ANALYSIS OF FORWARD CHAINING METHOD ON LAPTOP DAMAGE DIAGNOSIS EXPERT SYSTEM

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ABSTRACT

The forward chaining method is used in expert systems to reach conclusions by starting from known facts and moving forward to find a solution or diagnosis. In diagnosing damage to student laptops, this method will begin with information about the symptoms or problems experienced by the computer laptop. The system will evaluate these symptoms and match them with pre-programmed rules to identify possible causes of damage. This process continues by adding new information and making decisions based on sequentially applied rules until reaching a final diagnosis. In diagnosing damage to student laptops, the forward chaining method can help systematically identify problems based on observed symptoms, guiding users through the diagnosis process efficiently.

Keywords: forward chaining, expert systems, laptop damage.

INTRODUCTION

In the era of increasingly rapid digitalization, technological devices such as laptops have become an integral part of everyday life, especially in educational environments such as students. Laptops in academic, research, and administrative activities have become commonplace. However, like all technological devices, laptops are susceptible to damage and technical problems.

Laptop damage is the most frequently encountered case. Because it is a complex problem, you need good laptop knowledge to anticipate it. This is understandable because many users must understand the damage to laptop hardware and software(Hade et al., 2024).

To diagnose laptop damage, you need an in-depth understanding of the various problems that may occur and the right solutions to overcome them. Developing an Expert System is essential for diagnosing and solving laptop problems(Marpaung & Handoko, 2023).

Through interviews and observations, researchers found several problems related to laptop damage. Some users needed help understanding how to solve problems when their Laptop was damaged. Because of this problem, the Forward Chaining method will be implemented to detect laptop damage(Arzalega et al., 2023).

An expert system is a computer program that imitates the knowledge and skills of human experts in a particular scientific discipline. The main goal of an expert system is to offer answers or suggestions comparable to those made by human experts. Expert systems use this knowledge that has been transformed into rules or a knowledge base to solve problems or make decisions in a particular scientific discipline. Help expand this knowledge base by working with human experts who have deep knowledge and expertise in relevant fields(Maulida et al., 2021).

The forward chaining method is one method that can be used to develop expert systems. The decision-making approach known as the "forward chain" begins by considering premises or facts before concluding. This strategy uses data and is implemented by monitoring input data and trying to conclude (Anto et al., 2022). Using this method, the system is designed to operate on various devices such as websites, mobile, or desktops.

This journal aims to analyze an expert system that can diagnose and provide solutions to laptop damage problems using the forward chaining method.

METHOD

In conducting research at the Payakumbuh College of Technology, the author needed several methods to achieve the desired results. It can be seen in Figure 1 showing the author's research design.
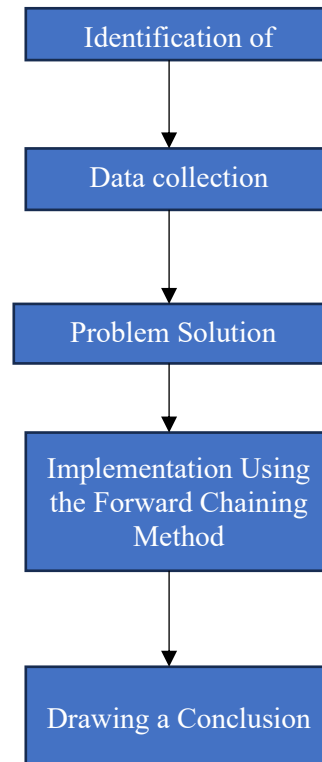
Picture1 Research Stages

Figure 1 shows the steps taken by the researcher. The first stage is data collection, and the second stage evaluates the collected data. After evaluation, the third stage is processing. The forward chaining method was used to reach the conclusions of this research. This research method is explained below:

1. Identification of problems

Identifying problems with a laptop damage diagnosis expert system requires several essential elements. First, accurate diagnosis is difficult because the symptoms of laptop damage are different and complex. Success depends on the expert system's understanding of the user's unique situation. As laptop software and technology continue to evolve, the knowledge base must constantly be updated and updated. Reliance on accurate and relevant input data can also impact how well an expert system functions. Therefore, understanding and solving this problem is very important to improve the performance and reliability of the laptop damage diagnosis expert system. As shown in Table 1 below, the problem identification results show several symptoms of laptop damage.

Table 1. Laptop Damage Data

Code	Damage
K01	RAM problem
K02	*Processor*problematic
K03	*VGA Card*problematic
K04	HDD or SSD problem
K05	*Sound Card*problematic
K06	*Motherboards*problematic
K07	*Power Supplies*problematic
K08	*Fans*problematic
K09	Lack of RAM capacity

After data on the type of laptop damage is obtained, data on the symptoms of the type is shown in Table 2 below.

