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Cat Disease Diagnosis Expert System Using Web-Based Forward Chaining Method

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Abstract

Currently, technological developments are growing rapidly. It can be seen from that most human activities require technology to meet daily needs. Technology has now fulfilled human needs that can be done by themselves. One of them is an expert system. Cats are one of the animals that are popular among people. Because it is so popular, the number of cat enthusiasts in Indonesia has become very large, and will continue to grow. However, this is not balanced by the knowledge of the keepers and the availability of sufficient veterinarians. This research develops an expert system application to diagnose diseases in cats. This expert system has 7 knowledge bases about diseases in cats and 30 symptoms, using the forward chaining inference method. The expert system was built and designed using the PHP programming language. The expert system provides output in the form of disease diagnosis results in cats based on the symptoms input by the user. The expert system developed is useful for helping the public obtain information about cat diseases and their symptoms easily and quickly.

Keywords : Expert System, Forward Chaining, Cat Disease, Inference.

1. Introduction

Cats are one of the pets most often kept by people today, especially in Indonesia. The cat ownership rate in Indonesia is currently 37%, exceeding dog ownership which is only 16%. This makes Indonesia different from other Asian countries, where dogs remain the main pet. Cats are one of the pets most kept by humans. Humans as cat owners are expected to know how to prevent and treat various diseases in cats so as not to disrupt environmental health [1][2]

Some cat keepers do not know how to care for and know the symptoms of diseases that occur in cats. This will certainly be very dangerous for a cat if it suffers from a chronic disease and the owner doesn't know about it, thus causing the cat's death. Therefore, information is needed that can educate the wider public to know the symptoms of illness suffered by their pet cats, so that if the cat is sick, the owner can quickly take medical action or take it to the veterinarian.

An expert system is an artificial intelligence technique that attempts to adopt human knowledge to a computer, so that the computer can solve problems as an expert would normally do. A good expert system is designed to be able to solve a particular problem by imitating the work of experts. An expert system is a computer program that imitates the reasoning of an expert with expertise in certain knowledge. This problem can be overcome by an expert system with its knowledge and experience [3] [4] . Compared to human experts, expert systems have several advantages, namely: 1) Subjective, 2) Fast disease diagnosis results, 3) Cheaper in terms of costs, 4) Solving quite complex problems that can only be solved with the help of experts, 5) Allows users to obtain information on diseases suffered by cats quickly and accurately [5] .

One of the reasoning techniques in expert systems is the Forward Chaining method. The Forward Chaining method collects premises or facts to determine a conclusion. The conclusions or conclusions drawn are in accordance with the objectives set at the beginning [6] [7] . Forward chaining starts working with available data and uses inference rules to obtain other data until the target or conclusion is obtained. Inference engines that use forward chaining search for inference rules until they find one of the correct antecedents (hypothesis propositions or IF - THEN clauses) [8] [9] . When the rule is found, the decision-making engine can make a conclusion, or consequence (THEN clause), which produces new additional information from the data provided. The machine will repeat through this process until the target is found. Forward chaining begins by entering a set of known facts into working memory, then deriving new facts based on rules whose premises match the known facts. This process is continued until the goal is reached or there are no more rules whose premises match the known facts. Matching facts or statements starts from the left (IF first) [10][11][12] . In other words, reasoning starts from the facts first to test the truth of the hypothesis.

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Previous research regarding an Expert System that can diagnose Osteoporosis in the elderly obtained a confidence value from the diagnosis results with an accuracy rate of 83.3% [13]. Research was conducted using the Forward Chaining method to determine children's interests and talents with an accuracy of 91.8% [14]. The application of the Forward Chaining method is also used in research to diagnose the spread of rice disease, producing an accuracy value of 100% [15]. Previous research regarding the Dempster-Shafer Method where the data used in this research came from experts with 32 symptoms and 10 types of pests, and the test results on the expert system were 80%, indicating that the expert system was accurate for use in detecting the types of pests contained in it [16].

With the implementation of the expert system application for diagnosing cat diseases, it is hoped that it will provide information about cat diseases to the wider community and be used to diagnose cat diseases, and provide accurate diagnosis results of symptoms like an expert/doctor.

