JOSAR Vol.6 No.1 March 2021
ISSN: 2502-8521 (Print) / 2503-1155 (Online)
DOI: https://doi.org/10.35457/josar.v6i1.1446

RUBBER PLANT DISEASE DIAGNOSIS SYSTEM USING DEPTHFIRST SEARCH AND CERTAINTY FACTOR METHOD

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Abstract

Rubber plants have a very important role in the economy in Indonesia, because many people depend on this commodity. The area of rubber plantations in Indonesia has reached more than 3 million hectares, while Malaysia and Thailand, which are Indonesia's main competitors, have a rubber plantation area below that number. Only 15% of the rubber area is large plantations, while 85% is smallholder plantations which are managed simply as is, some even rely on natural growth. The problems faced by rubber farmers are disease and treatment problems. With these conditions, the researcher aims to build an expert system application for the diagnosis of rubber plant diseases by applying the depth first search method and Certainty Factor is used so that the expert system can reason like an expert, and to get the highest confidence value. The problems faced by rubber farmers are disease and treatment problems. Given these conditions, the researcher aims to build an expert system application for the diagnosis of rubber plant diseases by applying the depth first search certainty factor method. Depth first search and Certainty Factor methods are used so that the expert system can reason like an expert, and to get the highest confidence value. The application design by applying the depth first search method and certainty factor was successfully built into a web-based application. Black box testing on this application system has been successful in accordance with the design that has been made. The test results by experts on the identification system are in accordance with direct identification. And the results of beta testing produce a percentage of 83%, which means that users have a high level of satisfaction with the application. With the results of this test, the selected diseases were fungus disease with an accuracy of 87.54%, spot cancer with an accuracy of 97.64% and root rot disease with an accuracy of 97.41%.

Keywords: Expert System, Rubber Plants, Depth First Search, certainty factor, webbased

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Citation in APA style: Wulansari, Z.,& Chulkamdi, M. T (2021). Rubber Plant Disease Diagnosis System Using Depth First Search And Certainty Factor Method. *JOSAR (Journal of Student Academic Research), 6*(1), 39-51.

Received:	**Revised:**	**Published:**
January, 31st 2021	February, 25th 2021	March, 1st 2021

DOI: https://doi.org/10.35457/josar.v6i1.1446

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1. INTRODUCTION

In an era that requires the speed of information for all parties, technology has an important role which of course cannot be separated from Information Technology (IT), especially the role of artificial intelligence (Artificial Intelligence) on human activities today, has a very big influence because of the many conveniences obtained in applying artificial intelligence technology. One of them is by implementing an expert system. By implementing an expert system, a program will model the ability to solve problems like an expert so that efficiency andeffectiveness can be obtained in obtaining a solution to existing problems [1].

During its development, expert systems are used in all fields, one of which is in the plantation sector. One of the benefits of an expert system in the plantation sector is that it makes it easier for farmers to detect diseases in plants so that farmers can find out the types of diseases and how to deal with them quickly without having to wait for experts who have competence in that field [1].

Rubber plants have a very important role in the economy in Indonesia, because many people depend on this commodity. The area of rubber plantations in Indonesia has reached more than 3 million hectares, while Malaysia and Thailand, which are Indonesia's main competitors, have a rubber plantation area below that number. Only 15% of the rubber area is large plantations, while 85% is smallholder plantations which are managed simply as is, some even rely onnatural growth.

The growth and development of rubber plants from seedling to planting require special treatment so that they get good quality and large quantities of rubber. Treatment of rubber plants which have an important role in plant growth and development is the eradication of pests and plant diseases. Knowledge of rubber plant diseases can increase the productivity of rubber farming so that it can be a promising source of income [2].

The problems faced by rubber farmers in Blitar Regency include problems with disease and treatment. Among the diseases that exist in rubber plants, root and stem diseases are the dominant diseases that occur in community rubber plantations and have serious impacts, such as reduced rubber production and even causing death in rubber plants [3]. However, in the effort to care for rubber plants in Blitar Regency, there are obstacles, namely the knowledge of farmers who do not know early about the diseases that are being suffered by rubber plants, and most farmers only depend on extension workers from the agricultural service to find out what diseases they are suffering from. by rubber plants and knowing the solutions faced, while the number of extension workers in Blitar Regency is very limited, not proportional to the number of farmers and the area of existing rubber plantations.