Table 2. Laptop Symptoms

Code	Symptom
G01	Continuous long beep sound
G02	The BIOS display does not appear
G03	An error message appears when running the OS
G04	HDD or SSD makes strange noises
G05	Hangs or crashes often occur when running the application
G06	Often perform Scandisk at boot time
G07	Audio driver is not detected, even though the driver has been installed
G08	Laptop experiencing Blue Screen
G09	An error message appears when running the audio application
G10	The Laptop often shuts down suddenly when it is turned on
G11	The fan on the Power Supply does not rotate
G12	HDD or SSD is not detected
G13	PC temperature heats up quickly
G14	USB cannot be detected

G15	The Laptop is slow when running applications
G16	The system turns on temporarily and then turns off
G17	Graphics performance feels heavy
G18	PC completely dead
G19	All input devices are not detected
G20	The PC turns on but does not display anything on the monitor
G21	PC Indicator Light does not turn on
G22	Loading HDD or SSD is very slow
G23	Corrupt files without a reason
G24	There is no electricity flowing to the PC
G25	The fan sound is boisterous
G26	Laptop does not turn on (Black Screen)

Damage and symptom data will be used to diagnose damage using an expert system.

2. Data collection

To facilitate research, the author collected data through the following stages:

1) Interview: The author conducted an oral interview with students at the Payakumbuh College of Technology.

2) Observations: The author made observations at the Payakumbuh College of Technology to collect data for this research.

3) Literature study to obtain information: To obtain information about this research, the author used references from books, journals, and other literature related to detecting laptop damage.

a. Problem Solution

Using an expert system can resolve the problem of diagnosing laptop damage. Applications that use the knowledge and expertise of human experts in a particular field to solve problems or provide advice are known as expert systems. An expert system for diagnosing laptop damage can collect information about the symptoms, find damage patterns, and provide appropriate solutions based on the knowledge programmed into the system. As a result, users can quickly and efficiently find the source of the problem and make appropriate repairs. Implementing an expert system in laptop damage diagnosis speeds up the damage identification process,

provides more accurate solutions, reduces dependence on individual expertise, and allows users to solve laptop hardware problems independently.

b. Implementation Using the Forward Chaining Method

The Forward Chaining method is one approach to artificial intelligence systems for rule-based decision-making. This method works to find facts using IF-THEN rules where the position (IF) leads to the conclusion (THEN), and this method has a forward tracking technique that starts with existing information and makes one of many rules to get results in the form of conclusions or goals. The Forward Chaining method is often referred to as a deductive research type of research. In this situation, the system begins by evaluating existing facts and then applying the relevant rules to reach the desired goal or conclusion. These steps are carried out sequentially, from initial facts until the conclusion. During this process, the system continuously evaluates possible rules and facts, updates its knowledge, and performs the necessary execution steps to achieve the goal. Expert systems and other AI applications often use forward chaining. This allows the system to explore various possibilities and produce structured and logical solutions. Based on the data on symptoms and damage, a decision description is made using the rules listed in Table 3 below.

Table 3. Rule Base Rules

Symptom Code	Damage Type								
	K01	K02	K03	K04	K05	K06	K07	K08	K09
G01	√								
G02				√					
G03				√					
G04				√					
G05									√
G06				√					
G07					√				
G08	√								
G09					√				
G10							√		
G11							√		

G12				√						
G13									√	
G14							√			
G15										√
G16		√								
G17			√							
G18							√			
G19							√			
G20			√							
G21								√		
G22				√						
G23				√						
G24										
G25									√	
G26		√								

c. Drawing a Conclusion

After data processing using the forward chaining method, the results of forward tracking will be used to arrive at conclusions and determine what solutions must be repaired for laptop damage.

