]

The process of knowledge acquisition in advisory systems is similar to that of traditional expert systems, but the difference is that it can be much more complicated because the unstructured nature of the problem domain can make the knowledge more difficult to capture and codify. In general, advisory systems are designed to support a broad category of problems, too broad to exactly specify all of the knowledge necessary to solve the problem [11].

Process 2- Cognition

Cognition does a better job of describing this process in advisory systems than does inference, because it encapsulate the added functionality of active monitoring and problem recognition, which was introduced in the transition from expert systems. Most unstructured decisions do not present themselves to the decision maker in convenient ways, so advisory systems supplement the task of problem identification by monitoring environmental variables [18,19].

Process 3- Interface

In this process encapsulates all sub processes that facilitate information exchange between the inference engine and the end-user. This includes the automated input of environmental parameters that are used in monitoring functionality.

Artificial Bee Colony Algorithm

The Artificial Bee Colony (ABC) Algorithm, developed by (Karaboga in 2005) observing the intelligent foraging behavior of honey bees, is a met heuristic algorithm for solving numerical optimization problems. Met heuristics are high-level strategies for exploring search spaces. The Artificial Bee Colony (ABC) algorithm2 uses a colony of artificial bees. The bees are classified into three types-

1. Employed bees,
2. Onlooker bees and
3. Scout bees.

Each employed bee is associated with a food source, which it exploits currently. A bee waiting in the hive to choose a food source is an onlooker bee. The employed bees share information about the food sources with onlooker bees in the dance area. A scout bee, on the other hand, carries out a random search to discover new food sources. Both onlookers and scouts are also called unemployed bees. In the algorithm, one half of the population consists of employed bees and the other half consists of onlooker bees. Initially, all food source positions are discovered by scout bees. Thereafter, the nectar of food sources are exploited by employed bees and onlooker bees. Then, the employed bee which was exploiting the exhausted food source becomes a scout bee in search of further food sources once again. In other words, the employed bee whose food source has been exhausted becomes a scout bee. In ABC, the position of a food source represents a possible solution to the problem and the nectar amount of a food source corresponds to the quality (fitness) of the associated solution.

Rule Based Expert System

Rule-Based Expert Systems represent knowledge as a bunch of rules and assertions. It involves a database that stores the assertions and rules that can perform some action. The implementation of the system makes many complicated problems into smaller ones. Unification (matching variables) allows flexibility of the rules, with which the systems can deduce more specific facts and solve more specific problems without having a giant set of similar rules. The expert knowledge will typically be in the form of a set of IF-THEN rules. The case specific data includes both data provided by the user and partial conclusions.

Chilli Expert Advisory System

In the present system, rules are important for diagnosing a disease in the Chilli plants using rule based and machine learning expert system. Here, the rules and rule combinations are prepared according to the data given by the subject experts and stored in the database. Here we had applied a machine learning algorithm such that to get better optimization results in the present Chilli expert system. In this we focus on the optimization algorithm which gives higher searching efficiency, better optimized and high quality results. Here an application of the diseases and symptoms in the Chilli plants and flowers is taken and developed expert system for diagnosing the diseases in Chilli plants. It is a two level expert system in which the system is considered with diagnosing the disease in Chilli plants in a better way. The present application is consisting of two systems rule based system and machine learning system

Here the System1 is Rule based system, where the set of rules are collected from the experts in the relevant field and knowledge base is purely build with rules and facts by taking variables. The system2 is machine learning system which uses the database for searching the symptom combination given by the user and gives better optimal solutions. Here, our aim is not to get minimal solutions but to get a good optimized better solution.

Database Generation

In this section, the setup for production rules in the knowledge base is presented. Generally the rules are of the form,

Rule 1- S1=1, S2= 0, S3= 0, S4= 0, S5=0, S6= 1, S7= 0, S8=1
Resultant disease may be D1
Rule 2- S1= 1, S2=1, S3= 0, S4= 0, S5= 0, S6= 0, S7=1, S8=0
Resultant disease may be D2
Rule 3- S1= 0, S2= 1, S3= 0, S4= 0, S5= 1, S6= 1, S7=0, S8= 0
Resultant disease may be D3.

