

Implementation of Case Base Reasoning Method to Detect Hard Drive Damage

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Abstract— *Using computers as one of the most commonly used electronic devices in various places such as offices, libraries, schools, and shopping centers. However, one of the challenges faced by computer users is the frequent occurrence of problems on the hard drive. Yayasan Sentra Computer is a Non-Formal Education Institution that provides computer courses and training. They face challenges in handling different brands and capacities of hard drives that are manually analyzed and repaired by technicians. Monitoring 20 computers is usually done by three people, and problems are reported to admins who then arrange fixes. To improve the efficiency of solving hard drive problems, a website-based expert system using similarity techniques is proposed. The Case Base Reasoning (CBR) method involves four stages; Retrieve, Reuse, Revise, and Retain. This system aims to provide initial diagnosis and detection of symptoms for hard drives, based on the knowledge and experience of experts. The Waterfall method was used to develop the system, and data was collected through observation, interviews, and literature reviews. The sample used in the study consisted of twenty hard drive units that experienced various problems. The programming system uses PHP and Javascript, and the database is managed with MySQL. The study used Blacbox testing for evaluation. The proposed system is expected to provide users with a more accurate and efficient diagnosis of hard drive problems.*

Keywords : Expert System; Case Base Reasoning; Hard disk.

I. INTRODUCTION

Computer is one of the electronic devices that is often used in the advanced modern era. Computers can even be found in offices, libraries, schools, and shopping centers. This is not surprising given the many benefits of computers for various human activities, such as playing games and doing office or school tasks. But the problem is that it often happens on the hard drive. Hard drives today are an important necessity for those who often work with computers. Hard drives that are varied enough make the latest computers better, and hard drive capacity increases CPU performance in reading programs, applications and data while running[1].

Yayasan Sentra Anugrah Mandiri Non-Formal Lean and Training Institute (LPK) engaged in computers since 2003 and located on Jl. Koti No. 80 Pelabuhan Weref Jayapura. Based on the location of the problem, sometimes many problems must be fixed with various obstacles from various brands of hard drives with different capacities. Hard drive damage analysis is done manually and only by technicians. In one class there are 20 computer units, which are on duty when monitoring usually three people, two monitoring people and one assistant. At the time of monitoring, there was a problem of schedule delays due to the teaching and learning process at the LPK location which was held Monday – Friday with four sessions, namely morning, afternoon, evening and night.

Expert systems are computer-based applications that are used to solve problems according to the thoughts of experts. An expert refers to someone who has specialized professional knowledge and can solve problems that ordinary people cannot solve[2]. The Case Base Reasoning (CBR) approach is a problem-solving technique by comparing and mapping new cases with previous cases in a knowledge database. The CBR process requires 4 main phases namely; Retrieve, Reuse, Revise and Retain. Therefore, it is necessary to build a website-based hard drive damage diagnosis expert system that aims to make users find problems more easily, and use the CBR method to help handle and provide first aid[3].

Based on the results of the description explained that an expert system early diagnoses symptoms related to hard drive damage by providing information about detecting damage based on expert experts. With the hard drive damage diagnosis system, it is expected to help facilitate early diagnosis and symptoms related to detecting hard drive damage in order to provide diagnostic information. In the problem of a computer taking a hard drive because during the monitoring process there is a lot of damage to the hard disk found a lot of hard disk damaged compared to other devices, then this research focuses on hard disks, this research focuses on hard drives with the CBR method used in this study as a level of confidence of an expert and expert. The system developer model used is the waterfall model. Data collection techniques include

observation, interviews, and literature studies. The samples used were twenty units of hard drives that were damaged. The programming languages used are *PHP* and *Javascript*. Database management using *MySQL*. The design model used in this study will use *Blacbox* testing. With this research a system that can help to diagnose early symptoms of damage, provide information about damage and display diagnostic results.

II. RESEARCH METHODS

Research Methods describe the Research Flow, Case Base Reasoning, DFD, ERD

2.1 Research Flow

This research data analysis contains current systems, functionality needs, and non-functionality needs. The analysis uses the waterfall method which is in the design stage until management is carried out in stages[4], and data analysis aims to make readers understand and understand directly.

