Instal: Jurnal Komputer

Available online at https://journalinstal.cattleyadf.org/index.php/Instal/index

Design of an Expert System Application for Disease Diagnosis in Burley Tobacco Plants Based on Android using the Backward Chaining Method

Romanus Damanik[1], Bersama Sinuraya[2], Zekson Matondang[3], Parasian D.P Silitonga[4]
Universitas Katolik Santo Thomas[1,3,4], Universitas Mandiri Bina Prestasi[2]

ARTICLEINFO	ABSTRACT
	Tobacco is cultivated through a series of special processes, which is a very important crop in industry due to its significant impact on the economy. Making seeds, soil preparation, planting, care, up to the harvest phase, and post-harvest processing are all tasks included in this stage. These plants often show various signs of disease during their life cycle, which can seriously worsen if not treated quickly. In situations like these, effective solutions are needed to find and nip the problem in the bud. An expert system application has been developed in recent research to overcome this problem. This system relies on the backward chaining method, a clever technique for diagnosing diseases in tobacco plants. With this method, the application tries to search and find facts that match the current data to set the right diagnostic goals. This research not only allows users to better diagnose diseases in tobacco plants, but also helps develop prevention strategies so that similar diseases do not appear again in the future.
Corresponding Author: **Romanus Damanik** Saint Thomas Catholic University E-mail: -	

INTRODUCTION

Tobacco plants come from the genus Nicotiana, and are included in the category of non-food plantation crops. One of its characteristics is the leaves, which are widely processed into cigarettes. Tobacco leaves are not only used in the tobacco industry, but are also used in agriculture as a pesticide and for chewing. Tobacco has a high content of secondary metabolites, which makes it the main ingredient in making medicines. On the other hand, various types of disease-causing microorganisms can attack tobacco plants, including viruses, bacteria, protozoa, fungi and nematode worms, which can attack various parts of the plant, from the roots, stems, to the leaves and fruit. Management and prevention of diseases in tobacco plants is very important during the cultivation of this plant because these diseases can cause severe damage to the plant and potentially lead to crop failure.

In the era of modern technology, we have witnessed great progress in the application of artificial intelligence (AI) in agriculture, especially in detecting disease symptoms in tobacco plants. Expert systems, which have in-depth knowledge of tobacco plants, have adopted AI ideas to help the general public and farmers spot disease symptoms faster, easier and cheaper. Revolutionary agricultural solutions can be created with these AI-powered expert systems, speeding response to plant health problems, increasing crop yields and reducing losses. The ability to quickly identify disease symptoms in tobacco plants helps farmers maintain the health of their crops, ensures sustainable production, and contributes to the vital tobacco industry.

METHODS
Data collection
The data collection stage is an important step in ensuring the success of the research. This stage aims to collect various relevant information about research needs. The data collection process involves identifying reliable data sources and selecting appropriate methods. Researchers have chosen three data collection methods for this research: literature study, observation, and interviews. Literature studies, through thorough literature reviews, help researchers understand the research topic better, while interviews give researchers the opportunity to talk to expert sources and get information directly from them. Research has a strong foundation for producing quality and relevant data by combining these methods. This data will help in achieving

Analysis
It is important for developers to conduct investigations to determine the needs of system users during the development process. This serves as a basis for determining which features or services should be created. System requirements analysis, proposed system analysis, and user needs analysis are the three analysis components used in this research.

Planning
The design stage is the next stage in the system development process. This stage aims to create a plan that will facilitate the system development process and provide a detailed description of the appearance and structure of the system to be built. It is important to organize the sequence of design steps as this will help in determining the software and hardware required during the development process. To achieve this goal, to design an effective system, this research uses the Unified Modeling Language (UML) tool. By using UML, researchers can describe the parts of a system, how they relate, and how they interact with each other. This allows for a structured and scalable design for the system to be built, which is critical to ensuring that the resulting system will meet everyone's needs and desires.

