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Implementation of Forward Chaining Method in Expert System to Detect Diseases in Corn Plants in Muara Tami District

1st Elvis Pawan*, 2nd Rosiyati M.H Thamrin, 3nd Widodo, 4nd Sariaty H.Y. Bei, 5ndJunus J. Luanmasa
[1,2,4,5],STIMIK Sepuluh Nopember Jayapura
[3nd] Universitas Sains dan Teknologi Jayapura
[1,2,3,4,5] Jayapura, Indonesia
[1]elvispawan09@gmail.com, [2]rosiyati.thamrin@yahoo.com, [3]widodommsi67@gmail.com,
[4]sariatybei@gmail.com, [5]junusluanmasa@gmail.com

Abstract*— Diseases in plants are very disturbing and hinder to obtain maximum results, corn plants are plants that are very susceptible to disease or pests, so expertise is needed in dealing with corn plant diseases. Problems arise when farmers do not have the ability and expertise to detect early corn plant diseases as experienced by farmers in mura tami sub-district. This study aims to design an expert system application as a form of solution for farmers in order to detect plant diseases as early as possible. An expert system developed using the forward chaining method which is a forward trace method. System development using the PHP programming language and mysql database. The results of this study conclude that the forward chaining method is suitable to be implemented in an expert system. The test results using the black box method stated that 100% of the system's functionality could be done well, while testing using the user acceptance test (UAT) method stated that 84% of respondents strongly agreed that the implementation was implemented.

Keywords : *Expert System, Forward Chaining, Crop Corn, Disease*

I. INTRODUCTION

The government has one of the main goals at this time is to focus Indonesia on achieving food self-sufficiency [1][2]. This can be achieved by increasing the food production of corn as an alternative staple food for Indonesians. At the same time that there are still many farmers in the Muara Tami sub-district who do not know how to increase the yield of quality crops, this is because the corn seeds planted by farmers are often attacked by various kinds of weeds or plant pests and this cannot be controlled effectively. independently by farmers. With the lack of knowledge and experience of farmers on how to deal with the rice disease, automatically the corn yields that will be obtained cannot reach the targets set by the central government and local governments specifically in the city of Jayapura. This study tries to offer a solution with a new method to farmers using information technology, an artificial intelligence-based system so that farmers in the Muara Tami district can detect types of corn plant diseases at an early stage. The expert system designed using the forward chaining method is a system that can be used as a consultation tool for farmers, no need to wait for counseling from the government on how to deal with the corn disease.

The forward chaining method has been used several times in research by previous researchers, but in different cases and objects including in 2018 the forward chaining method can be used to diagnose neurological diseases. calculation using forward chaining algorithm [3]. The test will be carried out by comparing expert testing with calculations using the forward chaining algorithm. Another research is an expert system application that is made based on Android so that users can easily consult anytime and anywhere just by opening the application. This study provides suggestions for adding more symptoms [4]. Symptoms that exist in this expert system are adapted to diseases in corn plants. Furthermore, research on the Disease Diagnosis System in Goats is designed with the rule base method and forward chaining inference. The number of rules used is 16 rules with 43 types of questions according to the

number of symptoms. The application of an expert system to diagnose goat disease has succeeded in detecting all 16 types of diseases with an accuracy of 100%. The research suggests that the forward chaining method can be combined with certainty factor weighting to produce more definite decisions. The weakness in this study does not include the results of system testing on the forward chaining algorithm [5]. The difference in this study is that the test is carried out on the suitability between expert opinion and the forward chaining algorithm. Furthermore, research on forward chaining inference engine was successfully used to identify children's talents according to USOE America standards. Algorithm testing and expert opinions are not carried out, besides that the system modeling is not made so that the data flow in the expert system cannot be clearly identified [6]. In this study, a test was conducted between expert opinion and algorithms, in addition to system modeling using DFD.

The advantage of this research is that the expert system application that has been designed can not only detect disease but also provides a treatment solution in the form of consultation, in addition to information on the causes of diseases in corn.

II. RESEARCH METHODS

2.1 Research Flow

The flow in this research consists of several important stages including the following steps (i) Literature study, in the literature study the researcher examines theories related to the research theme sourced from research results and journals. (ii) researchers identify problems so that they can obtain problems that will be solved in this study. (iii) data collection aims to obtain data from various sources such as experts and literature. (iv) processing of data is carried out by determining manual calculations and following the rules in the forward chaining method. (v) perform testing or validation using expert justification in agriculture, (vi) draw conclusions on research results. To further clarify the research steps can be seen in Figure 1.