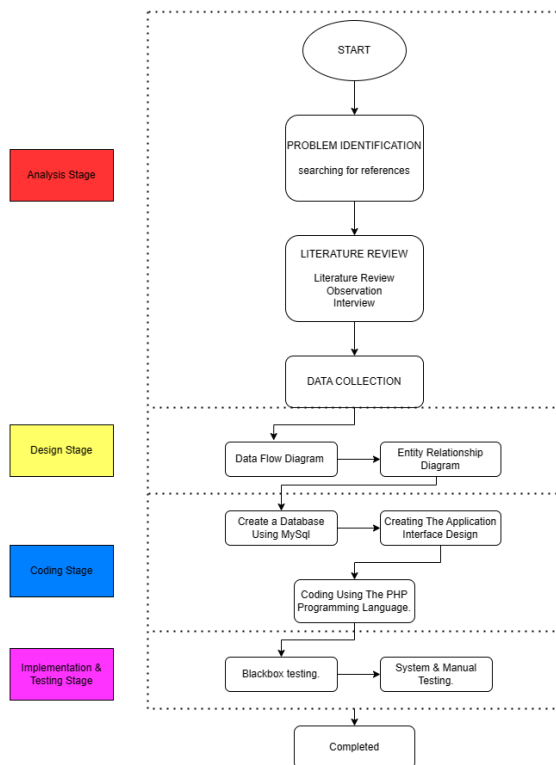


Figure 1 Research Flow

Based on figure 1, the initial step in this research is the analysis stage which is a step to find out the problems contained in LPK, the design stage which is a plan carried out before making a system. The coding stage is the analysis and design that is included in the programming language, while the implementation and

testing stage is the last step in order to get the final result.

2.2 Case Base Reasoning

Case Base Reasoning is a technique for solving problems by comparing and mapping new cases with previous cases in a knowledge database. The CBR process requires 4 main phases namely Retrieve, Reuse, Revise and Retain.[3]. It can be seen in figure 2.

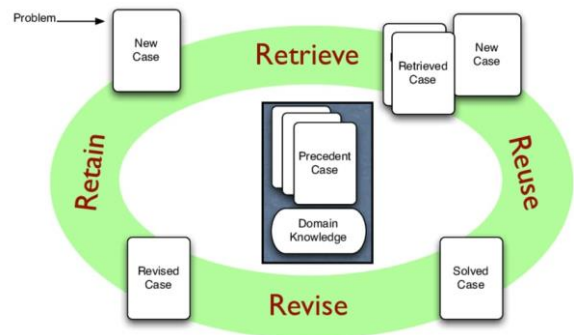


Figure 2 Case Base Reasoning Flow

- Retrieve**
Cases that are most similar to new cases will be searched by the system through the knowledge database.
- Reuse**
The solution of the case is taken and applied to the new case.
- Revise**
Solutions taken can be reviewed and revised if needed.
- Retain**
The process of storing or recording previously occurring cases as a basis for solving the same or similar problems.

2.3 Formulation of Similarity Techniques

The similarity weight method technique can be determined a case, the case is considered similar enough then this case is the solution user question, similarity weight calculation analysis for each case that becomes a solution[3].

$$Similarity (s) = \frac{s1*w2+s2*w2+...+sn*wn}{w1+w2+...+wn}$$

- Information;
- S = The similarity value is 1 for similarity and 0 for difference
 - W = weight (given amount)

2.4 DFD (Data Flow Diagram)

Data Flow Diagram shows parts of the system and data flow, including origin, destination, and data store. DFD development is usually done in stages, starting from context diagrams or tiered diagrams[5], DFD level 1 and so on. Figure 3 shows a context diagram to illustrate in general terms how data flows in the system.