Coding
Once the initial stage is complete, important components such as model design, implementation of business logic, and integration of various services will be included in the next stage, namely coding. At this stage, developers will start actively working on and writing code for the system, which will include all of its features and operational processes. To achieve this, they utilized the Flutter Application Framework and the Dart programming language, which allowed development to progress smoothly until it reached completion.

Testing
To ensure that all processes in the system that has been developed function as expected and run smoothly, the next important stage is the testing stage. This stage is not only important

but also very detailed, requiring great care in examining every aspect of the application. This testing, also known as testing, aims to find and fix errors or bugs that may not have been noticed during the development process. This testing allows us to ensure that the application not only performs its planned function, but is also consistent and stable.

Application testers are a very important part of the testing process. They are professionals whose specialty is searching for and finding various problems or bugs in applications. To ensure that every aspect of the application is thoroughly tested, they use a variety of testing methods and techniques, ranging from manual to automated testing. Application testers often encounter unexpected problems, which often require the development team to find new ways to solve them. The application becomes better, more reliable, and more ready to use after addressing this issue.

The first data to be processed is symptom data as shown in Table 1.

Table 1. List of symptoms

A	There is fungus on the leaves
B	The texture of the plant becomes soft and the stem does not grow taller
C	Leaves look wrinkled
D	Plant growth is stunted
E	The leaves are curly but the stems are sturdy
F	The leaves look small and yellow among the other leaves
H	Leaves change color
I	Infected leaves have spots
J	Stems wilt
M	The fibers in the roots rot
S	Leaves wilt
Y	The virus spreads on the leaves

Table 2. List of diseases

N	Hollow stem rot
G	Leaf viruses
L	Curly leaves
X	Dwarf Disease
Z	Leaf spot

Table 3. List of solutions

(Hole stem rot) (N) 1. Use Mono Potassium Phosphate fertilizer 16:16, Super Phosphate fertilizer, Super Sap fertilizer and Patent Kali grain fertilizer 2. Provide plant spacing when seeding 3.Pick old leaves immediately 4. Clean up rotten plant remains
(Leaf Virus) (G) 1. If one leaf is infected, immediately separate it from the other leaves 2. All plant debris, dead and diseased must be removed to prevent spread 3. Garden equipment must be sterilized 4. The leaves must have a stable color, then the tobacco plant must be settled 5.Avoid smoking when working in the garden as the tobacco can become infected and this can spread from the gardener's hands to the plants
(Leaf Virus) (L) 1. Don't use urea fertilizer during the rainy season 2. Use fertilizer organic 3. Provide planting distance 4. The single root must be straight, if it is bent it will damage the growth period.
(Dwarf Disease) (X) 1. Pay attention to land processing, post-harvest the land should not be planted immediately but left for several weeks 2. Don't use too much water 3. Use seeds that are healthy and free from disease
(Leaf Spot) (Z) 1. Leaves that are black or brownish are leaves that no longer have nicotine, so pick them immediately 2. Carry out sanitation 3. The distance between the plants should not be too close so that the plants get enough air

Table 2. contains data about diseases that can be concluded based on existing symptoms and explains how application users can choose treatment according to the disease that has been diagnosed by the expert system.

Table 4. Decision

A			X				
B		X	X				
C				X			
D				X		X	
E			X				
F					X		
H							X
I							X
J		X					
m		X					
S			X				X
Y		X					

RESULTS AND DISCUSSION

The first step is to carry out a number of thorough tests to find out how effective and successful the expert system that has been created is. The goal is to find out how accurate this system is in making diagnoses. Entering common symptoms into the system is part of this process. By paying attention to the response given by the system, we can determine how precise the analysis performed was to find a particular disease and provide appropriate treatment suggestions.

The concept of Backward Chaining is also the main concept in this examination. This method helps understand how the system draws conclusions from the entered data. This method will allow the system to analyze each symptom and look for cause-effect relationships. This allows a deeper assessment of how the expert system handles various cases and situations, providing a clear picture of the system's level of accuracy and reliability in real practice. By using this evaluation method, we can ensure that this expert system is operating according to high standards.

