Expert system to detects laptop damage using Naive Bayes method

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Abstract: During the Covid-19 pandemic, teachers and students carried out the online teaching and learning process from home. Distance learning has several problems including the limitations of teachers and students in the world of information and communication technology, the facilities and infrastructure they have, and environmental conditions that are less supportive. The use of laptops and the internet every day are used by students and teachers as the main means of the online teaching and learning process. Continuous use without proper maintenance and lack of knowledge in overcoming the problem of damage to laptops makes teachers and students unable to identify the location of the damage and how to deal with it. Therefore, this expert system application was created to assist teachers and students in detecting the symptoms of laptop damage experienced and solutions to overcome the damage. In the development of this expert system using the Naive Bayes method, this method only requires a small amount of training data to determine parameter estimates during the classi515-523fication process. The results of the application of the nave Bayes method produce appropriate calculations based on the symptoms of damage and a predetermined list of damage so that it can make it easier for users when analyzing the beginning by using existing symptoms with a system that has been built with very efficient time and has an accuracy rate of 100%.

Keywords: Expert system; Laptop Damage; Naive Bayes; Covid-19 pandemic; Web-based

INTRODUCTION

During the Covid-19 pandemic, the teaching and learning process at home was online, so the demand for laptops and cellphones was quite high, especially the demand for information technology (IT) products. A laptop is an electronic device that is much needed for distance learning activities and working from home via Zoom or Google Meet. Continuous use of laptops and lack of maintenance can cause laptops to quickly break, and important data files in them will be lost (Pramana et al., 2021). This situation makes users unable to process data quickly when it is needed. Laptop damage greatly hampers the teaching and learning process for teachers and students, lack of knowledge of the information in identifying the location of the damage with the symptoms caused, resulting in a long handling process. Especially for teachers and students who are in villages or remote areas. To solve this problem, usually, the teacher or student directly gives the laptop to a technician or laptop expert(Renggo & Rewa, 2021).

Existing problems can be overcome with the application of a laptop repair expert system that can help students and teachers quickly and efficiently based on symptoms and identification of damage so that conclusions can be drawn to obtain a solution for handling it(Pramana et al., 2021)(Ravizza et al., 2017). An expert system is a system such as an online questionnaire that is very easy to use and helps users in solving problems without the need to meet an expert directly. Laptops that have problems when used in the teaching and learning process are very annoying, especially if they are used for online exams.

Slow laptop performance will hinder work and productivity can decrease. the age of laptop hard drive is old, many applications are downloaded and have a large capacity, so the read and write process takes longer. Lack of cleanliness in the laptop hardware can cause the processor to not be strong. The use of a small RAM that cannot accommodate files that have a large capacity can cause a slow laptop(Renggo & Rewa, 2021)(Azhari & Fajri, 2021).

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The nave Bayes method is an expert system method that was chosen to overcome the problem of laptop damage by identifying damage and its symptoms that have a high level of accuracy and speed than other methods(Muhajir & Chotijah, 2020). To produce accurate results, the Naïve Bayes system is based on damage data and symptom data by statistically classified to predict the probability of membership in a class. Laptop damage identification application, not to replace the experts, but to implement the knowledge of the experts into the form of software, so that it can be used by teachers and students without large costs(No et al., n.d.). This research is to help and provide education to teachers and students in minimizing the occurrence of damage to laptops so that laptop users can overcome the damage. This study describes the application of an expert system to diagnose laptop damage (SIPAKSAKOM). The data used for the study consisted of 9 identification of damage and 4 symptoms that occurred in laptop damage.

In the expert system application, the identification of laptop damage using the Naive Bayes method has two stages, namely the first the user is asked to enter the symptoms experienced. The second stage of the system will automatically provide diagnostic results from the identification of damage that occurs on the laptop using the Naïve Bayes Classifier calculation. From the results of the trial, the percentage of conformity with the diagnosis of 100% was obtained from the trial stage which was carried out by comparing the results of the diagnosis obtained from the system with the results of the diagnosis from the experts(Sana et al., 2013).