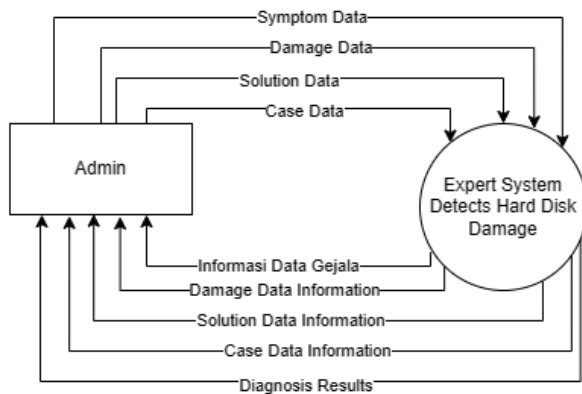


Figure 3 Context Diagram

2.5 ERD (Entity Relationship Diagram)

Entity diagrams illustrate the relationships between entities in a database system. ERD is used to help understand the database schema and can also identify interrelated relational entities and help define attributes and primary keys in the database[5].

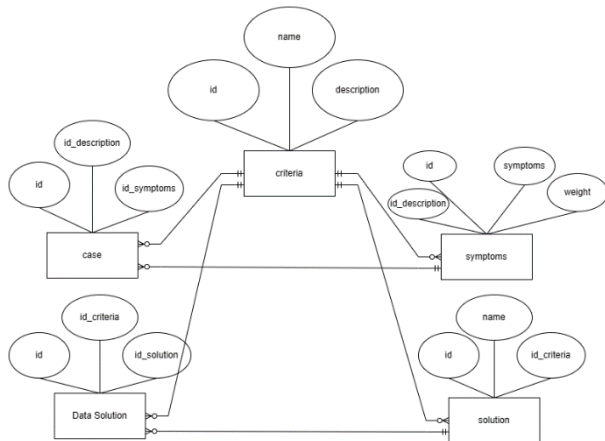


Figure 4 Entity Relationship Diagram

III. RESULT AND ANALYSIS

3.1 Inference Mechanism

Broadly speaking, damage to the computer hard disk can be seen in table 1.

Table 1 Hard Drive Damage

Crash Code	Damage
K1	Invalid Partition Tabel
K2	Hard Drive Stuck While Loading Window's
K3	Noisy Hard Drive
K4	Post Error
K5	Hard Disk Bad Sector
K6	Hard Disk Failure

3.2 Damage cases

With the gejala as shown in table 2.

Table 2 Hard Drive Damage Cases

Symptom	Harrdisk Damage					
	K1	K2	K3	K4	K5	K6
"Invalid Partition table" error message appears during boot	✓					
The boot process does not reach the operating system and enters the BIOS	✓					
A black screen appears after the boot process	✓					
The computer is deley or stuck during the boot process		✓				
When the computer is used suddenly blue screen		✓				
Error messages appear during the process						
There is a harsh sound during the window's laoding process		✓				
Braking sound			✓			
Vibrating sound in bearings						
Rough noise			✓			

Crackling sound on the <i>disk platter</i>			✓			
Hard disk spins fast and then stops			✓			
"No Bootable device found" <i>error message</i>			✓			
No black display or screen						
Beep				✓		
On-screen <i>error POST error message</i>						
Unable to boot				✓		
Can't be formatted				✓		
A freeze or hang occurs				✓		
Program files cannot be accessed						
Blue screen of death (BSOD)					✓	
Slow boot					✓	
Clicking sound on the <i>hard drive</i>					✓	
Slow opening of programs					✓	
BIOS not detected						✓
Frequent hangs or crashes						✓

3.3 Database

The set of data stored systematically on the computer where the data is obtained is called a database.

Table 3 Invalid Partitions Table

Symptom	Weight
"Invalid Partition Table" error message appears during <i>boot</i>	1
The <i>boot process</i> does not reach the <i>operating system</i> and enters the <i>BIOS</i>	3
A black screen appears after the <i>boot process</i>	5

Table 4 Hard Drive Stuck While Loading Window's

Symptom	Weight
The computer is <i>deley</i> or stuck during	3

<i>the boot process</i>	
When the computer is used suddenly <i>blue screen</i>	3
Error message appears during <i>windows loading process</i>	1
There is a rough sound during <i>the process of loading windows</i>	5

Table 5 Noisy Hard Drive

Symptom	Weight
Braking Sound	5
Vibrating sound in <i>bearings</i>	5
Rough noise	5
Crackling sound on the <i>disk platter</i>	5
The <i>hard drive</i> spins quickly and then stops	5
"No booting device found" error message	3