Sample case

In this section, an example of a case is made where there is a tobacco plant with symptoms A, B, C, D and E, where:

A: There is fungus on the leaves

B: The texture of the plant becomes soft and the stem does not grow taller

C: Leaves look wrinkled

D: Plant growth is stunted

E: The leaves are curly but the stems are sturdy

Does this tobacco plant have a disease? Leaf spot(Z) !

Rules

Rules in expert systems:

- Rule 1: IF Virus spreads on leaves   Y
  AND Plant growth is stunted   D
  THEN Leaf spot   Z

- Rule 2: Dwarf IF   X
    - AND The texture of the plant becomes soft   B
      and the stem does not grow taller
    - AND The leaves are curly but the stems are sturdy   E
    - THENThe virus spreads on the leaves   Y
- Rule 3: IF There is fungus on the leaves   A
    - THENDwarf   X
- Rule 4: IF Leaves look wrinkled   C
    - THENCurly leaves   L
- Rule 5: IF Leaves curl   L
    - THEN The fibers in the roots rot   M
    - THEN Hollow stem rot   N

Variables used:

- Y: The virus spreads on the leaves
- D: Plant growth is stunted
- Z: Leaf spot
- X: Dwarf
- B: The texture of the plant becomes soft and the stem does not grow taller
- E: The leaves are curly but the stems are sturdy
- A: There is fungus on the leaves
- C: Leaves look wrinkled
- L: Curly leaves
- M:The fibers in the roots rot
- N:Hollow stem rot

Simple form of Rule:

R1 = If Y and D then Z
R2 = If X and B and E then Y
R3 = If A then
R4 = If C then L
R5 = If L and M then N

Facts:

- A, B, C, D and E   value true.

Goals

- isLeaf spot(Z) is true?

Use illustrations to illustrate how Backward Chaining Inference works.

Databases				
A	B	C	D	E

Stacks	
Z	**Y**

Knowledge Base
R1 = If Y and D then Z
R2 = If X and B and E then Y

R3 = If A then
R4 = If C then L
R5 = If L and M then N

- Goal Z as the start of the stack
- Execute R1
- D is in the database
- Y is not in the database, save it on the stack

Databases				
A	B	C	D	E

Stacks		
Z	**Y**	X

Knowledge Base
R1 = If Y and D then Z
R2 = If X and B and E then Y
R3 = If A then
R4 = If C then L
R5 = If L and M then N

- Subgoal Y
- Execute R2
- B is in the database
- E is in the database
- X is not in the database, save it on the stack

Databases				
A	B	C	D	E
New fact				
X				

Stacks		
Z	**Y**	~~X~~

Knowledge Base
R1 = If Y and D then Z
R2 = If X and B and E then Y
R3 = If A then
R4 = If C then L
R5 = If L and M then N

- Subgoal
- Execute R3
- A is in the database
- X remove from stack, insert into new fact

Databases				
A	B	C	D	E
New fact				
X	Y			

Stacks	
Z	⊤

Knowledge Base
R1 = If Y and D then Z
R2 = If X and B and E then Y
R3 = If A then
R4 = If C then L
R5 = If L and M then N

- Subgoal Y
- Execute R2
- X is in the database
- B is in the database
- E is in the database
- Y delete from stack, insert into new fact

Databases				
A	B	C	D	E
New fact				
X	Y	Z		

Stacks
⇥

Knowledge Base
R1 = If Y and D then Z
R2 = If X and B and E then Y
R3 = If A then
R4 = If C then L
R5 = If L and M then N

- Goal Z
- Execute R1
- Y is in the database
- D is in the database
- Z remove from stack, insert into new fact

Databases				
A	B	C	D	E
New fact				
X	Y	Z		

Stacks

Knowledge Base
R1 = If Y and D then Z
R2 = If X and B and E then Y
R3 = If A then
R4 = If C then L
R5 = If L and M then N

As a result, leaf spot (Z) is proven to be a fact (valued TRUE) because Z is in the new fact along with the other facts. Backward chaining begins with the aim of showing that collected facts

turn into new facts. This process ends when the goal is found or when there are no rules that can prove that the subgoal or goal is correct. As a result, it can be concluded that this tobacco plant is sick.