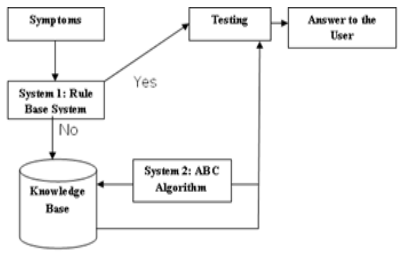


Fig.3- Proposed Architecture for the Chilli Expert Advisory System

By using these rules, the system can generate the solution accordingly the rule declared and if the particular rule is not declared in the database then the system goes for a machine learning expert system which is using the machine learning algorithm for its working. The step by step process of rule based system and machine learning system can be as follows

Rule based System

Step 1-Rule based algorithm- Simulated code for the implementation

Step 1.1-Enter the Symptoms to obtain the major disease. Let us take an example,

Ex1 10000101 From rule 1 s1=1, s6=1, s8=1

Step 1.2- If the exact match symptoms found in the Knowledge Base then Rule based system produce the output i.e., disease name as D1

Step 1.3- Exact match symptoms were not there in Knowledge Base i.e., Insufficient knowledge it fails and goes to System 2.

Ex2 10000100,

Machine learning Algorithms

Step 2- Artificial Bee Colony Algorithm1- The algorithm step by step can be converted to our present expert system can be as follows-

Step 2.1- Initialize the food source to employed bees Supply symptoms to obtain the major Disease.

Step 2.2- Each employed bee gets its food source and dances in its hive check any exact matching for the entered symptoms and display.

Step 2.3- Onlookers identify the employed bee positions and takes the nearest positions which are empty, If matching disease is not there, go with the neighbor disease and display

Step 2.4- Scouts are the bees where they don't have a single match of food Sources in hive If not even single symptom doesn't match with the symptoms in the knowledge base, then the system searches for more number of times for getting the better results.

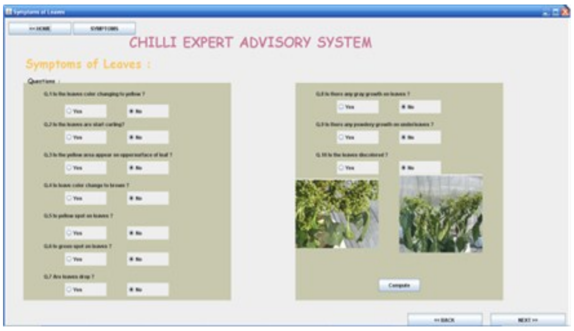
Step 2.5-Display the best food source which shows the place in the hive Repeat Step 2.2 until our requirement is satisfied (i.e., for getting better optimal result)

Table 1- Rules in the Table format

Disease	S1	S2	S3	S4	S5	S6	S7	S8	Cure
D1 Botrytis	1	0	0	0	0	0	0	0	C1
Different Combinations	0	1	0	0	0	0	0	0	C1
Different Combinations	0	0	1	0	0	0	0	0	C1
Different Combinations	0	0	0	1	0	0	0	0	C1
D2 Pink Rot	0	0	0	0	1	1	0	0	C2
Different Combinations	0	0	0	0	0	1	1	0	C2
Different Combinations	0	0	0	0	0	0	1	0	C2
Different Combinations	0	0	0	0	0	0	0	1	C2

C1- Use of Fungicides, C2- Use of Potassium, C3- Use of Water mixed with Sodium and Potassium

Testing



Conclusion

In the present proposed system, the Artificial Bee Colony (ABC) Algorithm gives better results, compared to the rule based system. Thus, the proposed system gradually reduces the processing time of rules and gives the solution to the problem in a more optimized level, in comparison with the Rule Based System. The algorithm can be further improved for more complex test problems and applications that subject to extended work.

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