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There are several methods used in implementing expert systems. The method that can be used is the Depth first search method. This method can help find the shortest route, so that it can get an effective solution. The Certainty Factor method is a method that shows a measure of the certainty of a fact or rule [4]. Both of these methods are used so that the expert system can reason like an expert, and to get solutions and trust values. Therefore, the researcher proposes a study entitled "Expert System for Diagnosis of Rubber Plant Diseases Using Depth First Search and Certainty Factor". This system was built with the hope of helping farmers find solutions to diseases that attack rubber plants, without having to consult directly with experts and can help experts by replacing experts if the experts are not availab.

2. METHODS

A. Time and Research Location

This research was conducted at PERUSAHAAN PERKEBUNAN PUSKOPAD 'A ", SUB UNIT PETUNGOMBO Village: Karangrejo Kec.: Garum - Blitar in April 2020.

B. Previous research

Previous research that has become a reference for researchers includes the first, research conducted by Deffy Susanti, Suhendri (2017) with the title of designing an expert system for diagnosing mango plant disease with a mobile- based depth first search algorithm. The purpose of this research is to make an expert system to diagnose diseases and pests on mango plants, users can identify and identify pests that attack mango plants and provide control solutions using a mobile-based depth first search algorithm and with an expert system to diagnose diseases and pests in this mango plant. users get solutions from solving problems more quickly, easily and accurately [5]. The second research was conducted by Permana, (2015) with the title Expert System for Diagnosing Pests and Diseases in Apples Using the Certainty Factor Method. The purpose of this study was to diagnose pests and diseases in apple plants. This system relies heavily on the level of confidence to support the inference (reasoning) process of data and facts stored in the database. So the use of certainty factor methods in this expert application can provide accurate results from weight calculations for the resulting diagnostic conclusions [6].

C. Data Collection

The method used to collect information is carried out in the followingstages:

1. Observation

ISSN: 2502-8521 (Print) / 2503-1155 (Online)
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Conducting observations and direct observations during April 2020 at PERKEBUNAN PUSKOPAD "A", PETUNGOMBO SUB UNIT Desa: Karangrejo

Kec. : Garum - Blitar to get data.

2. Interview

Primary data from the data collection method were interviews, which were conducted with Mr. Ucok as the Head of the Puskopad Plantation Company "A" for rubber plantations.

3. Literature study

Secondary data is obtained from national journals as well as international journals and from scientific books, both printed and e-books, research reports, and other scientific journals.

D. System Design

System design is a series of activities that provide a detailed description of how the application will run. This design aims to obtain software products in accordance with user needs based on the results of system requirements analysis recommendations. The system design contains various descriptions of the data, processes and interfaces of the proposed system.

1. Flowchart

The flowchart in Figure 2 shows a flowchart of the processes carried out in the application, from the start of the system creation to completion.

a. Application Flow Diagram

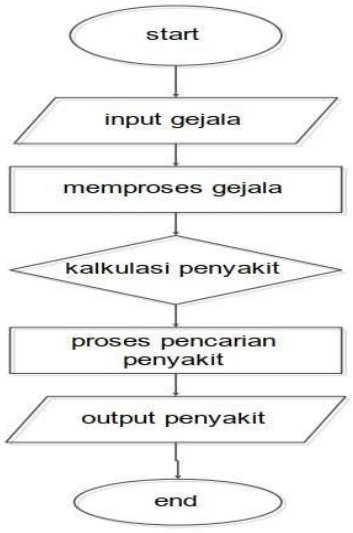

Figure 2 *Flowchart* System

ISSN: 2502-8521 (Print) / 2503-1155 (Online)
DOI: https://doi.org/10.35457/josar.v6i1.1446

Based on Figure 2 it can be explained that the application flowchart is as follows:

a. Start.

b. The user immediately enters the symptoms to make a diagnosis of rubber plantdisease.

c. The system will process the symptoms that the user has entered.

d. If the symptoms entered by the user are not in accordance with the disease data that the admin has inputted, the system will repeat so that the user enters the symptoms again until they match the data in the database.

e. Users get a diagnosis of rubber plant disease.

f. End

b. Flowchart of DFS and CF methods

Figure 3. Flowchart of DFS and CF methods

The method flowchart contains the running of the system flow in implementing the following application shown in the figure 3.

