Implementation Of Computer Damage Diagnosis By Expert System Based Using Forward Chaining And Certainty Factor Methods

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Abstract: The computer damage diagnosis expert system is used by the user to help to detect the damage faster without spending a lot of money and a long time if given to a computer service provider. People who do not understand the problem of computer damage always feel panic if there is a problem with their computer, so it is more likely to be resigned to waiting for the results of repairs made by technicians in computer service, so researcher developed an expert system to diagnose computer damage using Android-based the method of forward chaining and certainty factor. The method used is prototype (prototyping), while the tools used in conducting analysis and design are unified modeling systems (UML). The results of this study are expert systems for detecting hardware damage on Android-based computers and laptops that use the method of forward chaining in the work process and to prove the facts with the method of certainty factor.

Keywords: Expert System, Forward Chaining, Certainty Factor

1 INTRODUCTION

Along with the increasing number of computer users, the problem of computer damage is quite complicated. This is understandable because there are many computer users who lack knowledge about computers, especially in dealing with computer damage. These problems are generally experienced by both individuals, households and institutions, both private and government institutions. Lots of funds are spent to repair computer damage, even though computer damage that occurs is not necessarily complicated but can be repaired independently. On this background this research was made, so that those who want to try to improve themselves can use the results of this study.[1][2] Expert System is one branch of artificial intelligence. The definition of an expert system is a system that seeks to adopt human knowledge to a computer, so that the computer can solve problems as done by experts. A good expert system is designed to solve a particular problem by imitating the work of experts. For experts even this expert system will also help its activities as an experienced assistant. Expert Systems are a branch of artificial intelligence and also a field of science that has emerged along with the development of computer science today.[3][4] Forward chaining is a sequence that begins by displaying a data collection or convincing facts towards the final conclusion. So it starts from the premises or information input (if) first then leads to conclusions or derived information (then) or can be modeled as follows: IF (input information) THEN (conclusion) Information input can be in the form of data, evidence, findings or observations. While conclusions can be in the form of goals, hypotheses, explanations or diagnoses, so that the way forward chaining can be started from the data towards the goal and the evidence towards the hypothesis, from findings to explanations, or from observation to diagnosis [5] The certainty factor was introduced by Shortliffe Buchanan in making MYCIN. Certainty Factor (CF) is a clinical parameter value given by MYCIN to show the amount of trust.[6] The determination of CF in this study uses the parallel CF method, this is due to the results of the rule and the case as well as data obtained from experts and other supporting data. The formulation of parallel CF is:

CF(x and y) = CF(x) (Min CF(y))

Description:

CF(x,y) : CF parallel

CF(x) : CF sequences of all premises

CF(y) : CF Expert

2. METHODOLOGY

In the process of development, the hardware damage detection system on computers and laptops uses prototype (prototyping) methods, while the tools used in conducting analysis and design refer to object-oriented methods using modeling language namely Unified Modeling Language (UML) Prototyping [7] is a combination of methods that allow physical or visual forms to be given to an idea and play an important role in the product development process, allowing designers to determine design problems, meet user requirements and technical requirements, and verify design solutions. The stages of the prototyping model [8] consist of: (1) gathering the needs of customers and developers together to define the format of all software, identify all needs, and outline the system to be made. (2) Building prototyping is by creating a temporary design that focuses on presenting to customers (for example by making input and output formats). (3) Using this evaluation system is carried out by customers who have built prototyping according to customer desires. (4) Encoding the system at this stage is prototyping that has been agreed upon and then translated into the appropriate programming language. (5) Testing the system after the system has become ready-to-use software, must be tested before use. This test is done with the White Box, Black Box, Base Path, architecture testing and others. (6) Customer system evaluation evaluates whether the finished system is as expected. (7) Prototyping Evaluation Software that has been tested and accepted by customers is ready to be used. Another version of the prototype manufacturing process can be seen as follows in figure 1 below:

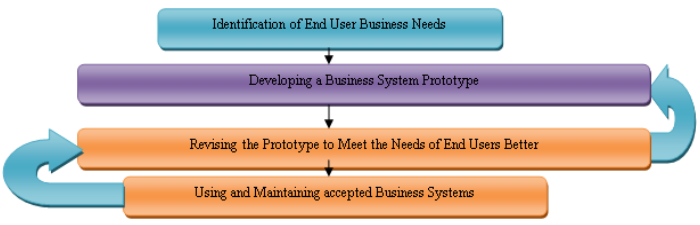


Figure 1. *Steps for Prototyping [2]*

To get the data needed in building this system, several techniques are carried out, namely: (1) literature study; Literature studies are conducted by learning about the theories that become references and complement in making expert systems for detection of hardware damage, studying the symptoms, causes, and solutions to mitigating damage to computer hardware, and programming based on Android mobile. (2) Interview and observation; this technique is used to consult with experts or experts in the field of computer hardware, including computer teachers, computer service technicians, and service centers to build a knowledge base that is a major component in an expert system. Unified Modeling Language (UML) [3] is a modeling language that has become a standard in the software industry for visualizing, designing, and documenting software systems. UML Modeling Language is more suitable for making software in object-oriented programming languages (C, Java, VB.NET), however it can still be used in procedural programming languages. UML will be used in the analysis and design stages. The resulting design is in the form of UML diagrams which will be translated into program code at the implementation stage. UML consists of 13 types of official diagrams, namely diagram: activity, class, communication, component, composite structure, deployment, interactive overview, object, package, sequence, state machine timing, and use case.

