Diagnosis of Rice Diseases by using Case-Based Reasoning

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Abstract

Rice cultivation is the major food crop enterprise in Myanmar. Numerous disease of rice has been found in rice field cause considerable crop losses field. Diseases control and treatment are required in rice field. Case-based reasoning is the computational reasoning paradigm that involves solving new problem by recalling old problems and their solutions adapt these previous experience represented as case. The effectiveness of CBR depends on the quality and quantity cases in case base. The proposed system is to get the information for rice disease and by providing the disease control and treatment for input cases. It uses the Nearest Neighbor technique for case retrieval and reuses the retrieve case's solution. Then, the system can also retain the current case solution for future assistance.

Keywords: Artificial Intelligence, Case-Based reasoning, Nearest Neighbor Retrieval

1. Introduction

Over the last few years, case-based reasoning (CBR) has grown from a rather specific and isolated research area to a field of widespread interest. CBR is Artificial Intelligence (AI) methodology that provides the foundations for a technology of intelligence systems. It has used to develop many systems applied in a variety of domains including manufacturing, design, law, disease and battle planning.

Case based reasoning is an approach for problem solving based on similar previous cases. Case based reasoning allows the case base to develop incrementally, while maintenance of the case library is relatively easy and carry out by domain experts. This paper implements a rice diagnosis system based on the case based reasoning approach. A case consists of problem description (symptoms) and solution (disease and treatment). To solve actual problem of similarity between current problems is used to retrieve similar cases from case base. After solving the problem, it will store in the case based.

Rice is the world's most important cereal crops and its protection from disease is vital to the many millions dependent on it as their staple food. Over the world, many rice diseases appear on the field. In our system, we solve five kinds of rice diseases. CBR recognized and well established method for building rice pathology system.

The rest of the paper is structure as follows: We start with presenting related work in section 2. Section three, we present the methodology for our system and proposed system described in section 4. In section 5, we present the experimental result of our system and finally we conclude in section 6.

2. Related Works

Case-based reasoning has already been applied in a number of different applications in medicine. The Medical Information Groups of Ain Shams developed a CBR-based expert system for diagnosis of Cancer diseases. Some real CBR systems are CASEY that gives the diagnosis for heart disorders, GD.52 that is a diagnostic support system for dimorphic syndromes, NIMON is a renal functions monitoring system, COSYl that gives a consultation for a liver-transplanted patient and ICONS that presents suitable calculated antibiotics therapy advised for intensive care patient.

Salem et al; presented the CBR-based expert system prototype for diagnosis of cancer diseases. The system aids the young doctors to check their diagnosis and it provides recommendation for controlling pain and providing symptom relief in advanced cancer [5].

Jaulent et.al is diagnosing histopathology in the breast cancer domain. Their system uses cases that derived from written medical reports [7]. A case has an internal tree structure, and represents a collection of macroscopic area. Every macroscopic area is a collection of histological areas, and each histological area contains a cytological description of subjective feature, like a big cell size the features are also weight for important. Cases compared for structural surface and feature similarity. A translation transposes the subjective feature into numerical value [6].

3. Reasoning Method

Reasoning can be defined in different ways; depending on whether it uses the context idealist

philosophy or logic and argument. In knowledge based systems, there are four main problem solving approaches: Rule based, Constraint based, Module based and Case-based reasoning.

3.1. Case-Based Reasoning

Case based reasoning is the act of developing solution to solve problems based on preexisting solution of a similar nature. When the problem appears, the program will search for similar problem in the case-based and the old solutions will be adapted to solve the current ones. This method will show the best solution available that sometimes cannot be exact solution. The new solution will introduce in the case-base and it will use to solve new problem in the future.

Case-based reasoning consists of following parts.

- Retrieving: most similar past experience cases retrieved for similar problem.
- Reusing: the cases from past retrieved cased by integrating and copying.
- Revising: the proposed solution from attempt to solve the new problem or adapt new proposed solution.
- Retaining: when the new solution was confirmed then new proposed solution was retained.

The following figure shows the CBR cycle.

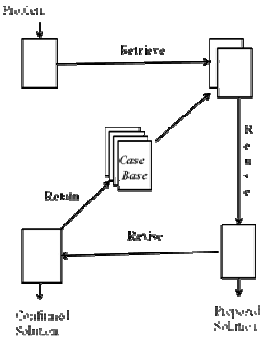

Figure 1. CBR cycle

3.2. CBR techniques

CBR has five techniques. These are case representation, indexing, retrieval, adaptation and case maintenance.

3.2.1. Case Representation. Cases in a case base can represent many different type of knowledge that can be stored in many different representation formats [8]. Case representation must be expressive enough for users to describe a case accurately.

3.2.2. Case Indexing. Case indexing refers to assigning indexes to cases for future retrieval and comparison. The choice of indexes is important to enable retrieval of the right case at the right time. Methodologies of choosing indexing include manual and automated method.

