Application of Expert Systems in Diagnosing Persian Cat Diseases using the Dempster Shafer Method

Diego Kristianda [1]

[1] Putra Indonesia University YPTK Padang
diegokristianda6@gmail.com

Abstract

The rapid development of information technology in the current era of globalization has provided many benefits in progress in various aspects. Information technology is inseparable from artificial intelligence which is used by humans in facilitating the completion of their daily tasks. An expert system is a system that seeks to adopt human knowledge into computers that are designed to represent the ability to solve problems like an expert. With this expert system, ordinary people can solve their problems or just look for quality information that can only be obtained with the help of experts in their fields. In this study, it is explained how the Expert System diagnoses Persian Cat disease using the Dhempster Shafer method. The Dhempster Shafer method is a method in the branch of mathematics and is commonly used to calculate probabilities. By using the Dhempster Shafer method, a similarity value was obtained with the previous case of disturbance experienced by the Persian cat. This expert system makes it easier to find out the symptoms suffered by Persian cats because this application provides a list of symptoms and is supported by a percentage. The results obtained by testing three types of diseases, it can be concluded that the member is affected by Feline Leukemia Virus with a value of 99.4 %.

Keywords: Expert System, Dhempster Shafer, Persian Cat, Percentage, Symptoms.

1. Introduction

The rapid development of information technology in the current era of globalization has provided many benefits in progress in various aspects. Information technology is inseparable from artificial intelligence which is used by humans in facilitating the completion of their daily tasks. In this case, the existence of artificial intelligence or artificial intelligence is one of the elements needed in the development of information technology which will provide many benefits to human life for that reason artificial intelligence is needed [1].

The Latin word for cat is Felis silvestris catus, which means a kind of carnivore. The word "cat" usually refers to "cats" that have been domesticated, but can also refer to "big cats" such as lions, tigers and leopards. Cats have mingled with human life since at least 6,000 years BC, from a cat skeleton on the island of Cyprus. The Ancient Egyptians from 3,500 BC have used cats to keep mice or other rodents away from barns that store crops, there are many types of diseases in Persian cats. Symptoms and severity can vary [2].

Artificial intelligence or artificial intelligence is a part of computer science that makes machines (computers) able to do jobs like and as well as those done by humans. One that is studied in artificial intelligence is an expert system. An expert system (Expert System) is a knowledge-based program that provides expert knowledge in solving a particular problem. An expert system is a computer program that mimics the thought process and expert knowledge in order to solve a problem [3].

An expert system is a piece of software or computer programming that is intended as an advisory facilitator and media aid in solving problems in certain sectors such as science, medicine, education and so on [4]. In essence, the Expert System is an information system that contains insights from experts so that it can be used for consultation [5]. The purpose of making an Expert System is not to replace the role of an expert but rather to substitute human abilities into a system so that it can be used by many people [6].

The dempster shafer method is a method in the branch of mathematics and is commonly used to calculate probabilities. This theory is used to combine separate pieces of information to calculate the probability of an event. This theory was developed by Arthur P. Dempster and Glenn Shafer. In dealing with a problem, answers are often found that do not have complete certainty [7]. Dempster Shafer is a mathematical theory to look for evidence based on the belief function and plausible reasons for use in combining separate information (evidence) and calculating the probability of an event [8] .

According to the journal (Dwi Purnomo , 2017) The expert system provides disease diagnosis output, calculation results, an explanation of the disease and suggestions for providing first aid measures for cat diseases based on the results of input symptoms carried

out by the user. The method used in this expert system is the Dempster-Shafer method. This method performs calculations through the symptoms selected by the user from each symptom that has a density value. The density value of each symptom is the result of an interview with a veterinarian. Applications made based on testing have a success rate with a comparison of medical record data in the last 1 year which is 94.59 % [9].

Based on the journal (Novi Amalia, 2019) Research The dempster shafer method has the ability to provide a high level of accuracy, where this method is able to think like an expert, but by using calculations through symptoms that have a density value, the density value is obtained from the results of interviews with doctors animal. The expert system for diagnosing cat diseases using the web-based dempster shafer method can make it easier for cat owners to find information on the types of diseases in cats, can also diagnose diseases and provide solutions to these diseases. The accuracy results obtained from the calculation are 88.88 % which shows that the application operates properly according to the dempster shafer method [10].

