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Garlic Expert Advisory System using Parallel ABC Algorithm

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Abstract

Expert systems are the computer based systems that are helpful for identifying the diseases on the basis of rules or the symptoms to the database of the expert system. In the current paper, we present an expert system on garlic such that to identify the diseases that were being taken place on the garlic crop when it is being cultivated by the farmers. By taking the decisions on the basis of the data given by the farmers, the farmers will get a good advice from the system rather than going to the agricultural scientists with early and get some prevention steps to control the diseases. In order to identify the diseases in garlic crop, an Artificial Bee Colony algorithm with Shared Memory Architecture was used with the expert system such that to recognize the disease in garlic crop. The machine learning algorithm, parallel artificial bee colony algorithm is an evolutionary algorithm which is to identify the diseases in the crop of the garlic. As per the result, the performance of the garlic expert system is excellent with the data given by the farmers from various locations.

Key words: *Garlic crop, diseases in garlic crop, Expert Advisory System, evolutionary algorithms, parallel ABC Algorithm*

1. Introduction

1.1. Expert Systems

Expert systems can be considered by most of the people in recent days as an artificial intelligent based system that can guide the people for identifying the diseases based on the data provided by the users [1]. The working of the system basically depends on the data provided by the user or the developers in the system that databases was known as the knowledge base. These expert systems will work with the help of the data and these systems can be considered as to replace the skilled people. The reason for that is that these systems can perform as like that of a skilled person or like a trained person. The applications or the things performed by human beings may have some small mistakes or errors in their performance of the work. But, in these systems or by using the machinery in place of the person, the accuracy can be expected as good as possible or in some cases it can be taken as 100% accurate [2, 3].

The working of expert system can be easy and follows the rules or the database we are providing to help the system to solve the current problems based on the data provided for previous cases [4]. Basically, an expert system consists of mainly three parts. They are inference engine, knowledge base and the working memory. The rules and regulations to be followed by the machine such that to take decisions and also to follow the working of the system as per the guidelines given by the user will be taken care by the inference engine. The knowledge base was the heart of any expert system. The whole working

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process will depends on this part of the system [5]. The decisions of the system will be taken based on the rules and data given by the developers in the database.

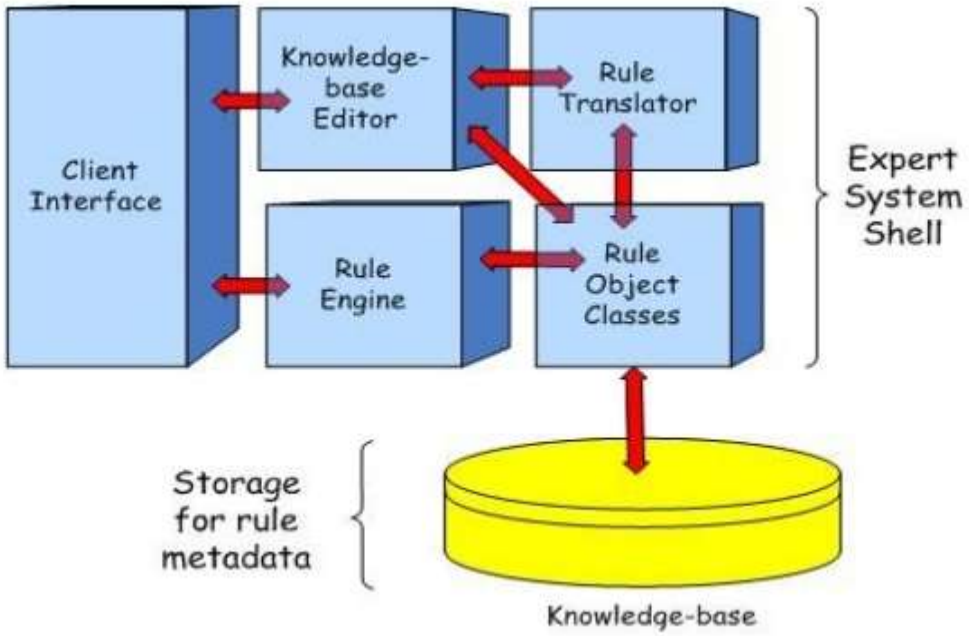

Figure 1. Architecture of Expert System

The other important part of the system was the derivation motor. The derivation motor is the main part for handling various components of the system and the total framework of the system. This motor picks or selects the rules from the database based on the questions selected from the database depending on the data given by the users. The rules in the knowledge base can be stored in general in the form of If/Then format [6]. The questions will be given to the user for answers and based on the answers given by the users, the system will decide the type of the diseases that may be occurred or taken place for the crop or for the human being. The selection rules may be in general in the form of an if/then format or in some cases, the developers may use the evolutionary algorithms such that to find the disease or the answer for the questions by the end user more accurately and more efficiently. In some systems, more evolutionary algorithms like Particle Swarm Optimization algorithm, Ant Colony Algorithms etc.