3.2.3. Case Retrieval. Case retrieval is a process of finding cases, which are closest to current case. For efficient case retrieval, there should be selection criteria, which will judge a case. CBR major research area is retrieval. There are four retrieval techniques. They are nearest neighbor retrieval, Inductive approach, knowledge-guide approach and validated retrieval.

Nearest Neighbor Retrieval

This approach involves the assessment of similarity between stored cases and the new input cases, based on matching a weighted sum of features. Several CBR implementations have used this method to retrieve matching cases. This approach implemented in this system.
The main distance equation is

$$S(I,R)=\frac{\sum_{i=1}^{n} w_i * sim(f_i^I, f_i^R)}{\sum_{i=1}^{n} w_i}$$

Where: w_i is the importance weighting of the feature I,
sim ( ) is the similarity function
f_i^I, f_i^R are the values for feature f_i in the input and retrieved cases respectively,
n is the number of attributes in each case, this similarity function defined as follows:

$$sim(f_i^I, f_i^R) = 1 - \frac{(|f_i^I, f_i^R|)}{f_{max} f_{min}}$$

If the feature f_i is numeric

0 if feature f_i is symbolic and $f_i^I \neq f_i^R$
1 if feature f_i is symbolic and $f_i^I = f_i^R$

3.2.4. Case Adaptation. Case adaptation is the process of transforming solution retrieved into a solution appropriate for the current problem. Structural adaptation and derivational adaptation are used mostly in CBR system [8].

3.2.5. Case Maintenance. When applying CBR system for problem solving, these are always a trade-off between the number of cases to be stored in case library and retrieval efficiency. Maintenance process may be required to remove the redundant cases.

4. The proposed system architecture

The proposed system performs what kind of disease happened and how to treat it under the five diseases, which are commonly found. The system will solve five kinds of diseases such as Rice Bleast, Brown Leaf Spot, Bacterial Leaf Blight, False Smut and Rice Ufra Diseases. When the system accepts the symptom from the user affected and match the problem with the source case processing case-based reasoning method.

The system stores the rice plant information in the form of index features in the case base. The system can use by two type of user depending on their roles. If user has authority, he/she will accept user test case and review the retain case. When admin found new case, he or she can save the new case into the case base. And admin has the authorization to update the treatment and control, disease information and maintain the new case into the case base. For administrator, he/she has the authority to update the treatment and control, disease information and maintain the new case into the case base.

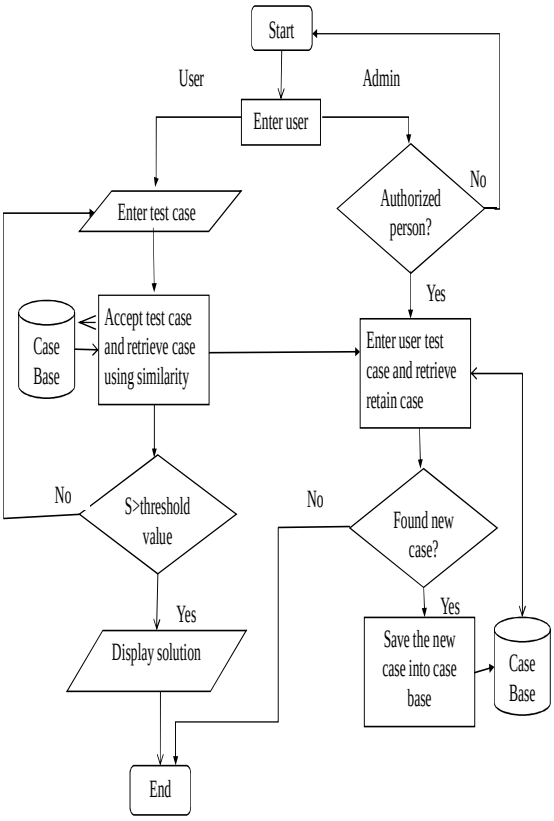

Figure 2. Data flow diagram of the proposed system

User makes the symptoms of rice diseases, the system starts processing. Target case (user's inputs) is matched cases in source case to retrieve most similar case using similarity methods. In this system, the nearest neighbor retrieval method applied to calculate similarity value. Weight value introduced in cases is considered the weighted summation of similarity between attributes. To get more efficient and correct result, it must have a predefined threshold value; it can say that the rice plant affected on one of the rice diseases. If similarity value is greater than threshold value, it can say that the rice plant affected on disease. When the symptoms selected by the user are not enough to define a disease name or less than threshold value, the system produces only possible percentage of each disease.