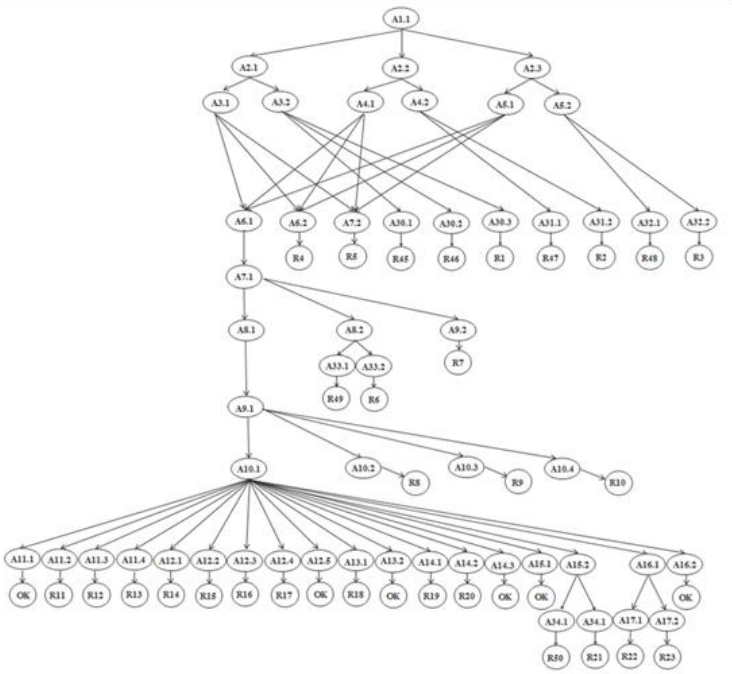
3. Result and Discussion

A. System Analysis

This system is made to make it easier for technicians to find solutions to problems that occur on computers and as an alternative presentation of information and consultation about damage to hardware along with solutions in the form of diagnostics to hardware damage problems, as expert systems that can detect hardware damage and problems analyzed that is about various kinds of damage that occurs in hardware along with symptoms, causes and resolution of the problem gradually. Based on this research through interviews and direct diagnoses in cases of computer damage and literature study sourced from Computer books [5] and equipped with questionnaire data collection on errors that are often encountered in computer damage, the system that will be created can diagnose 22 symptoms computer damage [4] includes: (1) keyboard error display, (2) keyboard keys do not work, (3) some buttons do not work, (4) keyboard response is too fast, (5) mouse cursor does not run, (6) cursor the mouse moves horizontally / vertically, (7) the computer often errors, (8) the computer cannot boot, (9) the continuous beep sound, (10) the sound of the beep is normal but there is no display, (11) the computer restarts itself, (12) the readings of the disc are halting, (13) it is difficult to open or close the CD / DVD ROOM, (14) the CD / DVD is not detected, (15) the hard drive cannot be partitioned, (16) the hard drive cannot be formatted, (17) hard drive bad sector, (18) fan or power fan the supply does not rotate, (19) the power supply fan or fan is noisy, (20) horizontal monitor display error, (21) vertical monitor error display, (22) RGB of monitor display error. The system can also diagnose 6 damage that often occurs on laptops [4], namely: (1) the laptop does not turn on, (2) screen error / no display, (3) hard disk error, (4) the CD / DVD has a problem, (5) error, (6) excessive overheating. An expert system has two main components, namely the knowledge base is a place for storing knowledge in computer memory where knowledge uses production rules. Inference engine is the brain of an expert system application. This section guides the user to enter facts so that a conclusion is obtained [6]. However, the two components are equipped with an interface for the user as shown in Figure 2 above, namely: 1. Expert Theory; Expert theory used is some expert theories about handling damage to computers / laptops and their solutions, theories related to this damage are stored on computer storage media as a knowledge base which will be connected to the forward chaining inference engine. 2. Inference Machine; the inference engine used is forward chaining (forward trace) which is the brain of an expert system application that will guide the user to enter facts so that a conclusion is obtained. Advanced continuous inference method is suitable to be used to handle controlling and forecasting problems (prognosis). [7] Based on analysis, it is necessary to make an application that can meet user needs and can help users with errors or damage to computers and laptops. as follows: (1) the application is able to detect damage to computers and laptops based on existing symptoms. (2) Applications can provide the location of damage. (3) Applications are able to provide solutions / direction to the damage that occurs. (4) Applications can be accessed anytime and anywhere (Mobile Application). The existence of a system design that aims to facilitate the user in getting information about various types and locations of damage to the computer / laptop is used by the user. From the design of this system, it will show the flow and workings of the application to be built. In designing the system, it is described every process and rule that exists in the system to be built so that it becomes a reference material in making applications so that the application is in accordance with the needs of the user and the application can work optimally. Designing an expert system application for detecting damage to computers and laptops uses modeling language, Unfield Modeling Language (UML) The use case model describes the actors involved with the software that is built along with the processes in it. The use case formed in the diagram below (figure 3) consists of a device selection function in which there are two choices, namely computer and laptop, symptom selection, dictionary of damage, damage information and diagnosis. The service information function is an extend relation that is connected with damage information, if the device damage experienced by the user is not solved.