2. Research methodology

So that the steps taken by the author in this research do not deviate from the main discussion and are easier to understand, the sequence of steps will be made systematically so that they can be used as clear and easy guidelines for solving existing problems. The sequence of steps that will be carried out in this research can be seen in Figure 3.1 below:

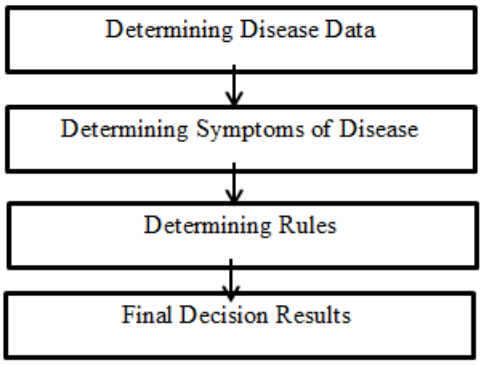

Figure 1. Research Framework

The steps taken in formulating the Forward Chaining method [17] are as follows:

1. Data
2. Determining the symptoms of disease in cats
3. Determine rules based on existing data
4. If the rule matches then a result is found
5. The rule has not been found, the system will trace it again based on the rule that has been set
6. The system will display the results of identification, prevention and treatment

3. Results and Discussion

3.1 Forward Chaining

Forward chaining is a search technique that starts with known facts, then matches these facts with the IF part of the IF-THEN rules. If there is a fact that matches the IF part, then the rule is executed. When a rule is executed, a new fact is added to the database. Each time matching starts from the top rule and each rule can only be executed once. The matching process stops when there are no more rules that can be executed.

3.2 Knowledge Acquisition

This process is the process of transferring expert knowledge into a program, which is processed into a simple program like an expert in diagnosing cat diseases. Furthermore, several types of cat diseases can be classified which are the result of the knowledge acquisition process, namely as follows:

1. *Feline Distemper*
2. *Nasty Snot in Cats*
3. *Leptospirosis in Cats*
4. *Scabies*
5. *Leukemia in Cats*
6. *Ringworm*
7. *Ear Infection*

3.3 Knowledge Base

From the results of the knowledge acquisition process described above, a knowledge base table can then be compiled which can be seen in table 1.

Table 1. Data on Cat Disease Symptoms

No	Disease	Symptom
1.	*Feline Distemper*	- Fever with body temperature 41-42 ° C - Diarrhea - Dehydration - Great depression - Vomit - Stomach pain
2.	*Evil Snot*	- Fever with body temperature 41-42 ° C - Loss of appetite - Sneeze - Depressive - Excessive tears - Excessive salivation - Thick snot starts to come out of the nostrils - Sores on the lining of the nose, mouth, lips or tongue
3.	*Leptospiros is*	- Fever with body temperature 41-42 ° C - Do not want to eat - A greenish yellow color appears on the eyes, gums, lips and skin - Weak - Reddish swollen eyes

4.	*Scabies*	-	Hair loss around the ears
		-	At the edge of the earlobe there is a white crust
		-	Cats often scratch
		-	Thickening and wrinkles on the skin covered with a crust that is yellowish gray in color
5.	*Leukemia*	-	Difficulty breathing
		-	Anemia appears from pale gums and lips
6.	*Ringworms*	-	Round spots on the skin
		-	Local hair loss (baldness).
		-	Crusty skin
		-	*Nodules* (festering lumps) occur
7.	*Ear infections*	-	His ears looked swollen
		-	Fluid comes out of the ear
		-	Cats often shake their heads

Table 2. Cat Disease Data

ID_Disease	Disease
P1	*Distemper*
P2	*Nasty Snot in Cats*
P3	*Leptospirosis in Cats*
P4	*Scabies*
P5	*Leukemia in Cats*
P6	*Ringworms*
P7	*Ear Infection*

Table 3. Assigning Disease Numbers to the *Tree Diagram*

No	Disease Name	Code
1.	Information regarding the required symptoms is not sufficient to carry out a consultation. Possible *feline distemper*	T1
2.	Information regarding the required symptoms is not sufficient to carry out a consultation. Possibility of experiencing *Nasty Snot in Cats*	T2
3.	Information regarding the required symptoms is not sufficient to carry out a consultation. Possibility of *Leptospirosis in Cats*	T3
4.	Information regarding the required symptoms is not sufficient to carry out a consultation. Possibility of experiencing *scabies*	T4
5.	Information regarding the required symptoms is not sufficient to carry out a consultation. Possibility of *Leukemia in Cats*	T5
6.	Information regarding the required symptoms is not sufficient to carry out a consultation. Possible experience of *Ringworm*	T6
7.	Information regarding the required symptoms is not sufficient to carry out a consultation. Possible *ear infection*	T7

