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COMPARATIVE ANALYSIS OF CERTAINTY FACTOR AND DEMPSTER-SHAFER METHODS FOR EXPERT SYSTEM ON FELINE DERMATOLOGY DISEASES

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ABSTRACT

Cat is one of the favourite pets in Indonesia, but there are some people who have abandoned their cats. Some of the reason is because their cats suffered from skin diseases. Skin diseases in Indonesia are commonly due to Ear Mites, Flea, Ringworm and Scabies. Along with the development of technology, Artificial Intelligence (AI) is needed to assist in the diagnosis process of skin diseases in cats like by using an expert system. To determine the best method that is used to build this system the comparative analysis method is carried out. The methods that can be used are Certainty Factor and Dempster-Shafer methods. Based on the analysis, earned accuracy value is 86.67% and error system is 13.33% in both methods. Despite having the results of the same accuracy and error, the average results of the two methods of diagnosis have a considerable margin of 10.9%. From the confusion matrix test results obtained accuracy value of 98.33%, precision value of 100%, and recall value of 93.33%.

Keywords: artificial intelligence; expert systems; certainty factor; confusion matrix; dempster shafer; skin disease;

1. INTRODUCTION

It is undeniable that there are now more people who started caring and loving cats. Evidenced by the increasing number of members from the Facebook group page *Peduli Kucing Jalanan Terlantar* (PKJT), based on data in author's undergraduate thesis in February 2017 PKJT has a membership of 50.494 members. Meanwhile, in July 2019 has a membership of 74.800. This proves that an increase of 20 thousand more members (the latest data in October 2019 as many as 76 147) [1].

However, although the number of people who care for abandoned cats continues to increase, didn't make the number of abandonment cats drastically reduced. Based on Instagram account instigators cat rescuer *Cat Lovers in The World* (CLOW) managed by Bimbim Wahyu, still there are cases of abandoned cats. Whether it's a domestic cat, and expensive cat breeds. Especially on long-haired cats that suffered from skin diseases.

Based on interviews with DVM. Rasi Rausanfikri Sadra, one of the factors that led to the cat's skin disease getting worse because there are owners who tried to treat the diseases by themselves without the help of an expert. So when already severe, the owner chooses the way out with abandon or discard their cats who suffered from skin diseases [2].

Continues with the follow-up interviews with the DVM Sadra, she welcomed the author's undergraduate thesis with the title "Expert System for Feline Dermatology Diagnosis Using Forward Chaining and Certainty Factor Methods"(2017) to help the cat's owners to make a record or basic observations against skin disease suffered by their cat. It should be underlined, that this system is not intended to replace the portion of an expert, is intended only as a connector of the laity when it will give action to the expert. Because the only person who has right to provide the handling and treatment is an expert [2]. In a previous study, researchers created a skin disease diagnosis expert system in this cat using certainty factor and named FiDerma which stands for Feline Dermatology.

Currently, Indonesia has entered a period of rapidly evolving technology and began to explore various fields, including in the field of health. As in the human health field may we already know about the **Halodoc** application, according to DVM. Sadra, health applications for the animal world can be develop into the business technology field [2].

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This expert system not only used for general users, it is also useful for veterinarians to assist in the identification process or the diagnosis process of the skin disease when the vet need to handling patients. The veterinarian can be easier to diagnose, because before the cat owner brings the cat, they can make observations on the cat and the owner can bring the observations records and can be easier to make an explanation of the symptoms that affects the cat to the vet.

To make the system have better results, further research was undertaken by experts testing with DVM. Sadra against data from previous studies using data from clinical diagnosis Amore Animal Clinic Jakarta, the test results are the accuracy value 80% and the error system 20% against of 10 data. In order to maximize the results of further research by the authors conducted a comparative analysis using the Dempster-Shafer method.

This comparative analysis is intended to measure the level of the expert confidence and the probability of symptoms that occur. Certainty factor analysis done on trust/belief in an event (or facts or hypotheses) from an expert, and Dempster-Shafer analysis conducted on the degree of belief and thought that went will (plausible reasoning) [3]. In this comparative analysis used a comparison parameter that is a percentage of the results of each method, the percentage of accuracy and error of expert testing, confusion matrix test, accuracy, precision and recall test from the system diagnosis result to the expert diagnosis.

2. LITERATURE REVIEW

Study literature by studying previous research related to expert system methods. The previous researches can be seen in Table 1.