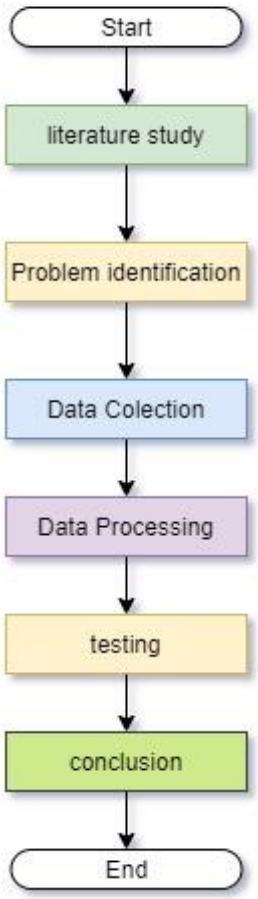

Figure 1. Research Flow

2.2 Forward Chaining Method

Forward chaining method is data-driven because information starts from existing information and then draws a conclusion. a simple example as follows: If you are passing by and then someone calls your name, it may draw a conclusion that person asks you to stop for a moment, this is an initial fact that can support a conclusion. Forward tracing makes use of a set of condition-action rules. To clarify how the forward chaining method works, see Figure 2. Forward chaining [7][8].

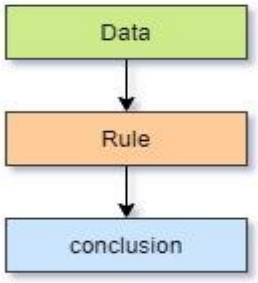

Figure 2. Forward Chaining

2.3 Data Flow Diagram

Data Flow Diagram (DFD) is a diagram that is useful for describing the processes that occur in the system that is being created. By describing the DFD model the visible data flow can be identified quickly [9][10]. DFD model usually starts from the stages of context diagrams, tiered diagrams, level 1 diagrams and so on up to detailed diagrams and adjusted to the level of complexity of the system being developed. The description of the context diagram on the expert system can be seen in Figure 3.

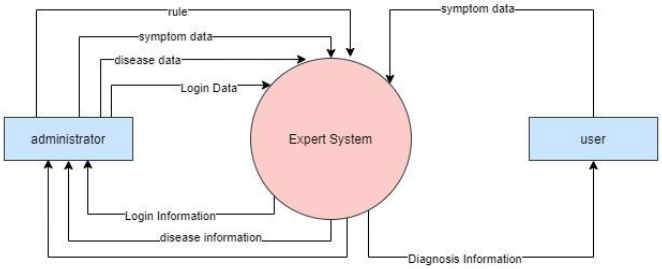

Figure 3. Contex Diagram

Based on Figure 3, there are two external entities connected by the expert system, namely users and admins.

2.4 Database

The next process after making a data flow design through a context diagram is to create a database design as shown in Figure 4.

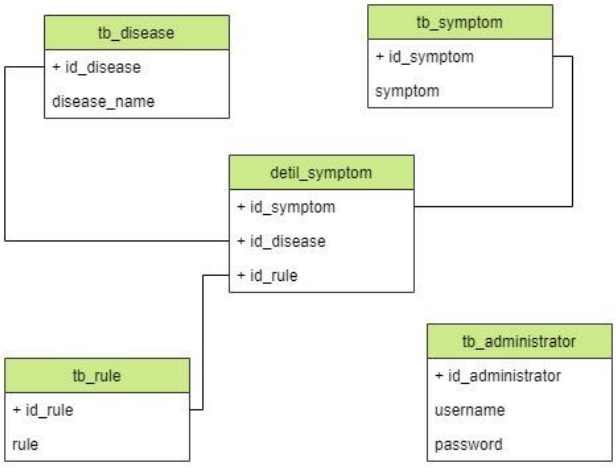

Figure 4. Database Design

III. RESULT AND ANALYSIS

The application of an expert system for detecting corn plant diseases with the forward chaining method makes it easy for application users who want specifically for farmers in the Muara Tami district, and agricultural extension workers.

3.1 Data on Jaundice and Symptoms

Data on symptoms and diseases of corn plants can be seen in table 1.

Table 1. Disease and Symptoms Data

Disease	Symptom
Bulai	1. Chlorotic Colored Leaves 2. Experiencing stunted growth 3. The color is white like flour on the upper and lower surfaces of the leaves which are chlorotic 4. Leaves curl and twist 5. The formation of the cob is disturbed
Blight	1. Affected leaves look wilted 2. Several small spots unite to form a larger spot 3. Elongated light brown spots in the form of a coil or boat 4. Brown spots shaped like an ellipse 5. Leaves look dry
Leaf Rust	1. Leaves look dry 2. Small brown or yellow spots on the leaf surface 3. Red spots on the midrib 4. There are irregularly shaped threads that are white and then brown 5. Out powder like yellowish brown flour
burn	1. Swelling of the cob 2. There is a white to black fungus on the seeds 3. Swollen seeds 4. Glands are formed in the seeds 5. Kelobot opens and a lot of white to black fungus appears

stem borer	1. There is a small hole in the leaf 2. slit on the stem 3. male flowers or the base of the cob, 4. stems and tassels (male flowers) that break easily 5. pile of broken tassels 6. male flowers are not formed 7. There is flour/dirt around the hoist 8. slightly yellow leaves
Cob borer	1. transverse holes in the leaves in the vegetative stage 2. Corn cob hair is cut / reduced / dry 3. the end of the cob has a quiver 4. often the presence of larvae

Table 1 is disease and symptom data, then to make it easier to code each disease which can be seen in table 2.