B. Tracking

From the picture below, it is explained that the tracking tree is a description of the sequence of processes that occur in the system. This tracking tree performs the tracking and tracing process based on the symptom table. The tracking process uses the forward chaining method. To be able to see the tracking tree (decision tree) the symptoms of damage from all damage can be seen in the attachment sheet. Each damage is represented by a damage code, and then followed by the symptoms associated with the damage[9][10]:



Formation of Rules

Rules are made based on the decision tree diagram that was made previously. With the rules, you can easily find out the final results based on existing rules. Examples of rule formation according to the decision tree in Figure 1 are[11]:

Result:
Charger / battery / motherboard
Symptoms:
A1.1 = The type of computer is a laptop
A2.1 = Power source uses a charger and battery
A3.2 = Not on when turned on
A30.3 = The computer still does not turn on using a battery or charger.

Production Rules

Production rules are rules that are used to reason / search the initial knowledge base so as to produce new knowledge that is useful for achieving goals. This production rule is basically an Antecedent and Consequent. Antecedent is the part that presents the situation or premise (statement on the beginning of IF) and Consequent which is the part that states a particular action or conclusion that is applied if a situation or premise is true (statement beginning with THEN)[12]. Following is an example of some of the production rules used by this application, for details, see the attachment

Rule 1
IF The type of computer is an AND laptop
(
Power source uses a charger and battery OR
Power source uses a charger OR
Power using a charger and battery OR
)
AND
On when turned on
AND
IF The monitor does not turn on
THEN Damage to Monitor / power supply
Rule 2
IF The type of computer is an AND laptop (
Power source uses a charger and battery OR
Power source uses a charger OR
Electricity using a charger and battery OR
)
AND
On when turned on
AND
The monitor can be on
AND
The fan cannot rotate
AND
The laptop is successful for booting
AND
The keyboard indicator is on
AND
Normal computer after booting AND
The temperature of the laptop is hot quickly AND
Air flow on the fan is normal
THEN the damage is on VGA
Rule 3
IF The type of computer is Desktop AND
The monitor can be on AND
The fan can rotate AND
The computer is successful for booting AND
The keyboard indicator is on AND
Normal computer after booting AND
CPU temperature is hot fast AND
The air flow on the fan is slow
THEN Damage to the Processor Fan

4. TEST RESULTS

After implementation, the next stage is testing using the Black box method. Tests include main menu testing, testing of computer symptoms, testing of laptop symptoms, and testing dictionary damage. The testing phase shows success. The final result of the system in the form of an android application is named dr. Had received a response that was considered positive. We can see this through the graph in Figure 12 regarding the results of the questionnaire that has been distributed to 50 respondents with the following results:

1. Ease of use of the system, shows the largest percentage of respondents who say good is (65%) which is followed by very satisfying responses as much as 25%, while those who give are less satisfied and moderate, each of them gets 5% response from 50 respondents.
2. Conformity between the symptoms of damage and identification of damage in the application display, which in this case is the result of the work of the forward chaining method, according to the results the respondent has no deficiencies, has a moderate value of 20%, good value 55%, and very good value 25%.
3. Respondents' understanding of the grammar and terms used in the application were assessed by respondents as 60% good, 20% moderate, 10% very good, less and very less 5%.

The results of this study are expert system applications that can be run on a variety of Android-based mobile devices and can provide results and efficient solutions to damage to desktop and laptop computers. An expert system is a computer program designed to model the ability to solve specific problems like an expert (human expert). The test results are carried out by testing the software to several computer stores, by comparing between testing manually with testing using software that has been made. The following table results are in a comparison of diagnostic testing of computer damage manually and using the application.

N0	Types of damage diagnosed	Time for diagnosis manually							To be diagnosed using the application
1	Power suplay	35	minutes	35	minutes	40	minutes	10	minutes
	Average			37	minutes				
2	Motherboard	45	minutes	50	minutes	45	minutes	10	minutes
	Average			47	minutes				
3	processor	40	minutes	40	minutes	45	minutes	10	minutes
	Average			42	minutes				
4	VGA	40	minutes	35	minutes	40	minutes	10	minutes
	Average			38	minutes				
5	RAM	35	minutes	40	minutes	40	minutes	10	minutes
	Average			38	minutes				
6	Hard drive	40	minutes	40	minutes	40	minutes	10	minutes
	Average			40	minutes				
7	CD/VCD	25	minutes	20	minutes	25	minutes	10	minutes
	Average			23	minutes				

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