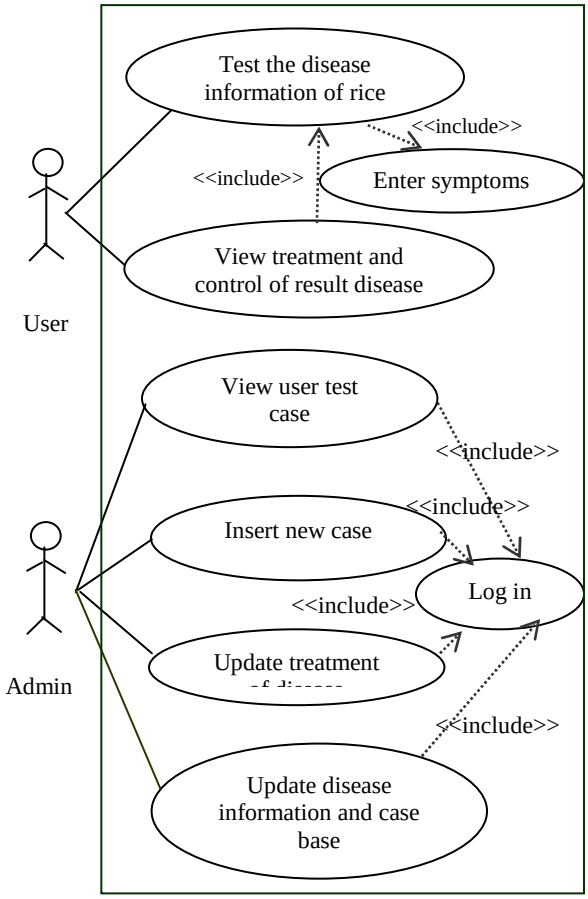

Figure 3. Use case diagram of the proposed system

In use case diagram, there are two users, such as user and admin. Admin must be log in. Then, he/she can view user test case, insert new case, update treatment and update disease information and case base.

If user wants to know disease of rice plant, they will know the symptoms of rice plant, causing in that plant. Then user can test the disease information of rice plant. After user tested the new case, he/she can view the treatment and control of the result disease. Figure 3 shows the use case diagram of the proposed system.

5. Discovering the Diagnosis of Rice Diseases by using Case-Based Reasoning

Rice diseases caused by Bacterial, Fungi, Virus and other sources. Disease can affect the yields through reduction of photosynthetic area in early stages and late infestations around botting stage. Disease causes reduction on photosynthate flow in plant [3].

The proposed system will help the farmer and agriculture expert to predict correct disease. Each case in the case-base described by 13 attributes. Table 1 lists three cases to solve new problem based on pre-existing solution of a similar nature. The system computes the similarity value between the input case and retrieve case in case-base using nearest neighbor retrieval. Then the proposed system describes the possible solution to the user.

Table 1. Cases in case-base

Symptom	Case id-1	Case id-2	Case id-3	Present/ new case
Rice-item	Shwe warTun	Shwe warTun	Shwe warTun	Shwe warTun
Group Name	Emata	Emata	Emata	Emata
Growing period	Rainy	Rainy	Rainy	Rainy
Plant life	A	B	B	A
Soil type	Alluvial	Compact	Loam	Compact
Amount of Nitrogen/ Fertilizer	More	More	Medium	More
Average temperature	>20□ C and <37.7□ C	>20□C and <37.7□ C	>20□C and <37.7□ C	>20□C and <37.7□ C
Part	Leaf	Leaf sheath	Leaf	Leaf
Appearance	Spot	Spot	Circular	Spot
Color	Dark brown	Dark brown	Yellow	Yellow
Center of disease spot	Pale green	Grayish	Dirty white	Pale green
Causing disease	Rice Bleast	Rice Bleast	Brown Leaf Spot	?

Similarity

$S(I, R_1)$ = (3+2+2+3+0+4+2+20+8+0+4)/55

= 48/55=0.87=87%

$S(I, R_2)$ = 32/55=0.58=58%

$S(I, R_3)$ =35/55=0.64=64%

I= input case,
R= retrieve case,
55=total weight value.

In above similarity, the given input case is matched with cases in the case base. In case matching, the Nearest Neighbor technique used to calculate the similarity value between two cases (given case and old cases). According to this equation, the best similarity value gets 0.87. And then 0.87 is multiplied by 100 to get the percentage of its. Therefore, as the last result, the system produces 87%. Because the percentage is greater than predefined minimum thresholds value (75%). Then the system shows the similarity calculation of two cases (target case and source case). The system chooses the causing disease of R_1 (Case-id 1) and will give the required output (Rice Bleast). Finally, the system shows the treatment and control of the of result disease.

6. Conclusion

The CBR approach appear to have some advantages concerning system development if compare with other knowledge-based methods This paper presents a solution with the classification of rice diseases based on observed symptoms and providing treatments. In CBR, new experience can retain each time a problem has solved, making it available or future problems. Due to the ability of CBR to expand its case base, we can achieve more accurate result overtime. The proposed system uses the advantages of CBR method and can support the decision-making in rice diagnosis. In our system, we intend to know rice diagnose and to control rice diseases at the right time.

7. References

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