Based on Figure 3, the expert method flowchart and the existing rules are as follows:

a. Start,

b. Displays a question in the form of a symptom,

c. The user enters an answer,

d. After that the disease search process with DFS,

ISSN: 2502-8521 (Print) / 2503-1155 (Online)
DOI: https://doi.org/10.35457/josar.v6i1.1446

e. After the search is continued, the process of calculating the weight using acertainty factor,
f. After the symptoms are processed by the program, the diagnosis results andsolutions will be displayed,
g. End.

3. RESULTS AND DISCUSSION

A. Application Implementation

This chapter will explain about designing a rubber plant disease diagnosis program using the Depth First Search (DFS) method and web-based certainty factors. This program is expected to be able to detect disease validly. This program is built using the web programming language HTML, PHP and uses the MySQL database.

The results of the implementation of the rubber plant disease diagnosis program using the Depth First Search (DFS) method and certainty factors after carrying out the research stages in a predetermined procedure as follows:

1. Home (main) page

The main page (Home) is the first page when the user starts the system. In this system, there are two users who can run this system, namely User and Admin. Here's the Main Page (Home), as in Figure 4 below:

Figure 4 Home Page

Figure 4 is a display of the Main Page (Home) in the rubber plant disease information system. On this page there are two menus that can be accessed by the user, namely the disease search menu and contact (contact us). The disease search menu is used by the user to search for diseases in rubber plants. Contact menu to enter complaints to admin.

2. Disease Search Page

Disease search page is a user's disease search page to search for diseases that occur in rubber plants. Here's the search page, as in Figure 5 below.

JOSAR Vol.6 No.1 March 2021
ISSN: 2502-8521 (Print) / 2503-1155 (Online)
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Figure 5. Disease Search

The process of searching for diseases is carried out by selecting the symptoms according to the conditions experienced by rubber planting, then selecting the search button.

3. Search Result Page

The search results page is a page to display disease results from the symptom data that the user has selected. The following is the page of the disease search results, as shown in Figure 6:

Figure 6. Disease Search Results

B. System Testing

System testing in this study uses three tests, namely black box testing, expert testing and beta testing. The following are the results of black box testing, system accuracy testing and beta testing.

1. Black Box Method

The Black Box System Testing Method is carried out to test and ensure that the identification system that has been built can function properly and in accordance with the previously made design.

a. Main Page Testing (Home)

ISSN: 2502-8521 (Print) / 2503-1155 (Online)
DOI: https://doi.org/10.35457/josar.v6i1.1446

Testing the Main Page (Home) aims to test the functions of the menus on the Main Page (Home). The following are the results of the Main Page (Home) Test, as in Table 6 below:

Table 1 Blackbox Testing Main Page (Home)

Description	Testing Procedure	Input	Output	Result	Information
HomePage	Home Page	-	Home Page Showed	Home Page Emerged	**Success**
Searching Disease Menu	Click Searching Disease Menu	-	DiseaseMenu Showed	Disease Menu Emerged	**Success**
Choose Symptomp Page	Answering Syptomp	Choose The Symptomp	AnsweringData Symptomp	Symptomp Data Saved	**Success**
SearchingPage	Showing SearchingPage	-	User Result Showed	User Analysis Emerged	**Success**
ContactMenu	Click Contact Menu	-	Contact Menu Showed	Contact Menu Emerge	**Success**

Based on table 6 blackbox testing on the main page (homepage). It can be concluded that the pages and menus on the main page are in accordance with their function.

b. Admin Page Testing

This Admin Page Testing aims to test the functions of the menus on the Admin Page. The following are the results of the Admin Page Testing, as in Table7 below:

Table 7. Admin Page Blackbox Testing

Description	Testing Procedure	Input	Output	Result	Information
Admin Homepage	Click admin home page	-	Admin home page showed	Admin home page emerged	**Success**
Symptompdata menu	Click symptom data menu	-	Data nenu page of the symptom showed	Symptom data pag eemerged	**Success**

ISSN: 2502-8521 (Print) / 2503-1155 (Online)
DOI: https://doi.org/10.35457/josar.v6i1.1446

Form add symptom data	Fill content of symptom data	Sympto m code:G001 symptom:pale leaf	Symptom data as thefilled form	Symptom data added	**Success**
Edit symptom data	click "Edit"	Symptom code G001	Symptom data saved	Symptom data saved	**Success**
Delete symptomdata	Click delete	-	Symtom data deleted	Symptom data deleted	**Success**
Disease datamenu	Click disease data menu	-	Page disease datamenu	Page data menu emerged	**Success**
Disease data addedform	Filled data form disease	Disease code P01: white root disease	Data form added as the form filled	Disease data added	**Success**
Data Disease	Clicking theedit	Disease Code: P01	Edit button Disease	Disease data saved	**success**
Delete data disease	Click delete	-	Disease data deleted	Idsease dta deleted	**success**

Based on table 7 the admin page blackbox test. It can be concluded that the pages and menus on the admin page are in accordance with their function.