LITERATURE REVIEW

1. Expert system, is an application of artificial intelligence that can simulate the decisions and actions of a person or association who has special facts and experience in a particular field using a computer program. An expert system contains a knowledge base and user interface experience, data representation, conclusions, and explanations, from an expert. Expert systems can increase reliability, reduce errors, reduce costs, use multiple skills, provide intelligence databases, and reduce hazards. An expert system using nave Bayes is an expert system that knows uncertainty in terms of probability. An expert system is a branch of artificial intelligence that uses special knowledge to solve problems at the human expert/expert level and is applied in the identification and symptoms of laptop damage with a good level of accuracy from the experts. The identification of laptop damage carried out in this study went through several stages including the design and manufacture of an expert system that was used to help determine the diagnosis of a symptom of damage. The process of determining the diagnosis in this expert system begins with a consultation session, where the system will ask relevant questions to users, namely teachers and students whose data are obtained randomly. A system that can solve a problem like an expert and can adopt human knowledge that can be modeled and designed into a computer-based on science is called an expert system. This system can solve problems when the expert is absent. An expert is an expert who has special abilities that are not possessed by other experts in a particular field of knowledge. With this system, users can solve problems or find information without the need for the presence of experts in their field, besides that this system can be used as an experienced assistant and has the required knowledge. Knowledge is the main part of the Artificial Intelligence application to identify laptop damage

2. Laptop damage, laptop is a small mobile computer and light in weight, weighing about 1-6 kg, has a screen size of 10 inches, and is powered by an adapter. The problem of laptop damage is the most common cause. So good knowledge of laptops is needed to anticipate laptop damage because the problem of laptop damage is complex. This is understandable because many users lack knowledge of laptop hardware and software damage (Muhajir & Chotijah, 2020). Some laptop users may only be able to operate the laptop as necessary, if there is a problem with laptop damage, they immediately take it to a service center to have the laptop repaired. And many of the users spend a lot of money just to repair the damage to the laptop, even though the damage to the laptop occurs is not necessarily difficult and not necessarily cannot be repaired by yourself. So we need an application that can help solve the problem of laptop damage. Where this application utilizes expert system technology that functions as a substitute for experts who can be used as user consultations(Rahman, 2020).

   Laptop damage in general can be divided into 2 types of damagely:

   a. Software damage, is damage that occurs in laptop software. Software damage is very common on laptops. The most frequent case of software is windows failing to start up. This is because there is a damaged start-up registry. The solution to this problem is recovery. If recovery fails then you have to reinstall. Another damage is that the application cannot be opened because the registry is attacked by a virus, windows is slow.

   b. Hardware damage is damage that occurs in laptop hardware. Laptop hardware produced in 2014 and above is more susceptible to damage. This is in line with the cheap price of laptops. Vendors have to

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reduce their production costs to be able to compete at market prices. As a result, the hardware quality becomes worse

3. Naïve bayes, The naïve Bayes method is a set of probability calculations with a combination of values from many datasets that can be classified simply and can predict future opportunities based on previous experience. The Bayes theorem algorithm uses all values in class variables whose attributes are not interdependent or independent. in the Naive Bayes method, the simplification of attribute values conditionally gives the output value independently, the probability is individual(Muhajir & Chotijah, 2020). The advantage of using Naive Bayes is that the data processing is relatively small to determine the parameter estimates needed in the classification process. Naive Bayes often performs much better in most complex real-world situations than one might expect(Kristen et al., 2017).

The steps of the algorithm using the Naïve Bayes method in this study:

a. The calculation is done by dividing the amount of each symptom data by the total amount of data in the training data.

b. The calculation is done by dividing the amount of each symptom data by the total amount of data in the training data.

c. This calculation is done by dividing the number of symptoms in each identified by the number of each damage

d. Searching for the posterior value (final probability) for each identification of damage, by multiplying the prior value with the likelihood value of each symptom. System algorithm for laptop fault diagnosis

e. Enter the symptoms that occur on the laptop. Determine the probability value of each piece of evidence based on the hypothesis.

f. Determine the universal value of the identification. Determine the probability value of the hypothesis regardless of the evidence. Calculate the value of IF P (Hi│E) or the probability value of Hi is true if given evidence of E.

g. Specifies the Bayes value, Equation of Naive Bayes Method

$$P(H|X) = \frac{P(X|H).P(H)}{P(X)}$$

Where:
X   : Unknown class data
H   : Data hypothesis with specific class
P(H|X)   : Probability of hypothesis H based on condition X (posteriori probability)
P(H)   : Hypothesis probability H (prior probability)
P(X|H)   : The probability of X based on the conditions on the hypothesis H
P(X)   : Probability X

METHOD

The study was structured in stages starting from collecting data on knowledge of laptop damage to obtaining classification results for the symptoms tested.