1.2. Garlic

Garlic is one of the most normally used vegetables in almost all parts of India. It is a saying that all the people in the country without considering area of the country will use garlic. Almost all parts of India will use in their day to day life for preparing various eatable things during their breakfast, lunch and dinners [5, 6]. It is good for health, as a reason everybody will use almost all parts of countries and around the world too. The other name of garlic is Lassan. The technical name of the garlic plant is known as Allium Sativa Linn. As it is very famous in India, it can be known with various names in various parts of India. The Sanskrit name of the garlic is known as Lashuna [7]. In telugu language, it is called as Vellulli. It is grown from various states of the country like Karnataka, Rajasthan, Tamilnadu, Maharashtra and Bihar.

1.3. Diseases in Garlic Crop

Some of the diseases observed in garlic crop during its harvesting or growth of the crop are,

i. White rot

White Rot is one of the famous diseases observed on the leaves of the garlic crop. It occurs during the season of the winter when the temperature range is very low. The symptoms of this disease include yellowing of leaves, dying of the leaves, leaf tipburn, rotting of the bulb and destruction of the root system.

ii. Fusarium (basal or bottom rot)

This disease is caused by the attack of the fungus and is usually considered as very huge disease for garlic crop as it attacks the roots of the plants. The symptoms of this disease was plants weakend by insects.

Proposed System:

In the current paper, we had developed a Web Based Expert system using ABC Algorithm for garlic crop. The current developed expert system has two parts. They are:

i). Information System

ii). Expert System using ABC Algorithm

The proposed Architecture is as follows:

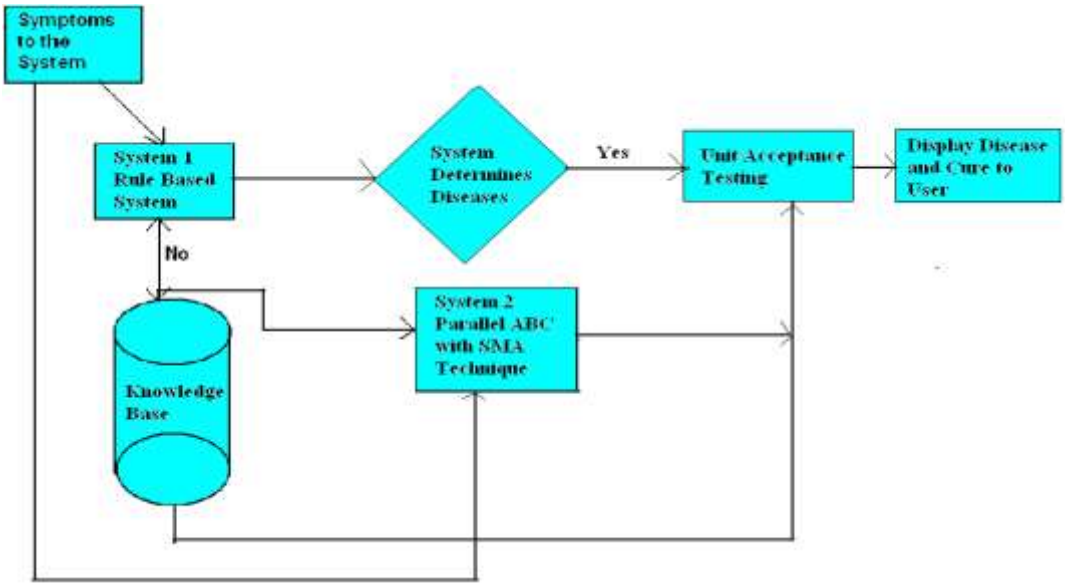

Figure 2. Architecture of Garlic Expert System

i). Information System:

The current developed expert advisory system consists of two sub systems. The first part was the information system. In the static system, the user can get only the static data about the garlic crop. The data that can be shown under this system was the basic details about the garlic crop, diseases about the garlic crop, prevention measures for not affected by various diseases surrounded in the climate. Various varieties of the garlic crop, the places where the crop can be grown more also displayed in the current system.

ii) Garlic Expert System using Machine Learning Algorithm

In the second part of the current system, we had developed the expert system with the usage of machine learning algorithm such that to get the more accurate and efficient results for identifying the diseases in garlic crop. The current system uses the Artificial Bee Colony algorithm from the set of evolutionary algorithms to make the system more accurately. In order to identify the diseases more accurately, we tried with the usage of the ABC algorithm with the expert system.