Table. 1 Previous research

No.	Author	Research Study	Result
[3]	Magdalena MA Sigalingging, Desi Andreswari, dan Yudi Setiawan	Perbandingan Certainty Factor dan Dempster Shafer Mendiagnosis Penyakit THT (Telinga Hidung Tenggorokan) dengan Sistem Pakar.	This research explained the design, development, and implementation of an expert system application that will be used to analyze the ENT diseases. In this study used the results of a comparison of Certainty Factor method and Dempster-Shafer method. From the test results show the value of an accuracy of 98.9% in the Certainty Factor method and 99.2% in the Dempster-Shafer method.
[4]	Ahmad Yatiman, Hindayati Mustafidah	Implementasi Certainty Factor pada Diagnosa Penyakit Mata.	This research explained the implementation of Certainty Factor method to be used to diagnose the eye diseases. The case study of this research was conducted at the Faculty of Health Sciences, University of Muhammadiyah Purwokerto with expert dr. Prapto Eko Widodo. Based on these results, the system can run diagnostics and system capable of storing representations of expert knowledge based on the value of CF (Certainty Factor).
[5]	Elsa Nuramilus Shofia, Rekyan Regasari Mardi Putri, Achmad Arwan	Sistem Pakar Diagnosis Penyakit Demam: DBD, Malaria, dan Tifoid Menggunakan Metode K-Nearest Neighbor - Certainty Factor.	This study describes an expert system that will be used for diagnosing fever: Dengue, Malaria and Typhoid using a combined method of K-Nearest Neighbor and Certainty Factor. This study uses data for a total of 143 data. based testing variations of the value of K obtained an accuracy of 88.37%, testing variations training data obtained an accuracy of 86.04%, testing the ratio of training data and test data obtained an accuracy of 95%, testing variations of the number of test data obtained an accuracy of 90%, testing variations of the test data obtained average accuracy of 97.22%, and comparative testing methods KNN-Certainty Factor produces an accuracy of 84.79%.

[6]	Khairina Eka Setyaputri, Abdul Fadlil, Sunardi	Comparative Analysis of Certainty Factor Method and Bayes Probability Method on ENT Disease Expert System.	This study describes the comparative analysis of the methods of Certainty Factor Probability and Bayes methods in disease Ear Nose Throat (ENT). The research was conducted on data of 10 patients suffering from ENT diseases. Based on testing, showed 100% accuracy using Bayesian methods Probability and accuracy of 80% using the method of Certainty Factor.

3. RESEARCH PROCESS

This research will discuss the comparative analysis of the expert system diagnosis of skin disease in cats. The object of this study is an expert system that will be compared, namely the Certainty Factor and Dempster-Shafer method. This method will be compared to the diagnosis of skin disease in cats which consists of 19 symptoms and 4 skin disease and 15 data testing sample.

3.1 Research Stages

The research method is steps being taken by researchers in preparing the research report. In this study, the research methods or stages of research undertaken include: data collecting, data analysis, data processing, data testing, and analysis result. More details can be seen in Figure 1.

