Implementation of Web-Based Chilli Expert Advisory System Using ABC Optimization Algorithm

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Abstract:
The presently developed paper deals with the concepts of web based online expert systems and machine learning Algorithms in the field of Artificial Intelligence. An expert system follows the methodology of task-based specification and it is independent in case of problem solving. Where as, 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 effected to the chilli plants by using the mechanism of Rule based system and Artificial Bee Colony[1] (ABC) algorithm. The rules in the database is processed by the rule based 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, resulting to best global optimized solution for recognizing the diseases in chilli plants. This expert system is a web based online application for online users with java as front end and MySQL as backend.

Keywords: Expert System, Rule Based System, Artificial Bee colony Algorithm, JSP, MySQL.

Introduction:

Expert System:

An expert system is a software that attempts to provide an answer to a question, problem or

Clarify uncertainties where normally more human experts would be needed to be consulted for giving good solutions. Expert systems are most common in a specific problem domain, and are traditional application. A vast variety of methods is existing at present and can be used to simulate the performance of the expert system. Expert systems may or may not have learning components but a third common element is that once the system is developed it is proven by being placed in the same real world problem solving situation as the human, typically as an aid to human workers or a supplement to some information system.

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 user interacts with the system through a user ***interface*** which may use menus, natural language or any other style of interaction. Then an ***inference engine*** is used to reason with both the ***expert knowledge*** (extracted from our friendly expert) and data specific to the particular problem being solved. 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 (along with certainty measures) based on this data.

ABC Algorithm:

The Artificial Bee Colony (ABC) Algorithm, developed by observing the intelligent foraging behavior of honey bees, is a metaheuristic algorithm for solving numerical optimization problems. Metaheuristics are high-level strategies for exploring search spaces.

The ABC algorithm[1] was proposed by Karaboga in 2005 for unconstrained optimization problems. Later on, the algorithm has been extended by Karaboga[3] along with Basturk[3] for solving constrained optimization problems. They had also proposed improvements to the performance of the algorithm.

The Artificial Bee Colony (ABC) algorithm[2] 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. In the

algorithm, one half of the population consists of employed bees and the other half consists of onlooker bees.

Chilli Expert Advisory System:

In the implementation of 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. The cost of searching reduces by using machine learning algorithm instead of rule based systems. The paper focuses 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. The Architecture of the Expert Advisory System is as follows:

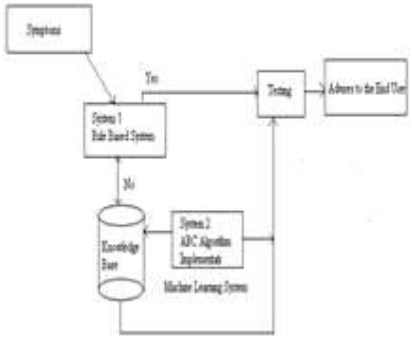

Fig-1: Proposed Architecture for the Chilli Expert Advisory System

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. The machine learning algorithm is important for such type of situation instead of generating a vast number of rules for the rule based system. By using this machine learning algorithm we can get a whole optimized better solution at last.

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, S9= 0,S10= 0,S11= 0,S12= 0
Resultant disease may be D1

Rule 2: S1= 1,S2=1 ,S3= 0 ,S4= 0, S5= 0,S6= 0 ,S7=1,S8= 0 ,S9= 0 ,S10= 0 ,S11=0,S12= 1Resultant disease may be D2

Rule 3: S1= 0,S2= 1 ,S3= 0 ,S4= 0 , S5= 1,S6= 1 ,S7= 0,S8= 0 ,S9= 0 ,S10=1 ,S11=0 ,S12= 0 Resultant disease may be D3.

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:

A. Rule based System:

Step 1: Rule based algorithm:

Pseudo code for the implementation

Step 1.1: Enter the Symptoms to obtain the major disease.

Let us take an Ex1 100001010000

From rule 3 s2=1, s5=1, s6=1 and s10=1 s

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

Ex2 100001000000,

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

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**

Fig: Rules in the Table format

C1: Use of Fungicides C2**:** Use of Potassium **C3**: Use of Water mixed with Sodium and Potassium

B. Machine learning Algorithms

Step 2: Artificial Bee Colony Algorithm[1]: The algorithm step by step can be converted to our present expert system can be as follo0ws:

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)

Test Results:

Fig: Selection of System

Fig: Machine Learning Expert System

Fig: Result from the Machine Learning Algorithm with Optimization Values

Conclusions:

In the present proposed system, the Artificial Bee Colony (ABC) Algorithm gives better results, compared to the rule based system. Thus, the implementation of 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 used in the system can be treated as quite effective, in most cases it finds a solution which represents a good approximation to the optimal one and fast enough for the number of iterations. By the thorough interaction with the users and beneficiaries the functionality of the System can be extended further to many more areas in and around the world. The algorithm can be further improved for more complex test problems and applications that subject to extended work.

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