Followed by research (Nia Nofia Mitra , 2019) An expert system is a system that adopts human knowledge to a computer designed to model the ability to solve problems like an expert, one of the methods applied in an expert system is the Dempster Shafer method. Dempster Shafer is a method for proving whether a fact is certain or uncertain in the form of a metric which is usually used in expert systems. The Dempster Shafer method applied in this expert system has a working concept by calculating the certainty value given by the user from each of the symptoms felt, then it will be entered into the rule set by the expert, where those who have the same hypothesis will be calculated. back using the combined formula. So that it can produce conclusions about the diseases suffered by Persian cats according to the selected symptoms [11].

Previous research on an expert system for diagnosing skin diseases in humans with the Dempster Shafer method obtained the results of testing the accuracy of the system, it was concluded that the average value of the system accuracy was 90% based on 30 case examples tested on 3 experts. However, if the system diagnostic results are seen as a subset of expert diagnostic results, then the system accuracy value is 92.22% [12].

Research in the expert system for diagnosing shallot pests and diseases uses the dempster shafer method to assist farmers in detecting early symptoms of pest and disease attacks on shallots so that the handling of pest and disease attacks is carried out more focused and maximally. The processed data is 10 attack data using the Dempster Shafer method. This method processes data in the form of symptoms that result in a diagnosis of types of shallot pests and diseases and steps for

handling them with an accuracy rate of 95%. So this method is suitable for use in the diagnosis of shallot pests and diseases [13].

2. Research methodology

To assist in the preparation of this research so that the steps in solving the problems to be discussed can be clearly structured, it is necessary to have a framework arrangement. The research framework contained in Figure 1:
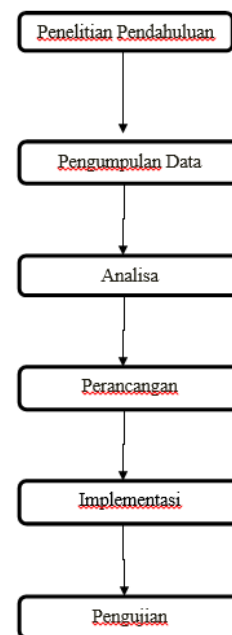

Figure 1. Research Framework

The research stage is a sequence of processes or steps that will be carried out in completing this research. The stages of this research are as follows :

2.1 Field Research

This research was conducted by interviewing at the Andalas Veterinary Practice, asking questions and analyzing problems and obtaining the necessary data.

2.2 Research Library (Library Research)

This library research was carried out by reading journals, books, the internet, articles that discussed the Dhempster Shafer method and related to expert systems . So that the data obtained can be used as a basis for further research stages.

2.3 Analysis

Based on the problem identification above, the researcher conducted data analysis first. This is so problem solving can produce new solutions.

2.4 System planning

At the expert system design stage with the Dempster Shafer method using the Css Framework as the output of the system to be run.

2.5 System Implementation
The testing method used in this study is the direct testing method, namely by using Black Box testing. Used to test the special functions of the designed software. The correctness of the software being tested is only seen based on the output generated from the data or input conditions

2.6 Testing
System testing is carried out in order to monitor system applications before they are implemented later.

3. Results and Discussion

The design at this data analysis stage includes types of diseases, symptoms and treatment solutions according to the type of disease carried out by the user in consultation. The following are types of Persian cat diseases:

Table 1. Disease Data

Disease Code	Disease Name
P01	Feline Leukemia Virus
P02	Feline Infectious Virus
P03	Diabetes

Table 2. Symptom Data

Kd Symptoms	Symptom	Weight
G01	Appetite Disappears	0.60
G02	Skin Lesion (Abnormal Tissue On Skin	0.80
G03	seizures	0.40
G04	Appetite reduced drastically	0.40
G05	Swelling of the lymph nodes	0.60
G06	Anisocoria (the pupil of the right eye is different in size from the left eye	0.60
G07	Diarrhea	0.20
G08	Weight loss despite eating a lot	0.40
G09	Sneezing and watery eyes	0.20
G10	Skin infection	0.30
G11	Swelling of the gums	0.20
G12	Increased Water Intake	0.40
G13	Excessive and unnatural urination	0.40
G14	Lethargic Cat Body	0.40
G15	Excessive appetite	0.20

Table 3. Relationship of Symptoms and Disease in Persian Cats

Kd Symptoms	P1	P2	P3
G01	●	●	
G02	●		
G03	●		
G04		●	
G05	●		
G06	●		
G07		●	
G08			●
G09		●	●
G10	●		
G11	●		
G12			●
G13			●
G14		●	
G15			●

Rule a knowledge representation technique syntax rule IF E Then H. Evidence (existing facts) and the resulting hypothesis or conclusion.