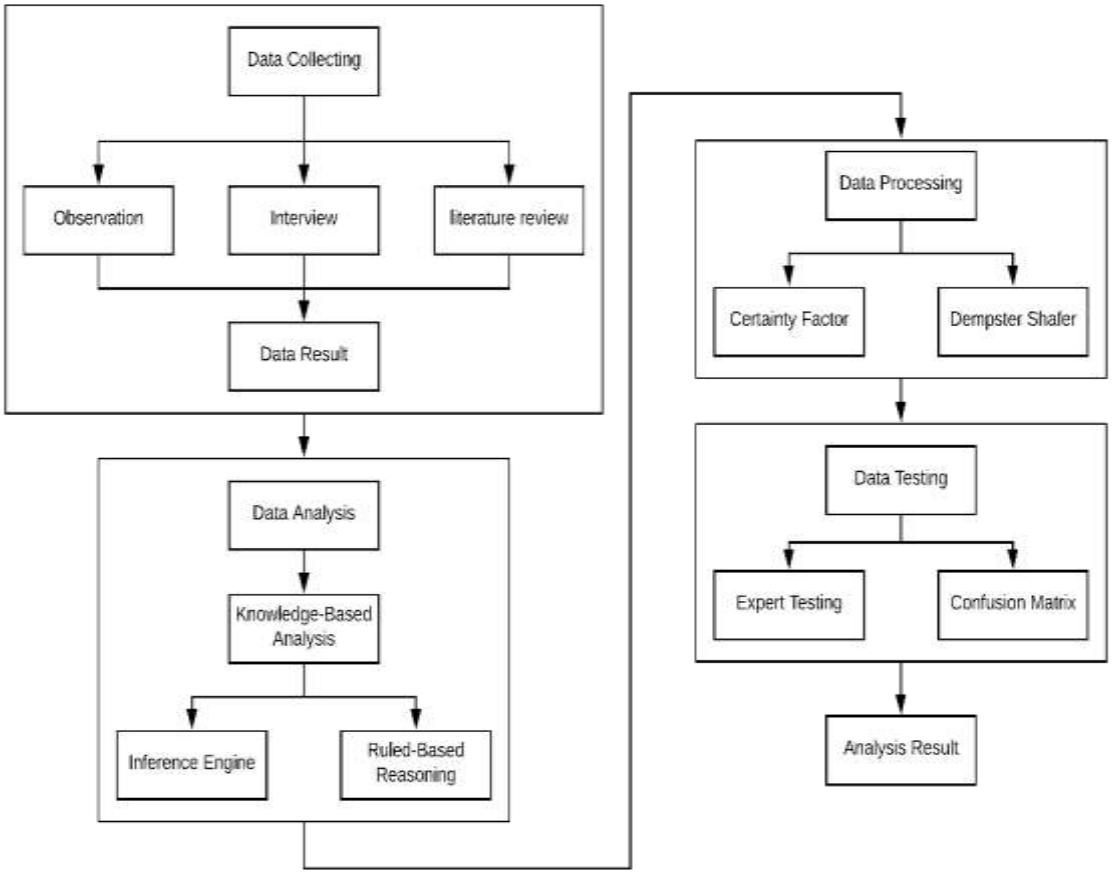

Figure. 1 Research methodology

3.2 Data collecting

Method of data collecting to obtain the information needed to achieve the research objectives. As discussed in the previous section research object, the data object associated with the subject in the form of symptoms and skin disease in cats. The research data was taken from PDHB Amore Animal Clinic Jakarta. To obtain the data required in this study, conducted in a variety of ways, namely:

a) Observation

A method of data collecting is done by direct observation, retrieve data needed at the research site. This activity is carried out in PDHB Amore Animal Clinic Jakarta in the vulnerable period of August 2019 until September 2019.

b) Interview

The interview is a technique of data collecting was done by face to face with the speaker or in this study is called as an expert by question and answer. This interview activity carried out in stages to the expert, on August 2nd, 2019, August 15, 2019, August 24, 2019, and August 29, 2019. Located in PDHB Amore Animal Clinic Jakarta, Jl. Pejaten Raya Blok A 21 Villa Pejaten Mas, Housing Barat, Pasar Minggu, South Jakarta. The subject of the interview or expert is DVM. Rasi Sadra Rausanfikri.

c) Literature Review

In a literature review, author searches and studies from book, journal, thesis, and web pages that can be used as sources of data and information that became the amplifier making this application. The literature that used as a reference can be seen in the bibliography. Similar literature studies are conducted as a comparison against research and writing that is being done by the author.

3.3 Analysis and data processing

Data processing is the process of searching for the meaning of the research, design, and field data in accordance with the purpose. At this stage, the raw data is processed according to the needs, so it can be understood to solve research problems. While data analysis is an activity that classify, manipulate, create a sequence, and compress data so easy to understand. In this study, the data is processed in several stages.

3.3.1 Analysis knowledge base

The knowledge base is at the core of the expert system, the expert system development knowledge extracted and represented in a form that can be processed by a computer. A knowledge representation system based on the combination of two elements, namely the structure of data and interpretation of procedures used as knowledge to preserve the structure of the data.

The knowledge base that is used in the manufacture of expert systems are rule-based approach (Rule Based Reasoning). In this approach represented knowledge using IF-THEN rules. This approach is used when the experts had some knowledge, so that experts can solve the problem in a sequence based on the existing rules. Based on the knowledge of experts made a list of information about skin diseases and symptoms. Each of these diseases and symptoms of the disease are given a code and the code of symptoms.