RESULTS

When carrying out repairs on a laptop device, several problems or damage will occur. Because of this incident, this research aims to find and convey solutions and conclusions for types of laptop damage using the Forward Chaining method. This research carried out the following steps:

a. Decision Tree

An expert system with a forward chaining method using a decision tree is a hierarchical model that helps make decisions based on a series of rules. The expert system in forward chaining

starts the process with initial facts or symptoms provided by the user. Then, through gradual steps, the system applies the rules sequentially and evaluates the conditions corresponding to the symptoms. Decision trees, visual representations of rules, allow systems to follow relevant decision branches and take action based on the information they gather. Thus, decision trees and forward chaining enable expert systems to diagnose problems, create solutions, and help users make the right choices in a particular area—the following image of a decision tree for diagnosing laptop damage, as shown in Figure 2 below.
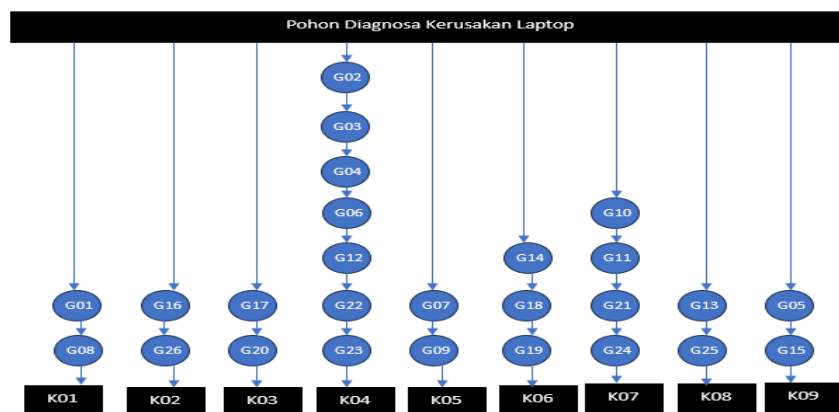
Picture 2. Laptop Damage Diagnosis Tree

In Figure 2, it can be explained below that to get a decision tree, you have to look at the symptom table and damage table first, and you will get a damage decision from the symptoms experienced on the Laptop.

From the symptoms of damage that occurred, the author created a solution for the damage that occurred in the form of Table 4 as follows:

Table 4. Rule Base Rules

Code	Damage Type	Damage Solution
K01	RAM problem	Clean RAM with deletion
		Replace with new RAM.
		Repair unstable electrical voltage.
K02	*Processor*problematic	Clean from excess dust
		Adding Thermal Paste
K03	*VGA Card*problematic	Update the Driver of the VGA Card
		Remove the VGA Card, then reinsert it.

		Check the connector on the VGA cable
K04	*Hard disk* problematic	Check the HDD connection cable on the casing
		Perform a full scan on the HDD.
		Change HDD settings in BIOS.
		Check whether the jumper is appropriate.
K05	Sound card problem	Reinstall the driver
		Check Cable Connectors
		Replace with a new Sound Card.
K06	Motherboard problem	Replace a new motherboard
		Remove all components on the motherboard except the power supply cable, take the motherboard out of the casing, and try turning it on. Then, a Taspen test will be performed to determine whether the electric current flows.
K07	Power supply problem	Check whether the Cable is connected correctly and the plug is properly installed in the socket.
		Use a stabilizer to stabilize the Power.
		Check the Power ON/OFF button to see if it still works
K08	*Fans*problematic	Check whether the connector is connected correctly
		Use New Fan
K09	RAM capacity is reduced	Plus, RAM corresponds to the DDR RAM on the Laptop

b. Knowledge Base

Knowledge Base is an essential component in the structure of an expert system and functions as a store of information and rules used by the system in the decision-making process. In the case of a laptop damage diagnosis expert system, the Knowledge Base will contain logical rules

derived from expert knowledge and facts gathered from users or other sources. It provides a framework for expert systems to identify and repair laptop defects. Knowledge base data using the forward chaining method can be seen in Table 5 below.

Table 5. Forward Chaining Knowledge Base Data

| ID	*Rule (IF THEN)*
K01	If G01 and G08 Then K01
K02	If G16 and G26 Then K02
K03	If G17 and G20 Then K03
K04	If G02 and G03 and G04 and G06 and G12 and G22 and G23 Then K04
K05	If G07 and G09 Then K05
K06	If G14 and G18 and G19 Then K06
K07	If G10 and G11 and G21 and G24 Then K07
K08	If G13 and G25 Then K08
K09	If G05 and G15 Then K09