The stages of the research used::

1. Preparation of knowledge data on laptop damage

2. Design and create an expert system

3. Determine the classification criteria

4. Input data on symptoms of laptop damage

5. Process new knowledge and data using nave Bayes

6. If there is a match, new classified data will come out if it doesn't *return to process 3*

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The collection of knowledge about laptop damage was obtained from laptop repair shops around Bekasi random that provide laptop service services, then the design and manufacture of an expert system for diagnosing damage disorders were carried out with knowledge data knowledge-based. The classification of the new damage data is processed by the Naïve Bayes method by first determining the criteria that are used as classification standards. The result of the highest Bayes calculation is the desired classification result.

RESULT

A. Analysis Using Naïve Bayes Method

To detect damage to the laptop, data is needed for damage and symptoms of each damage. The data corruption and symptoms on the laptop are as follows:

Table 1. Table of damage to laptops

No	Code	Information
1	K1	Damage to IC power
2	K2	Damage to the VGA IC
3	K3	Broken inverter/flex cable
4	K4	LCD damage
5	K5	Broken on keyboard
6	K6	Broken on the LCD touchscreen
7	K7	Damage to the operating system (OS)
8	K8	Hard disk damage
9	K9	Damage to laptop charger

Table 2 Symptoms of damage from laptop

No	Code	Information
1	G1	The laptop does not display the image on the screen
2	G2	Laptop engine not running
3	G3	Indication of the light connected to the laptop charger is not on
4	G4	When plugged into the charger, the laptop suddenly turns off
5	G5	The laptop engine is still alive
6	G6	If it is connected to an external LCD via a VGA card, it can display
7	G7	The light on the laptop screen is dim dark but displays the image
8	G8	The screen sometimes turns on and off in displaying images
9	G9	There are lines on the laptop LCD
10	G10	There is a dot pixel on the laptop
11	G11	Cannot display partial images on the LCD
12	G12	Some or all keyboard keys not working
13	G13	When the laptop is turned on, a long beep sound
14	G14	Touchscreen does not work partially or completely
15	G15	When the state is normal the cursor presses itself
16	G16	Can't enter OS
17	G17	Displays an error message on the hard drive when running the OS
18	G18	Can enter windows but slow when running windows
19	G19	I've reinstalled Windows but it's still slow
20	G20	Been installed but when the installation process fails
21	G21	Charger won't charge to the laptop
22	G22	The indicator light on the charger is not on

Table 3 Expert table

	K1	K2	K3	K4	K5	K6	K7	K8	K9
G1	∨	∨		∨					∨
G2	∨								
G3	∨			∨					
G4	∨			∨					
G5		∨							∨

*name of corresponding author

G6		∨							
G7			∨				∨		
G8			∨			∨			
G9				∨					
G10								∨	
G11		∨			∨				
G12					∨				
G13			∨		∨				
G14						∨			
G15						∨	∨		
G16		∨					∨	∨	
G17							∨		
G18							∨		∨
G19							∨		∨
G20									∨
G21								∨	∨
G22								∨	∨

In the table above, there are problems and causes of laptop damage that usually occur. There are nine defects with twenty-four causes or symptoms appearing. Some of the damage and the symptoms of the laptop serve to find out how the laptop is damaged, where each damage has a different number and symptoms. The symptoms that exist are obtained from various daily habits of the author and include observations, interviews, and literature studies. Observations and interviews were obtained from the activities of laptop repairmen in the writer's area. The literature study was carried out by collecting information data about the naive Bayes method.