Corn Disease	Corn Disease Code
Bulai	P001
Blight	P002
Leaf Rust	P003
burn	P004
stem borer	P005
Cob borer	P006

Table 2 shows 6 diseases with codes, P001, P002, P002, P003, P004, P005, P006. The next step is to code the symptoms of corn plant disease. Which can be seen in table 3.

Tabel 3. Code Symptom

Symptom	Symptom code
Chlorotic Colored Leaves	G1
Experiencing growth retardation	G2
The white color is like flour on the upper and lower surfaces of the leaves which are chlorotic	G3
Leaves curled and twisted	G4
Impaired cob formation	G5
Affected leaves look wilted	G6
Several small patches unite to form a larger spot	G7
Elongated light brown patches in the shape of a coil or boat	G8
Brown spots shaped like an ellipse	G9
Leaves look dry	G10
Small brown or yellow spots on the leaf surface	G11
Red spots on the midrib	G12
There are irregularly shaped threads that are white and then brown	G13
Comes out powder like yellowish brown flour	G14
Swelling of the cob	G15
There is a white to black fungus on the seeds	G16
Swollen seeds	G17
Glands are formed in seeds	G18
Kelobot opened and appeared a lot of white to black fungus	G19
there is a small hole in the leaf	G20
slits in stem	G21
male flower or cob base,	G22
stems and tassels (male flowers) that break easily	G23
stack of broken tassels	G24
male flowers are not formed	G25
there is flour/dirt around the hoist	G26
slightly yellow leaves	G27
transverse holes in the leaf in the vegetative stage	G28
corncob hair cut / reduced / dry	G29
the tip of the cob has a hoist	G30
often there are larvae	G31

Table 3 shows the code for each symptom of corn disease. There are 31 symptoms of 6 diseases.

3.2 Inferensi Metode Forward Chaining

Inference in this expert system application works using rules that are in accordance with the

forward chaining method, the logic used in this expert system can be seen in table 4.

Table 4. Inferensi Forward Chaining

Symptom	Corn Disease					
	P001	P002	P003	P004	P005	P006
G1	√					
G2	√					
G3	√					
G4	√					
G5	√	√				
G6		√				
G7		√				
G8		√				
G9		√				
G10		√	√			
G11			√			
G12			√			
G13			√			
G14			√			
G15				√		
G16				√		
G17				√		
G18				√		
G19				√		
G20					√	
G21					√	
G22					√	
G23					√	
G24					√	
G25					√	
G26					√	
G27					√	
G28						√
G29						√
G30						√
G31						√

3.3 Design Interface

The design of the feed system application uses the PHP programming language and mysql database, in general it has a disease consultation feature on corn plants, the consultation menu interface design can be seen in Figure 5.

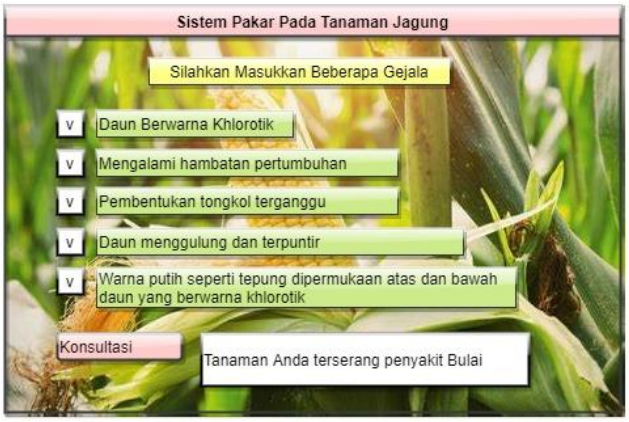

Figure 5. Design Interface

3.4 Blackbox Testing

The Blackbox testing method is a testing method for software, by observing the results of execution through test data and emphasizing the functionality of the application or software.

In Table 5. An overview of what has been done on software testing.

No	Scenario	Desired result	Information
1	Input symptoms according to the rules in the database	Detect disease	Valid
2	Input Symptoms Irregularly	Displays the type of corn plant disease that is closest to, and has the most symptoms	Valid
3	Click the Consult button	The system displays the disease based on the symptoms entered	Valid

3.5 User Acceptance Test (UAT)

Testing using a user acceptance test aims to find out whether the system made is suitable for implementation and in accordance with user needs.

Table 6. Testing Acceptance Test (UAT)

No	Question	Respon (%)				
		SB	B	N	KB	TB
1	Is the system easy to use	90	10			
2	Can the system provide the required information?	90	10			
3	Can the system provide the required information?	80	20			
4	Can the system print information?	80		20		
5	Can the system solve farmers' problems?	80	10	10		
Respondent's Answer		84%	10%	6%		

VI. CONCLUSION

From the results of the study it can be concluded that:

1. Based on testing using the user acceptance test method, 84% of respondents answered that the system was in accordance with the needs, 10% answered accordingly and 6% neutral did not provide an answer.
2. From the Blackbox method, all system functionality works well and in accordance with the application development plan.
3. The forward chaining method is suitable to be implemented in an expert system, but it should be combined with other methods such as the certainty factor method to obtain more accurate results.

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