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Expert System in Detecting Rice Plant Diseases Using Certainty Factor

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Abstract

The livelihoods of most people in Indonesia are cultivate rice which is the staple food for the people of Indonesia. The productivity of rice plants can be obstructed when rice attacks disease. Diseases can be addressed from young if farmers know how to handle it. In fact, farmers are difficult to obtain knowledge about the disease of rice caused by a lack of trainers and the limited amount of time trainers. To resolve these problems, teh one of the solution is to make an expert system application, the system adopts the knowledge from an expert / counselor. For the decision of this application, it's using certainty factor. The certainty factor is a method that uses weights certainty assumption of an expert in rice plants. The output is given in the form of images, the solution, as well as the percentage of the rice plant diseases conviction. The output is obtained from the results of the consultations that conducted by user. Users must answer the questions in the form of symptoms of the disease. In the design of this applications making by using the PHP programming and used a MySQL database. Applications make based on the WEB. The results of the research has been done is about 60% of respondents found that this application helpful to use or for the needs of the farmers, and approximately 78% found that this application is have an interesting features.

Keywords: Expert System , Certainty Factor , Disease of Rice

1. Introduction

One of the livelihoods of the Indonesian population is in the field of agriculture is rice crops. Furthermore, rice is also a staple food for Indonesians. Therefore, the income of farmers depends on agricultural products. Farmers should pay attention to factors affecting inhibition of growth in rice, one of which is the disease problem in rice plants. If the disease attacks the plant when it is premature and late in control it can lead to crop failure and it can lead to decreased yields of rice crops [1-2]. A counselor is very important in this case. But to solve the problems faced by farmers, they are constrained by the time, place, and ratio of the farmers with counselor. To overcome these problems it is proposed an expert system application to detect the disease of rice plants. The expert system is one of the fields in Artificial Intelligent science. This application will adopt a science such as an expert in agriculture [3-5]. Some research on the application of expert systems in agriculture has been done, such as chili and corn using forward chaining method [6-7]. This research uses certainty factor method, that is method of certainty (trust), diagnosis of symptoms of the disease will obtain certainty of disease rice plant and provide solutions [8-10]. In CF is also known as the believe and disbelieve. The notation or the formula of magnitude are:

CF[h,e] = MB[h,e] – MD [h,e] (1)

Where CF[h,e] is *Certainty Factor* in hypothesis h influenced by fact e, MB[h,e] is *Measure of Believe* that is an increase value of hypothetical confidence h influenced by fact e, and MD[h,e] is *Measure of Disbeliev* that is an increase value of mistrust hypothetical h influenced by fact e, with h is Hypothesis and e is Evidence (event or fact).

CF[H,e]1 = CF[h]*CF[e] (2)

Where CF[e] is *certainty factor evidence* E influenced by *evidence* E, CF(H) is *certainty factor hypothesis* (Assuming the evidence is known with certainty if CF(E,e) = 1), and CF[H,e] is *certainty factor hipotesa* influenced by *evidence e* is known with certainty.

Certainty Factor for similary concludes rules:

CF combine CF[H,E]1,2 = CF[H,E]1 + CF[H,E]2 *[1-CF[H,E]1]
Cfcombine CF[H,E]old3 = CF[H,E] old + CF[H,E]3*(1-CF[H,E]old] (3)

Certainty factor or the final result of the percentage:

% Confidence = Cfcombine*100% (4)

2. Material And Method

A. Context Diagram

In Figure 1 the context diagram of the user conveys the symptoms seen, after which the consultation application of this disease will process and diagnose the symptoms. The application will provide the type of disease as well as the solution of the disease. In this application there is a knowledge base that is controlled by the admin and experts.

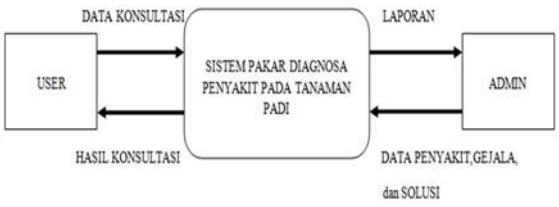

Figure 1. Context Diagram

B. Knowledge Base

In this research the representation of the knowledge base is shown by tables 1 and 2. In table 1 shows the relationship between symptoms and disease in which there are four (10) diseases P1, P2, P3 and P10 with symptoms G1 up to G76. Table 2 shows the weight of certainty factor obtained from the expert.