Is known:

[RULE 1] IF G01 AND G02 AND G03 AND G05 AND G06 AND G010 AND G11 THEN P01

[RULE 2] IF G01 AND G04 AND G07 AND G09 AND G014 THEN P02

[RULE 3] IF G08 AND G09 AND G012 AND G13 AND G15 THEN P03

From the fact table of the above symptoms, the value is entered into the rule that has been previously set as follows:

[RULE 1] IF G01 AND G02 AND G03 AND G05 AND G06 AND G010 AND G11 THEN P01

G01 (YES=0 ,60)
Then: $M_1 \{P_1\} = 0.60$
$M_1 \{\theta\} = 1 - 0.60 = 0.40$

G02 (YES=0 ,80)
Then : $M_2 \{P_1, P_2\} = 0.80$
$M_2 \{\theta\} = 1 - 0.80 = 0.20$

Next, the new density value for the M_3 combination will be calculated as below :

	$M_2 \{P_1, P_2\}$ (0.80)	$M_2 \{0\}$ (0.20)
$M_1 \{P_1,\}$ (0 .60)	(P1) 0.48 $\{P_1,\}$ 0.12	
$M_1 \{0\}$ (0 ,40)	(P1) 0 .32	$\{0\}$ 0.08

Then the M3 density value is calculated as follows:

G03 (YES=0.60)
Then: $M_4 \{P_1\} = 0.60$
$M_4 \{\theta\} = 1 - 0.60 = 0.40$
$M_4 \{P_1\}$ 0.60 $M_4 \{0\}$ 0.40

$M_3 \{P_1\}$, 920.552 $\{P_1, \}$ 0.368
$M_3 \{0\}$ 0.048   { 0.032

G05 (YES=0 ,60)
Then: $M_6 \{P_1\} = 0.60$
$M_6 \{\theta\} = 1 - 0.60 = 0.40$
$M_6 \{P_1\}$ 0.60 M6   { } 0.40

M5 {P1}
{P1} 0.5808   {P1} 0.3872
M5 { }
{P1} 0 .0192   { 0.0128

G06 (YES=0 ,60)
Then: M8 {P1} = 0.60
M8 {θ }= 1-0.40=0.40
M8 {P1} 0.60 M8   { } 0.40

M7 {P1}
{P1} 0.59232   {P1} 0.39488
M7 { }
{P1} 0.00768   { 0.00512

G10(NO=0)
Then: M10 {P1} = 0
M10 {θ }= 1-0=1
M10 {P1} 0   M10 { } 1

M9 {P1}
{P1} 0   {P1} 0.99488
M9 { }
{P1} 0   { 0.00512

G11(YES=0.20)
Then: M12 {P1} = 0.20
M12 {θ }= 1-0.20=0.80
M12 {P1} 0.20   M12 { } 0.80

M11 {P1}
{P1} 0.198976   {P1} 0.795904
M11 { }
{P1} 0.001024   { 0.004096

From the calculation above, the risk density value of Feine leukemia virus or 99.4%

[RULE 2] IF G01 AND G04 AND G07 AND G09 AND G014 THEN P02

G01 (YES=0 ,60)
Then: M_1 {P1} = 0.60
M_1 {θ }= 1 –0.60= 0.40

G02 (NO=0)
Then : M_2 {P1,P2} = 0
M_2 {θ }= 1-0 =1

Next, the new density value for the M_3 combination will be calculated as below :

M2 {P1, P2 }(0) M2 {0}(1)

M1 {P1,} (0 .60)   (P1) 0{P1,}0.6
M1 {0} (0 ,40)
(P1) 0   {0}0 ,4

Then the M3 density value is calculated as follows:

G07 (NO=0)
Then: M4 {P1} = 0
M4 {θ }= 1-0=1
M4 {P1} 0   M4 {0} 1

M3 {P1 } , 60   {P1,} 0,6
M3 {0}
{ 0.4

G09 (YES=0 ,20)
Then: M6 {P1} = 0.20
M6 {θ }= 1-0.20=0.80
M6 {P1} 0.20   M6 {0} 0.80

M5 {P1 } , 60.12   {P1,} 0.48
M5 {0} 0.08   { 0.32

G14 (NO=0)
Then : M8 {P₁} = 0
M8 {θ }= 1-0=1
M8 {P1} 0   M8 {0} 1

M7 {P1 } .680   {P1,} 0.68
M7 {0 } 0   { 0.32

From the calculation above, the density value of the risk of getting Feline Infectious Virus Disease is equal to or 68%.