CONCLUSION

This application is called "An Expert System for Android-Based Disease Diagnosis in Burley Tobacco Plants Using the Backward Chaining Method", and is intended to help farmers find diseases in their tobacco plants early and find the right solution. This application uses the backward chaining method to produce a diagnosis based on the symptoms experienced by burley tobacco plants. Based on the information provided by the application, this diagnostic application is able to manage disease data, farmer data, and symptoms accurately, as well as displaying diagnostic results based on symptoms identified on burley tobacco plants.

REFERENCES

[1] Anon., 2019. Flutter Documentation. [Online] Availabl

[2] AS Honggowibowo, "Web-based expert system for diagnosing rice plant diseases with forward and backward chaining," Telkomnika. vol.7, no.3, December 2009.

[3] Abdullah, Ahmad and Soedarmanto. 2009. Tobacco Cultivation. CV Yasaguna. Jakarta Cahyono, B. 2011. Botany of Tobacco Plants (Nicotinae Tabaccum L.). Canisius. Yogyakarta.

[4] Ajlan, A. (2015). The Comparison Between Forward and Backward Chaining. International Journal of Machine Learning and Computing, 106-113.

[5] Arhami, Muhammad. 2005. Basic Concepts of Expert Systems. Yogyakarta: ANDI.

[6] Balittas (Tobacco and Fiber Plant Research Institute), 1994. Tobacco Situation in Indonesia. Report January 1994. Research Institute for Tobacco and Fiber Crops, Malang.

[7] Dahria, M. (2012). SAINTIKOM Journal Vol.11 / No.1 / January 2012. Implementation of Backward Chaining Inference to Determine Computer Monitor Damage, 1-9.

[8] Firmansyah, H. 2010. Tobacco Plant Cultivation Techniques http://binaukm.com/2010/05/teknik-budidaya-tanaman-tembakau/. Accessed on February 6, 2015.

[9] Hartono, Jogiyanto. 2003. Expert System Development Using Visual Basic. Yogyakarta: ANDI

[10] Herliana, A., Setiawan, VA, & Prasetio, RT (2018). Application of Backward Chaining Inference in an Expert System for Early Diagnosis of Bone Disease. Journal of Informatics, 5(1), 50- 60. DOI: https://doi.org/10.31311/ji.v5i1.2818 .

[11] Hunt, D. (1986). Artificial Intelligence & Expert Systems Source Book. New York: Chapman and Hall

[12] Kusrini. 2006. Expert Systems Theory and Applications. Yogyakarta: CV. Andi Offset.

[13] Makfoeld, D. 1982. Getting to Know Some Physical Assessments of Tobacco Quality in Indonesia. Yogyakarta: Liberty.

[14] Matnawi, M. 2012. Systematics of Tobacco Plants (Nicotinae Tabaccum L.). University of North Sumatra.

[15] Muta'ali, L. (2015). Study of Tobacco as a Leading Commodity in Temanggung Regency, 9.

[16] Suleman, Fitriana, S., & Putra, TC Expert System for detecting computer damage using the Naive Bayes method. Journal of Evolution, 2018, Volume 6 No 2, 67

[17] Tani Karya Development Team. 2008. Plant Cultivation. Yrama Widya: Bandung. Accessed via https://www.onesearch.Author on February 13 2018.

[18]   Trisnadi R K. 2015. Tobacco Pest and Disease Attacks in 2015 in Probolinggo Regency and the Impact of Losses. Plantation and Forestry Service. Probolinggo.