Table 4. Giving Symptom Numbers to the *Tree Diagram*

Symptom_ ID	Symptom
G1	Fever with body temperature 41-42 ^{o}C
G2	Diarrhea
G3	Dehydration
G4	Great depression
G5	Vomit
G6	Stomach pain
G7	Loss of appetite
G8	Sneeze
G9	Depressive
G10	Excessive tears
G11	Excessive salivation
G12	Thick snot starts to come out of the nostrils
G13	Sores on the lining of the nose, mouth, lips or tongue
G14	Do not want to eat
G15	A greenish yellow color appears on the eyes, gums, lips and skin
G16	Weak
G17	Reddish swollen eyes
G18	Hair loss around the ears
G19	On the edge of the earlobe there is a white crust
G20	Cats often scratch
G21	Thickening and wrinkles of the skin covered with a yellowish-gray crust
G22	Difficulty breathing
G23	Anemia appears from pale gums and lips
G24	Round spots on the skin
G25	Local hair loss (baldness).
G26	Crusty skin
G27	*Nodules* (festering lumps) occur
G28	His ears looked swollen
G29	Fluid comes out of the ear
G30	Cats often shake their heads

Table 5. Results of Cat Disease Symptoms

Symptom	Disease						
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
G1	*	*	*				
G2	*						
G3	*						
G4	*						
G5	*						
G6	*						
G7		*					
G8		*					
G9		*					
G10		*					
G11		*					
G12		*					
G13		*					
G14			*				
G15			*				
G16			*				
G17			*				
G18				*			
G19				*			
G20				*			
G21				*			
G22					*		
G23					*		
G24						*	
G25						*	
G26						*	
G27						*	
G28							*
G29							*
G30							*

3.4 Decision Trees

Making *decision trees* is used to help simplify the knowledge acquisition process so that it is easier to convert it into rules. Decision trees are designed with the aim of knowing the attributes (conditions) that can be reduced so as to produce efficient and optimal rules as well as simplifying the decision search process. *The decision tree* for the cat disease expert system can be seen in Figure 2.

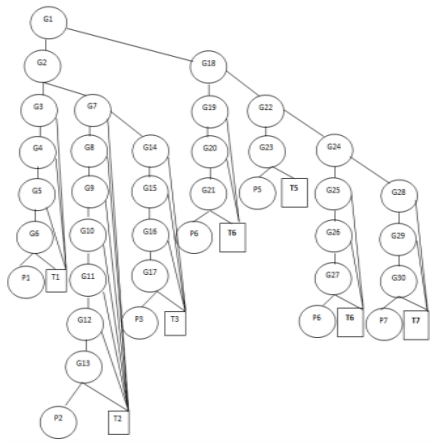

Figure 2. Cat Disease *Decision Tree*

3.5 Rule *Production*

Production rules are usually written in the form if then (IF-THEN). A rule can be said to be an implication relationship between two parts, namely the premise (if) and the conclusion (then). If the premise is fulfilled then the conclusion will also be true. The following are production rules for identifying diseases:

Table 6. Production Rules

RULES	IF	THEN
1	G1,G2,G3,G4,G5,G6	P1
2	G1,G7,G8,G9,G10,G11,G12,G13	P2
3	G1,G14,G15,G16,G17	P3
4	G18,G19,G20,G21	P4
5	G22,G23	P5
6	G24,G25,G26,G27	P6
7	G28,G29,G30	P7
8	G1,G2,G3,G4,G5	T1
9	G1,G2,G3,G4	T1
10	G1,G2,G3	T1
11	G1,G2	T1
12	G1,G7,G8,G9,G10,G11,G12	T2
13	G1,G7,G8,G9,G10,G11	T2
14	G1,G7,G8,G9,G10	T2
15	G1,G7,G8,G9	T2
16	G1,G7,G8	T2
17	G1,G7	T2
18	G1,G14,G15,G16	T3
19	G1,G14,G15	T3
20	G1,G14	T3
21	G14	T3
22	G18,G19,G20	T4
23	G18,G19	T4
24	G18	T4
25	G22	T5
26	G24,G25,G26	T6
27	G24,G25	T6
28	G24	T6
29	G28,G29	T7
30	G28	T7