[RULE 3] IF G08 AND G09 AND G012 AND G13 AND G15 THEN P03

G08 (YES=0 ,40)
Then: M_1 {P₁} = 0.40
M_1 {θ }= 1 –0.40= 0.60

G09 (YES=0 ,20)
Then : M_2 {P₁,P₂} = 0.20
     M_2 {θ }= 1-0.20 =0.80

Next, the new density value for the M_3 combination will be calculated as below :

M2 {P1, P₂ }(0.20)   M2 {0}(0.80)

M1 {P1,} (0 .40)   (P1) 0.08{P1,} 0.32
M1 {0} (0 ,60)
(P1) 0 .12   {0}0.48

Then the M3 density value is calculated as follows:

G012 (NO=0)
Then: M4 {P1} = 0
M4 {θ }= 1-0=1
M4 {P1} 0   M4 {0} 1

M3 {P1 } , 520   {P1,} 0.52
M3 {0 } 0   { 0.48

G013 (NO=0)

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Then : M6 {P₁} = 0
M6 {θ }= 1-0=0
M6 {P1} 0   M6 {0} 1

M5 {P1 } 520   {P1,} .52
M5 {0 } 0   { 0.48

G015 (NO=0)
Then : M8 {P₁} = 0
        M8 {θ }= 1-0=0
        M8 {P1} 0M8 {0} 1

M7 {P1 } .520   {P1,} .52
M7 { 0} 0   { 0.48

From the calculation above, the density value of the risk of developing diabetes is equal to or 52%. From the results of calculations using the Dempster-Shafer method, the following results are obtained:

Disease Code	Disease Name	Mark
P01	Feline Leukemia Virus	99.4 %
P02	Feline Infectious Virus	68%
P03	Diabetes	52%

From the results of a comparison of the three types of disease above, it can be concluded that the member is affected by Feline Leukemia Virus with a value of 99.4%.

Testing System Interfaces

1. Home Page Display

The home page is the page that will be displayed for the first time when accessing this application as shown in Figure 2 below:

Figure 2 Home Page

2. Disease Information Page Display

In this view, information about the diseases that exist in Persian cats will be explained, which can be seen in Figure 3 below:
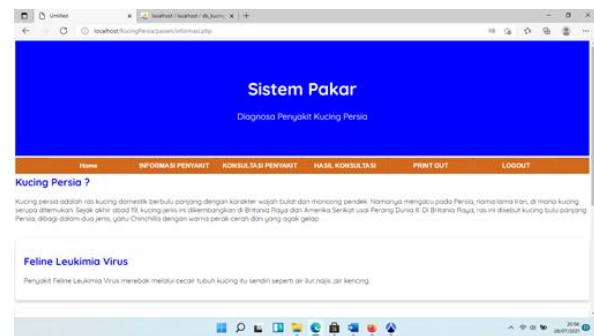

Figure 3 Display of Disease Information Pages
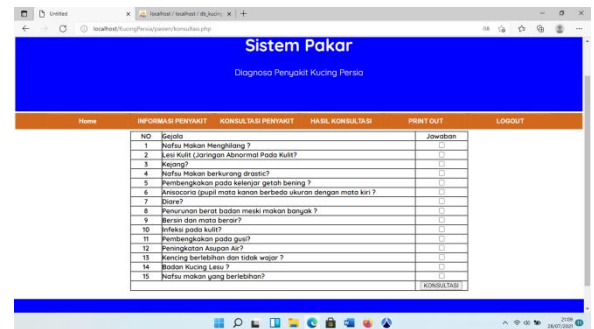
3. Consultation Page Display

Figure 4 Display Consultation Page

The image above contains how to do a consultation from this website

4. Consultation Result Page

Figure 5 Display of the Consultation Results Page

The image above contains the results of the consultation from this website.

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4. Conclusion

By designing an expert system for diagnosing diseases in Persian cats, the Dempster Shafer method can simplify and accelerate Persian cat owners in diagnosing Persian cat diseases, this can be proven by the availability of consulting services in this expert system application. It makes it easier to find out the symptoms suffered by Persian cats because this application provides a list of symptoms and is supported by a percentage of possible diagnoses of each type of Persian cat disease. Can find solutions to the prevention and treatment of every type of Persian cat disease. This can be proven in this application which provides solutions for the prevention and treatment of every type of Persian cat disease.

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