The symptoms that appear on a laptop malfunction are two symptoms, namely the laptop does not display an image on the screen (G1) and the machine does not turn on (G2).
Based on these symptoms, it can be calculated:
Damage to Ic-Power If the probability of Damage to Ic-Power (K01) is :0,10
If the probability of symptoms is:
a. The laptop does not display an image on the screen (G01): 0.25
b. Engine does not start (G2) : 0.25

Bayes value calculation:

$$K\,(K1|G1) = \frac{K(G1|K1) * K(K1)}{K(G1|K1) * (K1) + K(G1|K3) * (K3)}$$

$$= \frac{0.25\ x\ 0.10}{0,25\ x\ 0,10 + 0,25\ x\ 0,10}$$

$$= \frac{0,025}{0,025 + 0,025}$$

$$= 0.5$$

$$K\,(K1|G2) = \frac{K(G2|K1) * K(K1)}{K(G2|K1) * (K1) + K(G2|K3) * (K3)}$$

$$= \frac{0.25\ x\ 0.10}{0.25\ x\ 0.10 + 0\ x\ 0,10}$$

$$= 1$$

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$$Bayes\ Total = K\ (K1|G1) + K(K1|G2)$$
$$= 0.5 + 1$$
$$= 1{,}5$$

Damage to the inverter or cable (K2)
If the probability of damage to the inverter or cable (K2) is : 0.14
If the probability of symptoms is:
a. Laptop does not display an image on the screen (G1) : 0.75
b. Engine does not start (G2) : 0

$$K\ (K1|G1) = \frac{K(G1|K2) * K(K2)}{K(G1|K1) * (K1) + K(G1|K3) * (K3)}$$

$$= \frac{0.75\ x\ 0.14}{0{,}75\ x\ 0{,}14 + 0\ x\ 0{,}14}$$

$$= \frac{10{,}5}{10{,}5 + 0}$$

$$= 1$$

$$K\ (K1|G2) = \frac{K(G2|K2) * K(K2)}{K(G2|K1) * (K1) + K(G2|K3) * (K3)}$$

$$= \frac{0\ x\ 0.14}{0.75\ x\ 0.14 + 0\ x\ 0,14}$$

$$= \frac{0}{10{,}5}$$

$$= 0$$

$$Bayes\ Total = K\ (K2|G1) + K(K2|G2)$$
$$= 1 + 0$$
$$= 1$$

Result = First Bayes Total + Second Second Bayes Total

$$Bayes\ Total\ first\ and\ second\ = K(K1|G1) + K(K1|G2) + K(K2\ \big|\ G1) + K(K2\ \big|\ G2)$$
$$= 1{,}5 + 1$$
$$= 2{,}5$$

Then the calculation of the probability of damage is:

1. *Damage to IC-Power (K1)*

$$\frac{Total\ Bayes}{Results}\ x100\%$$

$$K1\ \frac{1.5}{2{,}5}\ x\ 100\% = 60\%$$

2. Damage to IC-VGA (K2)

$$\frac{Total\ Bayes}{Results}\ x100\%$$

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$$K2 \ \frac{1}{2,5} \ x \ 100\% = 40\%$$

B. Program Display (Layout)

The following is an Entity Relationship Diagram (ERD) from the SIPAKSAKOM program which can be seen in Figure 1 below:
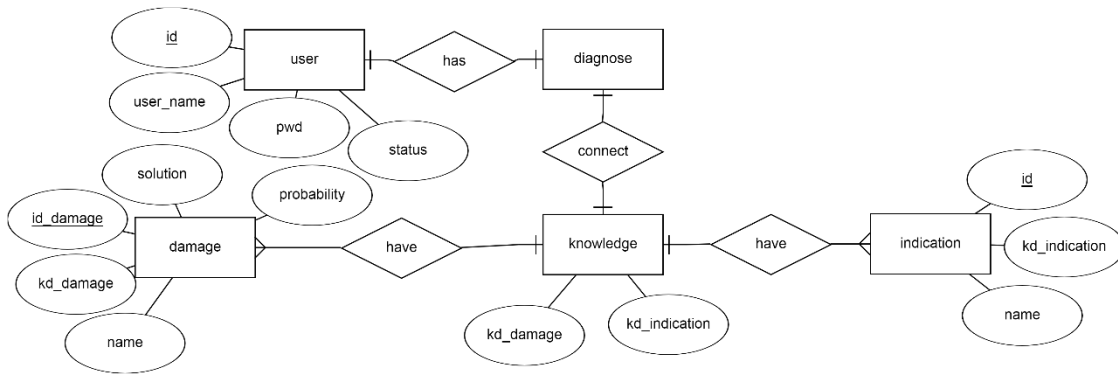