Table 1. Knowledge Base

Rule	Condition (*If*)	Result (*Then*)
1	G57&G56&G58&G48&G06&G17&G16&G18&G19&G41	P01
2	G59&G57&G73&G12&G11&G68&G09&G07	P02
3	G72&G13&G23&G01&G49	P03
4	G60&G55&G64&G65&G14&G15&G23&G25&G52&G54	P04
5	G08&G10&G05&G46&G47	P05
6	G66&G63&G28&G34&G32&G01&G42&G37&G24&G74&G21	P06
7	G67&G23&G39&G52&G31&G70&G40&G36&G44&G71&G20	P07
8	G02&G53&G62&G71&G35&G29	P08
9	G61&G35&G30&G69&G33&G40&G76&G43&G27&G23&G04&G75&G51&G26&G71	P09
10	G50&G38&G03&G45&G22	P10

Table 2. Relation Symptoms with CF Weight from Expert

Id_ Penyakit	Id_ Gejala	CF	Id_ Penyakit	Id_ Gejala	CF
P01	G57	0.6	P02	G07	0.5
P01	G56	0.6	P03	G72	0.2
P01	G58	0.6	P03	G13	0.2
P01	G48	0.8	P03	G23	0.4
P01	G06	0.3	P03	G01	0.2
P01	G17	0.4	P03	G49	0.2
P01	G16	0.3	P04	G60	0.25
P01	G41	0.6	P04	G55	0.25
P01	G19	0.3	P04	G64	0.2
P01	G18	0.6	P04	G65	0.2
P02	G59	0.15	P04	G25	0.2
P02	G57	0.15	P04	G52	0.25
P02	G73	0.1	P04	G54	0.1
P02	G12	0.1	P04	G14	0.1
P02	G11	0.1	P04	G15	0.1
P02	G68	0.1	P04	G23	0.1
P02	G09	0.1			

C. Certainty Factor Analysis

In user consultation session we are given weight in answer. Here is the description:

For 2 answer choices:

a. Yes : 1
b. No : 0

Examples of cases in this case is about Brown Spot (bercak coklat) disease.

Rule 1: If present on the grain (grain) AND present on AND leaves brown spots like sesame

seeds on AND leaves young and undeveloped spots on older leaves small and circular brown or grayish brown. AND Spots are fully developed in older leaves oval, brown with gray in the middle white with reddish-brown sheets. AND Plants that are attacked cause the plant to be stunted or dead. AND Black or brown patch on grain / grain skin. AND Infections Severe brown spots cause leaf drops, damaging larger parts of the leaves. THEN brown spots

And the question for brown spots are:

1. Is there a patch on the grain (grain)?
2. Is there a patch on the leaves?
3. Does the leaf have spots like sesame seeds?
4. Are there patches on old leaves that are small and circular and brown or grayish-brown?
5. Are the patches on the leaves oval and brown with gray in the middle and the sheet is reddish brown?
6. Does the plant dwarf or die?
7. Does the skin on the grain (grain) have black or brown spots?
8. Is the leaf falling or the leaf is damaged?

Then determine the weight of the expert CF of the symptoms. Here's the description:
(CF Expert) spots on grain (grain): 0.15, (Expert CF) spots on leaves: 0.15,
(CF Expert) on the leaves there are patches like sesame seeds: 0.1, (CF Experts) spots on old leaves small and circular shape and brown or grayish brown: 0.1, (CF Experts) spots on the leaves are shaped Oval and brown with gray in the middle and the sheet is reddish brown: 0.1, (CF Expert) dwarf or dead plants: 0.1, (Expert CF) the skin on grain has black or brown spots: 0.1, (CF Expert) The leaves become falling or the leaves are broken: 0.5, Then specify the weight of the user's answer. Here's the description:

a. Spots on grain (not): 0
b. Spots on leaves (yes): 1
c. In the leaves there are spots like sesame seeds (yes): 1
d. Spots on old leaves are small and circular and brown or grayish brown (yes): 1
e. Spots on the leaves are oval and brown with gray in the middle and the sheet is reddish brown (yes): 1
f. Plants dwarf or dead (not): 0
g. The skin on the grain (grain) has black or brown spots (not): 0
h. The leaves become falling or the leaves are broken (yes): 1

To get the CF value then the expert cf multiplied by the weight of the user's answer:

CF[H,E]1 = CF[H]1 * CF[E]1
= 0.15 * 0 = 0
CF[H,E]2 = CF[H]2 * CF[E]2
= 0.15 * 1 = 0.15
CF[H,E]3 = CF[H]3 * CF[E]3
= 0.1 * 1 = 0.1
CF[H,E]4 = CF[H]4 * CF[E]4
= 0.1 * 1 = 0.1
CF[H,E]5 = CF[H]5 * CF[E]5
= 0.1 * 1 = 0.1
CF[H,E]6 = CF[H]6 * CF[E]6
= 0.1 * 0 = 0
CF[H,E]7 = CF[H]7 * CF[E]7
= 0.1 * 0 = 0
CF[H,E]8 = CF[H]8 * CF[E]8
= 0.5 * 1 = 0.5

The last step:
CFcombine CF[H,E]1,2 = CF[H,E]1 + (CF[H,E]2 *(1-CF[H,E]1]) = 0 + (0.15 * (1-0)) =0.15 old, CFcombine CF[H,E]old2= CF[H,E]old + (CF[H,E]3 *(1-CF[H,E]old)) = 0.15+ (0.1 * (1-0.15)) =0.23 old2, CFcombine CF[H,E]old3= CF[H,E]old2 + (CF[H,E]4 *(1-CF[H,E]old2))= 0.23+(0.1 * (1-0.23)) =0.31 old3, CFcombine CF[H,E]old4= CF[H,E]old3 + (CF[H,E]5 *(1-CF[H,E]old3))= 0.31+(0.1 * (1-0.31)) =0.38 old4, CFcombine CF[H,E]old5= CF[H,E]old4 + (CF[H,E]6 *(1-CF[H,E]old4)) = 0.38+(0 * (1-0.38)) =0.38 old5, CFcombine CF[H,E]old6= CF[H,E]old5 + (CF[H,E]7 *(1-CF[H,E]old5))= 0.38+(0 * (1-0.38)) =0.38 old6, CFcombine CF[H,E]old7= CF[H,E]old6 + (CF[H,E]8 *(1-CF[H,E]old6))= 0.38+(0.5 * (1-0.38)) =0.69 old7, CF[H,E]old7* 100 = 0.89 * 100% = 69%.
Thus, the calculation of certainty factor in brown spot disease in rice plants has a percentage of confidence level of 69%.

3. Result and Discussion

A. Main Page

Main Page is the first page that appears at the start of the first application.

Figure 2. Main Page

B. Rice Disease Information Page

This page contains information about diseases that attack on rice plants. If selected one of the name of the disease will display as below.

Figure 3. Rice Disease Information Page

Figure 4. One Of Rice Disease Information Page

C. Consultation Page

For consultation then user first log in. After logging in then the user must choose the disease. If the disease has been selected it will come out the questions as the symptoms that appear on the plant. Users should consult with choosing all diseases to know the name of the disease that attacks the rice plant.

Figure 5. Consultation Page

After answering questions, it will get a percentage of confidence in the conclusion.

Figure 6. Certainty Graph

D. Application Testing

Expert system application testing of 50 respondents. Respondents consist of 2 respondents from the Agriculture and Horticulture Agency of Pasaman Barat Regency, and 48 respondents from farmers and the general public. Then each respondent filled the questionnaire. The results of the questionnaire are shown in Figure 7.

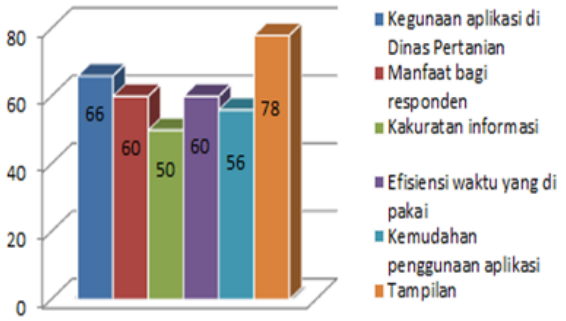

Figure 7. Graph of Questionnaire Result

The graph in Figure 7 shows that about 66% answered very useful if this application is used by the Department of Agriculture and Horticulture West Pasaman. Approximately 60% of respondents answered this application is useful for respondents use, about 50% answered very accurate information given this application, 60% answered quickly in obtaining information in consultation with the application, 56% answered very easy to use application, and 78% The look of this app is very interesting. It can be deduced from the results of questionnaire that the application is useful for farmers and

counselors in obtaining information and knowledge about rice disease.

4. Conclusion

Expert system application designed in the form of application that detects disease in rice plants using Certainty Factor (CF) method. Certainty Factor is a method of certainty, where certainty is obtained in the form of weight obtained from the opinion of an expert on the symptoms that arise, it will be calculated in a formula to get the final results or conclusions. The final process or final conclusion is obtained if the user has consulted by answering the symptoms given in the application. This application is able to provide certainty a disease of rice plants as well as providing solutions.

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