2. Parallel ABC Algorithm

In parallel ABC algorithm, the working of the algorithm was implemented in three types of honey bees. They are onlooker honey bees, scouts and employing honey bees. In actual scenarios, the bees are only one type of bee. But the bees will act as different performances in various scenarios. As a result, different bees with different names were taken place based on the tasks they are performing on the honey hives. The employing bees are the bees which will go for various places in the outside world for various plants and trees to collect the honey related parts and will keep that honey parts in the hive. The duty of the another type of bees the onlookers will take care about the placement of the honey brought from the outside world by the employing bees and the content was placed in the correct location by these bees. The scouts are the bees which will take care about the total functioning of the hive works during the entire process of the collection of honey from various locations and keeping the same in the hive and distributing the same to the other bees in the hive in the order manner such that the food will be available for all the bees in the hive. The actual working of these honey hive process and the algorithm was developed on the process of this method and the algorithm can be represented as follows,

Step 1: Provide the symptoms to the expert system to identify the diseases.

Step 2:
Repeat
Try to identify the correct match or the symptom that may match with the existing one to identify and display

Step3: If the exact disease was not identified or not matched, then go for the nearest neighbor disease and display

Step 4: If any symptom does not match with the current symptoms we have given to the system for identification, then the system will display the message as that it has no sufficient data to identify the disease and it will display the message as " Please submit more data to the knowledge base for further processing"

Step 5: Among the list of diseases identified, the highest value of the disease will be displayed as the disease that took place for the garlic crop

Step 6: The results from the algorithm execution will be made available to the end users.

2.1. Database Generation

The database of the current expert system was made with a set of rules and appropriate decisions to be taken for the existing of such rules. In the following lines, we have given some set of rules we had given for the system to identify the diseases in garlic crop and suggest the answers for the questions or the suggestions for the disease that took place in the garlic crop. The rules are as follows,

Rule 1: S1=0,S2= 0,S3= 1,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= 1
Resultant 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.

Table 1. Database Format Table

Disease no.	Symptom1	Symptom 2	Symptom 3	Symptom 4	Symptom 5	Symptom 6	Symptom 7	Symptom 8	Symptom 9	Symptom 10	Symptom 11	Symptom 12	Symptom 13	Cure
Disease1	0	0	0	1	0	0	0	0	0	0	0	0	0	C1
Disease 2	0	0	1	0	0	0	0	0	0	0	1	0	0	C2
Disease 3	1	1	0	0	0	0	0	1	0	0	1	0	0	C3
Disease 4	0	0	1	0	1	1	1	0	0	0	1	0	0	C4
Disease 5	0	0	0	0	0	0	0	0	1	1	0	1	0	C5

Table 2. Database

Disease	Symptom 1	Symptom 2	Symptom 3	Symptom 4	Symptom 5	Symptom 6	Symptom 7
Disease 1	1	0	0	0	0	0	0
Disease 2	0	1	0	0	1	0	0
Disease 3	0	0	1	1	0	1	1
Disease 4	0	1	0	0	0	1	0
Disease 5	0	0	0	0	0	0	0
Disease 6	0	0	0	0	0	0	0

Table 3. Partitioned Systems

Symptom 8	Symptom 9	Symptom 10	Symptom 11	Symptom 12	Symptom 13	Cure
0	0	0	0	0	0	C1
0	0	0	0	0	1	C2
0	0	0	0	0	0	C3
0	0	0	1	0	1	C4
0	1	0	0	1	1	C5
1	0	1	1	1	0	C6

3. Results

Figure 3. Symptoms Selection

Figure 4. Symptoms Selection (continued)