3.6 Accuracy

The accuracy level test in question is to find the percentage of accuracy in the classification process of the testing data being tested. The level of accuracy is calculated using the formula:

Accuracy = $\Sigma\ matc\ h\ \Sigma\ tp$ x100%

Σ match = Number of correct classifications

Σ tp = Number of testing data

c) How Forward Chaining Works

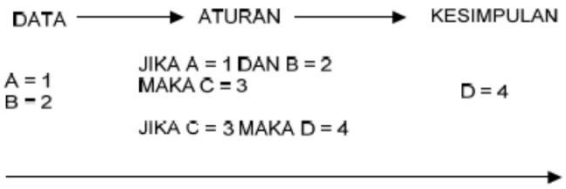

Figure 3. How Forward Chaining Works

System Implementation

The consultation page is a page that can be used to carry out a consultation. By answering questions according to the cat's symptoms, users will find out what disease the cat is suffering from.

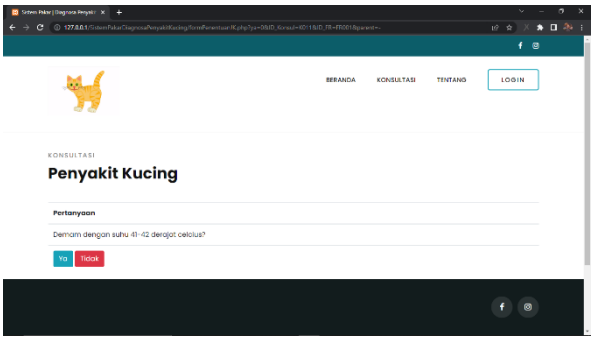

Figure 8. Consultation page

The consultation results page is a page where users will be able to see the results of consultations that have been carried out according to the selected symptoms.

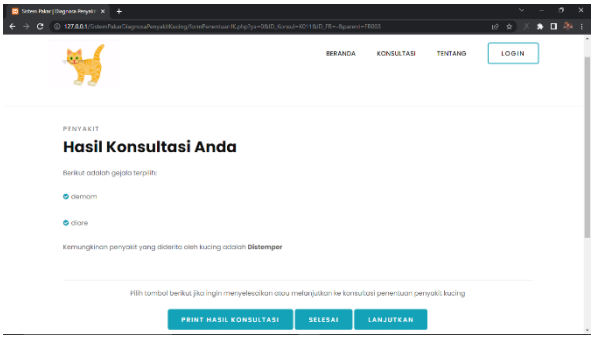

Figure 9. Consultation Results Page

The Consultation Data Page is a page that accommodates and displays all data on the results of consultations that have been carried out. All data from the consultation results will be displayed on this page.

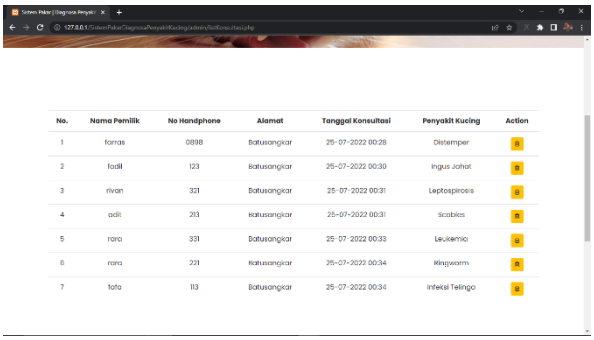

Figure 10. Consultation Data Page

4. Conclusion

By designing a computerized system using the PHP programming language and MySQL database, you can improve quality and increase effectiveness in diagnosing diseases in cats. An expert system for diagnosing cat diseases using the forward chaining method was successfully built and can be used by users to diagnose cat diseases even if there are no experts. The application of this cat disease diagnosis expert system application is web-based, making it easier for users to consult the system whenever and wherever the user is

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