Table 6 Hard disk Post Error

Symptom	Weight
No black display or screen	1
<i>Bunyi beep</i>	3
Pesan <i>error POST error</i> pada layar	3
Tidak dapat <i>booting</i>	5
Tidak dapat diformat	1
Terjadi <i>freeze</i> atau <i>hang</i>	3

Table 7 Bad Sector

Symptom	Weight
<i>Program file</i> tidak dapat diakses	3
<i>Blue screen of death (BSOD)</i>	3
<i>Booting</i> lambat	5
<i>Bunyi clicking</i> pada <i>harddisk</i>	5

Table 8 Harddisk Failure

Symptom	Weight
Slow opening of programs	3
<i>Blue screen of death (BSOD)</i>	3
Clicking sound on the hard drive	5
Inaudible <i>BIOS</i>	3
Frequent hangs or crashes	3

For the given weight has several levels

Table 9 Tingkatan Bobot

Weight level (w)	
Significant symptoms	5

Mild symptoms	3
Common symptoms	1

Calculation on damage (K1)

$$\begin{aligned} \text{Similarity} &= \frac{(1*1)+(1*3)+(1*5)}{9} \\ &= \frac{9}{9} \\ &= 4,55555556 \end{aligned}$$

Calculation on damage (K2)

$$\begin{aligned} \text{Similarity} &= \frac{(1*3)+(1*3)+(0*1)+(1*5)}{12} \\ &= \frac{11}{12} \\ &= 6,41666667 \end{aligned}$$

Calculation on damage (K3)

$$\begin{aligned} \text{Similarity} &= \frac{(1*5)+(0*5)+(1*5)+(1*5)+(1*5)+(1*3)}{28} \\ &= \frac{23}{28} \\ &= 0,821428571 \end{aligned}$$

Calculation on damage (K4)

$$\begin{aligned} \text{Similarity} &= \frac{(0*1)+(1*3)+(0*3)+(1*5)+(1*1)+(1*3)}{16} \\ &= \frac{12}{16} \\ &= 0,75 \end{aligned}$$

Calculation on damage (K5)

$$\begin{aligned} \text{Similarity} &= \frac{(0*3)+(1*3)+(1*5)+(1*5)}{16} \\ &= \frac{13}{16} \\ &= 0,8125 \end{aligned}$$

Table 10 Hard Drive Solutions

Solution	Hard drive Solutions					
	K1	K2	K3	K4	K5	K6
Check cables	✓			✓		
Reset settings BIOS	✓					
Replace hard drive	✓					
Clean the hard drive simply running the operating system		✓				
Turn off unnecessary startup programs		✓				
Add ram to improve system		✓				

performance						
Reinstall the operating system		✓				
Check the IDE cable connection			✓			
Check hard drive temperature			✓			
Use a third-party program called HD Tune			✓			
Repair system files				✓		
Use data recovery				✓		✓
Check the hard drive periodically					✓	
Perform regular data backups					✓	✓
Use data recovery						✓

3.4 Interface Design

The web-based expert hard drive fault diagnosis system is created using PHP programming language and MySQL database. In short, the system has an administrator menu, a damage menu and a solution menu. When the user gives a warning or identifies symptoms through symptom checks that match the conditions found on the damaged hard drive, it can be seen in Figure 1.

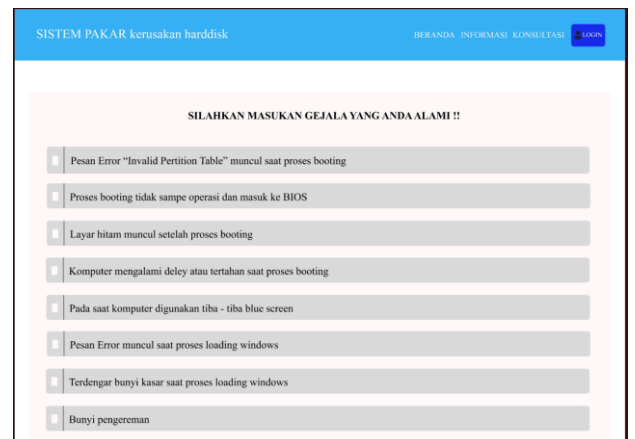


Figure 5 Symptom Menu

Figure 1. Displays which symptoms the user will select based on the characterization on the hard drive