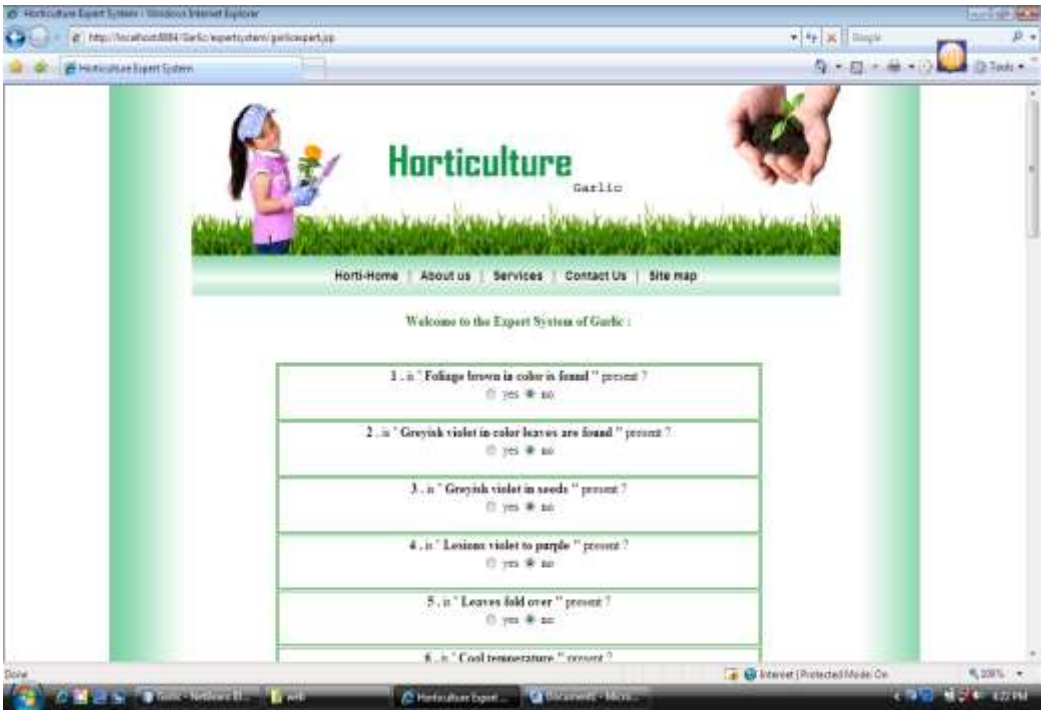

Figure 5. Symptoms Selection

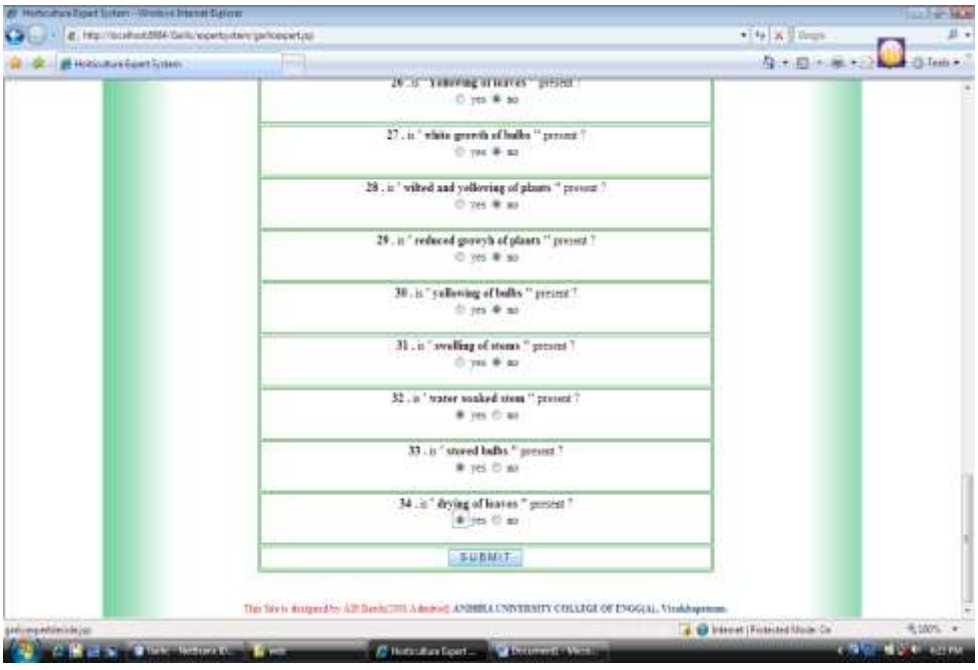

Figure 6. Symptoms Selection

Figure 7. Result Display

In the above results section, we had tried to implement the current expert system by giving the data. The process was easy and simple to implement by anyone. The user needs to simply give the input to the system by clicking on the simple on click buttons for the symptoms that were being observed on the garlic crop during the process of cultivating of the garlic. Based on the symptoms given by the u ser, the system checks the available combination of the symptoms for various diseases in the available database. The system also tries to identify the near combination of symptoms if at all no exact combination of symptoms were found in the database. After finding the symptoms, the appropriate disease which was given in the database will be displayed to the end user in the form of a neat note. Also with the diseases, the proper medicines are also suggested to the farmer and also with curing measures and prevention measures will be given to the end user.

4. Conclusions

In the current paper, the detailed discussion and the performance of the expert advisory system for identifying the diseases in garlic crop has been discussed in detail. First, we tried to present the information about the garlic crop and its details were presented in detail and then we went for the expert system. We tried to implement the artificial bee colony algorithm in the inference engine of the expert system with the help of set of rules. We tried to identify the various diseases that were present in the garlic crop and we presented the good advices to the end users by providing the disease details based on the input symptoms data provided by them. It will be useful to the farmers more and more during their growth and harvesting of the garlic crop. The free suggestions will be given to the farmers without the help of the agricultural experts.

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