c. System Implementation

Expert system applications offer innovative solutions and open new opportunities to increase efficiency and innovation in various aspects of life and business. Implementing expert system applications also involves developing and integrating artificial intelligence technology to offer recommendations or solutions in a particular domain. Implementing expert system applications can also increase the accessibility of expert knowledge without relying on resources owned by other people. Users can quickly get fast and precise suggestions or solutions by using the data they provide. The login page application display is shown in Figure 3 below.
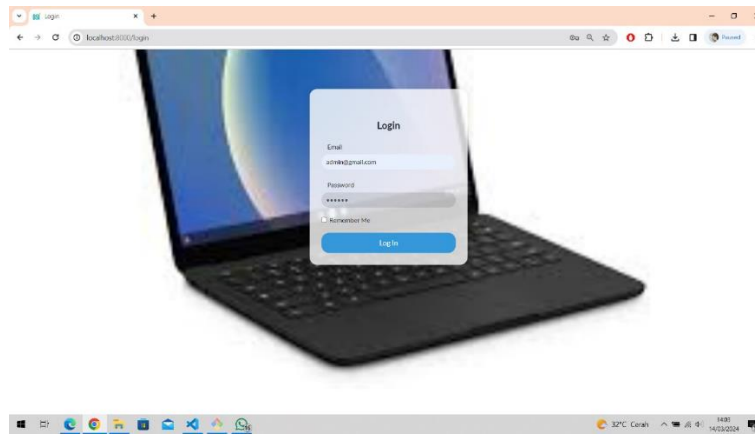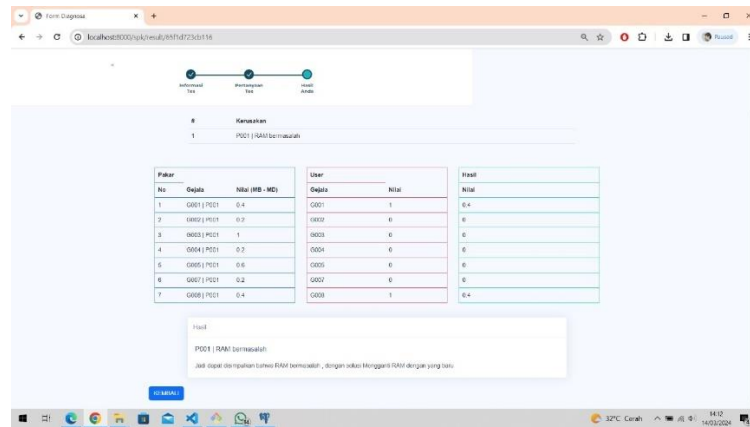
Picture 3. Login Page Display

The display above helps system administrators enter data on laptop symptoms and damage. It also helps determine rule-based knowledge in forward-chaining methods. The consultation page is shown in Figure 4 below.
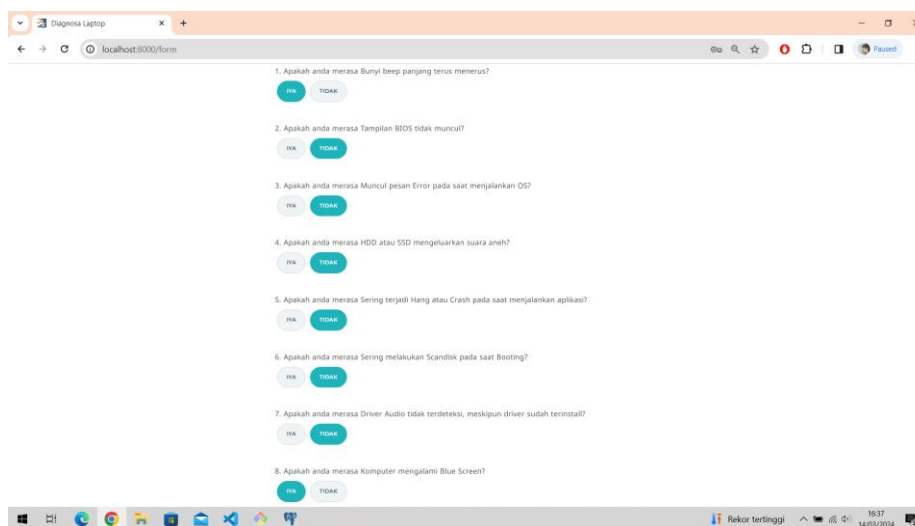
Picture 4. Consultation View

Picture5 Laptop Diagnostic Results Display

Users can identify the type of damage based on existing symptoms by entering symptoms such as a blue screen, laptop freezing, and unstable applications. The knowledge rule of the forward chaining method will detect RAM damage or problems.

CONCLUSION

As a result of a series of studies carried out, which began with the analysis procedure and ended with the results of actions to identify laptop damage using the Forward Chaining method, can be understood as follows.

1. To detect various symptoms of damage to a laptop device, it can show several previous symptoms and perform valid calculations to increase damage clarity more than other ordinary methods.
2. This research helps people who use laptops diagnose and repair their own laptops. The results may be partially correct, but they can be used as a reference to diagnose and repair laptop damage.

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