2. Testing The Dfs And Cf Method

The test method was chosen based on the input of symptoms shown in Figure 4.The first test was carried out 3x tests to get the results of fungus disease with an accuracy of 87.57% and spot cancer with an accuracy of 98.5% from the results of the accuracy of the two diseases having a difference of 0.8. The second test was carried out 3 times the test to get the result of carnker spot disease with an accuracy of 97.64%. The third test was carried out 3 times the test to get the result of root rot with an accuracy of 97.41%.

ISSN: 2502-8521 (Print) / 2503-1155 (Online)
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3. Beta Testing

Apart from the blackbok test the author also includes the beta test shown inequation 2.

Tabel 3 Questionnaire Data Result

NO	Nama	Desain Sistem				Kesesuaian Sistem				Kemudahan Sistem			
		SB	B	C	K	S B	B	C	K	SB	B	C	K
1.	Karyadi	80	150	60	0	160	150	40	0	120	150	40	0
2.	Sutrisno	0	210	60	0	200	150	0	0	200	150	0	0
TOTAL		**80**	**360**	**120**	**0**	**360**	**300**	**40**	**0**	**320**	**300**	**40**	**0**

Score:

SB = 40 C = 20

B = 30 K = 10

[1] Total score of System Design Aspect = 560 a. Less = 0/560 x 100% = 0%

b. Enough = 120/560 x 100% = 21.4%

c. Good = 360/560 x 100% = 64.2%

d. Very good = 80/560 x 100% = 14.2%

[2] Total value of System Suitability Aspect = 700 a. Less = 0/700 x 100% = 0%

b. Enough = 40/700 x 100% = 5.7%

c. Good = 300 / 700x 100% = 42.8%

d. Very good = 360 / 700x 100% = 51.43%

[3] Total score of System Ease of Aspect = 660 a. Less = 0/660 x 100% = 0%

b. Enough = 40/660 x 100% = 6.06%

c. Good = 300/660 x 100% = 45.46%

d. Very good = 320/660 x 100% = 48.49%

Based on the results of the questionnaire above, it can be concluded that in terms of System Design, a Good rating was obtained with a percentage of 64.2%, while the System

ISSN: 2502-8521 (Print) / 2503-1155 (Online)
DOI: https://doi.org/10.35457/josar.v6i1.1446

Conformance Aspect received a Very Good rating with a percentage result of 51.43% and the Ease of System Aspect was consideredVery Good with a percentage of 48.49% .

4. CONCLUSION

Research on the expert system for diagnosing rubber plant diseases by applying the method Depth first search and certainty factors can be concluded as follows:

1. The expert system application for the diagnosis of rubber plant disease by applying the depth first search method and certainty factors was successfully built into a web-based application with the success of this test on the selected disease, namely upas fungal disease with an accuracy of 87.54%, spot cancer with an accuracy of 97.64% and root rot with an accuracy of 97.41%.
2. Expert system testing for rubber plant disease diagnosis is carried out by black box testing and beta testing. Black box testing on the application has been successfully carried out, the results obtained state that the expert system is functioning properly according to the design that has been made. The test method shows the system output that is in accordance with the results of diseaseidentification that is carried out directly.

ACKNOWLEDGEMENTS

This research was supported in part by The Islamic University of Balitar and PDP Dikti. We thank our colleagues from Balitar Islamic University and the Research Team (Zunita Wulansari, Septian Lukas Cahyono and Nurma Rianita) who provide insights and expertise that greatly help research, although they may not agree with all interpretations or conclusions of this paper.

The JOSAR (Journal of Students Academic Research) expresses its gratitude and sincere appreciation to all the reviewers who have contributed their expertise and time to review the manuscripts, to evaluate and to assess the articles submitted for consideration in the publication process; to be accepted or rejected in the journal publishing process. All of these are very important toensure the quality and scientific impact of JOSAR.

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