The Symptoms menu displays the symptoms that are found when the hard disk is damaged. Users who want to diagnose hard drive damage can enter symptoms through an expert system to detect hard drive damage

The checklist method shows symptoms corresponding to hard disk damage. It can be seen as shown in Figure 2

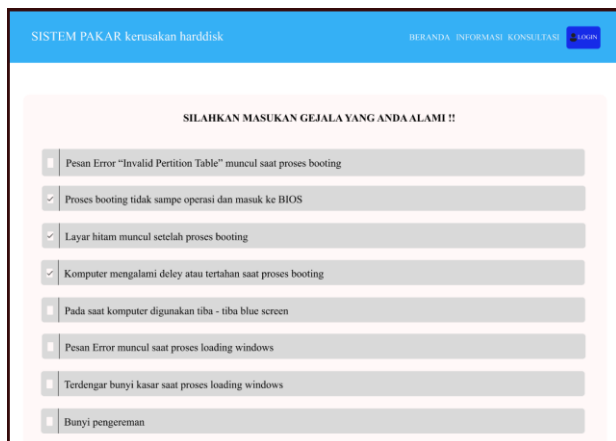


Figure 6 Symptom Selection Example

Figure 2. User options that match the features of the sample hard drive

Furthermore, the data that has been entered will be used to analyze the condition of the hard drive in accordance with expert rules.

Next, expert rules will be used to analyze the condition of the hard drive with the entered data, which will indicate the results of the diagnosis. Can be seen in Figure 3

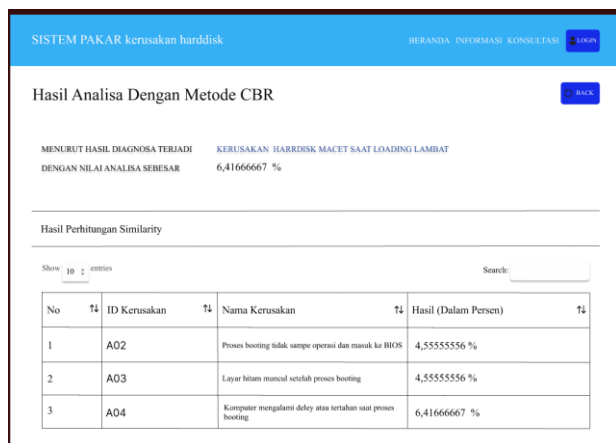


Figure 7 Hard drive Damage Diagnostic Menu

Based on the rules of the case base reasoning method, the system displays multiple malfunctions with the same symptoms as a result of a diagnosis based on the symptoms provided by the user.

3.5 System Testing

Systems are tested to ensure design objectives are met.

a. Blackbox testing

The software method known as "Blackbox" focuses on functional specifications without thoroughly examining the program code or design. This test aims to ensure that the functions, inputs and capabilities of the software conform to its specifications[6].

Table 11 Blackbox Testing

No	Tester scenarios	Expected results	status
1	After removing all symptom options, click the Advanced button	Because it cannot read the menu, the system remains in the same menu	Succeed/valid
2	Setelah mengisi data gejala secara acak yang sesuai dengan gejala yang muncul As a result of hard drive damage, click Continue	Indicates the type of damage most likely to be diagnosed and produce Symptoms that is the strongest	Succeed/valid
3	Click Continue to determine the types of symptoms that are caused by a particular hard drive malfunction and whether those symptoms are not caused by other damage	Will only show three errors that are in accordance with the rules	Succeed/valid

VI. CONCLUSION

Although computers are often used in many places, hard drive problems are a major problem. Manually, Yayasan Sentra Computer faced the problem of handling the problem of hard drives sharing brands and capacities. The journal proposes a website-based expert system that uses the Case Base Reasoning (CBR) method to provide early diagnosis and detect symptoms of hard drive damage. It is hoped that this system can provide a more accurate and effective diagnosis for computer users.

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