Figure 1. ERD Program

Program implementation is the implementation of the program and an explanation of how to run it. This program explanation is to assist users in using the program. The following is the final result of a web browser-based application to diagnose laptop damage using the Naive Bayes method:
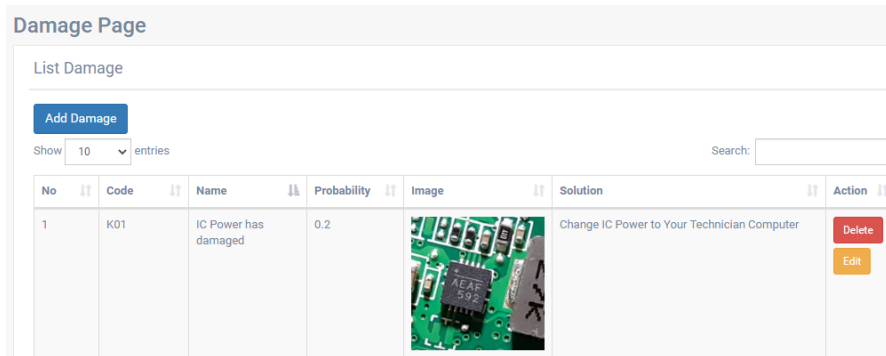

Figure 2. Add Damage Menu Form

Figure 2 about the added damage menu form, on the damage data menu the admin can add damage data by filling in the damage data pop up menu, where the admin can write about the damage data which includes the damage id, the damaged name, and the definition of the damage and the solutions to be obtained.
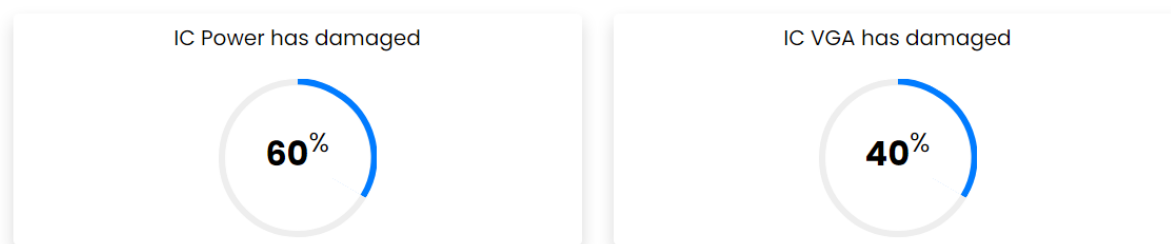

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Figure 3. Menu form add symptoms

Figure 3 regarding the Add Symptoms menu form. In this form, the admin can add symptom data by selecting the symptom data menu and a pop-up menu will appear adding symptom data containing the symptom id and existing symptoms. In addition, admins can also add photos of existing symptoms.

Result

Figure 4. Possibility and analysis of damage

Figure 4 is a form regarding the possibility and analysis of damage, after the user checks the symptoms of the laptop malfunction and presses the process button, the user will be redirected to a menu of symptom calculation results using the naive Bayes method which shows the possibility and analysis of damage to the laptop.

DISCUSSIONS

The use of the naive Bayes method on laptop damage expert systems has a very good level of data accuracy compared to other algorithmic methods, based on the case sample data used in determining the standard grade classification that has been determined. This calculation can be seen from the highest value of the tested training data so that the nave Baye method is successful in analyzing the classification of laptop damage with an accuracy level of 100%. In the classification process, it will be more accurate depending on the amount of data obtained, and this algorithm can be applied as a method of classifying the effectiveness of identifying damage.

CONCLUSION

Based on the research above, with SIPAKSAKOM application using a sample of 9 damage and 22 symptoms of laptop damage, an accuracy rate of 100% was obtained. the uncertainty of each technician to find out the damage that occurred to the laptop, this system can display the results of the damage according to the symptoms experienced by students or teachers. Where previously had to wait up to 3 days or a week with this system it only took about 30 minutes, this research makes an expert system with the nave Bayes method to diagnose damage information on laptops based on existing symptoms. And according to the results of testing the symptom and damage data that have been tested on this system, the nave Bayes method can help users determine laptop damage and get solutions easily and quickly, so that users can find out damage information before submitting the laptop to experts.

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