3.3.2 Certainty factor method

Certainty Factor method used to show the certainty factor. Thus, the diagnosis results produced are able to describe the level of confidence against a disease expert. In this method, experts give weight or degree of confidence in the clinical symptoms associated with the disease there. Certainty factor on the application method, there are the stages of this method in flowchart form. The following is a flowchart of the algorithm certainty factor in diagnosing skin disease in cats and is described as Figure 2.

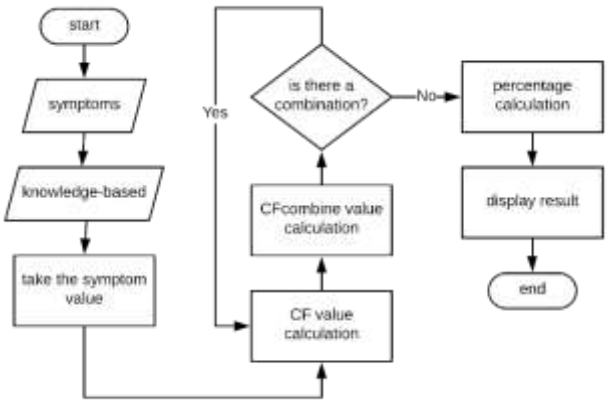

Figure. 2 Certainty factor method flowchart

According to beginning Theory certainty factor (CF) proposed by Shortlife and Buchanan in 1975 to accommodate the uncertainty of thinking an expert. A specialist / expert in this case usually doctors often analyze information by phrases such as "may", "likely", "almost certainly". To accommodate this, we use to describe the certainty factor confidence level of experts on the matter at hand. To get a conclusion by using certainty factor, can be used the following formula [7]:

$$CF\ (Pk, G) = MB\ (Pk, G) - MD\ (Pk, G) \qquad \text{Eq. (1)}$$

by:

$$MB(Pk, G) = \begin{cases} 1 & , P(Pk) = 0 \\ \frac{\max[Pk|G], P(Pk)] - P(Pk)}{Max[1,0] - P(Pk)} & , yang\ lain \end{cases} \qquad \text{Eq. (2)}$$

$$MD(Pk, G) = \begin{cases} 1 & , P(Pk) = 0 \\ \frac{Min[Pk|G], P(Pk)] - P(Pk)}{Min[1,0] - P(Pk)} & , yang\ lain \end{cases} \qquad \text{Eq. (3)}$$

Where:

CF (PKG)	: Pk disease degree of certainty, based on symptoms G
MB (Pk, G)	: Measurement of rate increases certainty Pk disease, because of their G
MD (Pk, G)	: Measurement of unbelief does not rise to the disease Pk, symptomatically G
P (Pk | G)	: The probability of an unknown disease with symptoms G Pk has occurred
P (Pk)	: The probability of disease Pk

3.3.3 Dempster-Shafer method

Dempster-Shafer method or theory of evidence used to show a way to give weight to the belief in accordance facts collected. This theory can distinguish between uncertainty and ignorance. This theory allows one to combine evidence from different sources lead to a certain confidence level (represented by mathematical objects called belief function) taking into account all available evidence. in its application, there are stages of use Dempster-Shafer method depicted in flowchart form to facilitate the understanding of this method. The following is an algorithm flowchart Dempster-Shafer in diagnosing skin disease in cats and is described as Figure 3.

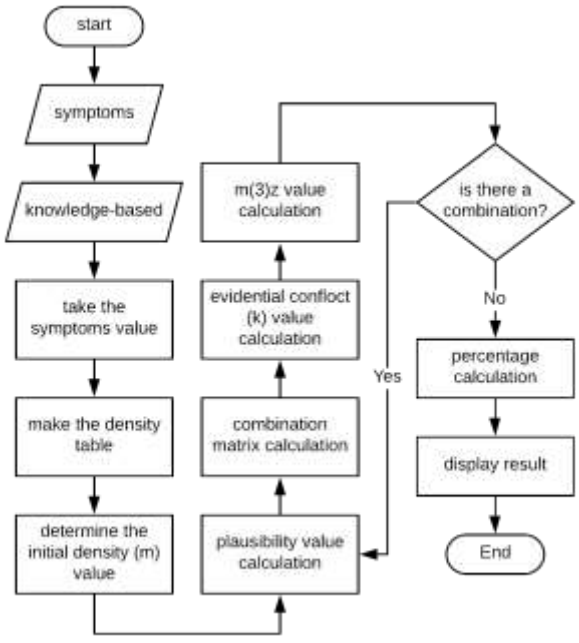

Figure. 3 Dempster-Shafer Method Flowchart

In general, Dempster-Shafer theory written in the form of a range interval [Belief, plausibility]. Belief (Bel) is a measure of the strength of evidence in support of a set of propositions. If the value is 0 (zero) it indicates that there is no evidence, and if the value of 1 indicates certainty. According to [8] belief functions can be formulated with the following formula:

$$Bel(X) = \sum_{Y \subseteq X} m(Y) \quad \text{Eq. (4)}$$

whereas plausibility (Pls) denoted by formula as follows:

$$Pls(X) = 1 - Bel(X') = 1 - \sum_{Y \subseteq X'} m(Y) \quad \text{Eq. (5)}$$

Where:

Bel (X): Belief (X)
Pls (X): plausibility (X)
m (X): mass function of (X)
m (Y): mass function of (Y)

3.4 Data testing

In this stage testing process data that has been processed in the previous stage or the stage of data processing. data testing will be performed using several methods. In this study, the data will be tested using the expert testing method, confusion matrix test, and testing Accuracy, Precision and Recall.

3.4.1 Confusion matrix

Confusion matrix according to [9] can be defined as a device that has a function to analyze whether the classifier is better at recognizing tuple of a different class. The value of True-True-Positive and Negative provide information when classifier within the classification of data is true, while False-Positive and False-Negative provide false information when classifier within the classification data. Confusion matrix representing predictions and actual conditions (actual) of data produced by ML algorithm. Based on the confusion matrix, we can determine Accuracy, Precision and Recall.

		True Class	
		Positive	Negative
Predicted Class	Positive	true positives count (TP)	false negatives count (FP)
	Negative	false positives count (FN)	true negatives count (TN)

Figure. 4 Confusion Matrix displays the total positive and negative tuple [9]

Where:
True Positive (TP): the amount of data with a positive real value and positive predictive value
False Positive (FP): the amount of data with the actual value of the negative and positive predictive value
False Negative (FN): the amount of data with the actual value of the positive and negative predictive values
True Negative (TN): the amount of data with negative real value and negative predictive value

3.4.2 Accuracy

Accuracy is defined as the degree of closeness between the predicted value to the actual value. Accuracy is the ratio of correct predictions (positive and negative) with the overall data.

$$accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

3.4.3 Precision

Precision is the degree of accuracy of the information requested by the user with the answers given by the system. Precision is the ratio of true positive predictions compared to the overall positive predictable results.

$$Precission = \frac{TP}{TP + FP}$$

3.4.4 Recall

Recall is the level of the system's success in rediscovering an information. Recall is the ratio of true positive predictions compared to the overall positive right data.

$$Recall = \frac{TP}{TP + FN}$$

4. RESULTS AND DISCUSSIONS

4.1 Knowledge base

Table 2 is about list of skin diseases in cats.

Table. 2 List of cats skin diseases

Disease code	Types of diseases
P01	ear Mites
P02	flea
P03	ringworm
P04	Scabies

Furthermore, the code list of symptoms and symptom names contained in this expert system can be seen in Table 3.

Table. 3. List of symptoms of cats' skin diseases

Code	Description of symptoms
G01	Scratching
G02	excessive scratching
G03	scratching the ear area, neck, and head
G04	often shaking their heads
G05	blackish brown ear wax
G06	Dry earwax (sandy) and not oily
G07	ruffled feathers
G08	ruffled feathers on the ear
G09	circular ruffled feathers
G10	crusty skin
G11	dry crusty skin
G12	the skin on the ears, elbows, legs, and stomach crusty
G13	skin redness
G14	skin sores and blisters on the back of the head, ears or neck
G15	skin color becomes blackish
G16	visible brownish red mite runs fast in the body
G17	looks black dirt like sand in the back
G18	often lick
G19	sometimes lick the feet and other body areas

the relationship between the disease and the symptoms also described the relationship tables diseases and symptoms that can be seen in Table 4. symptoms of existing code written with symptoms and will be used to create an inference rule.

Table 4. Diseases and symptoms relation

Symptom	Disease
G01, G03, G04, G05, G06, G14	P01
G01, G07, G16, G17	P02
G07, G09, G10, G11, G15, G18, G19	P03
G02, G03, G07, G08, G10, G12, G13, G18	P04

Table 5 contained the weight CF for Certainty Factor methods and weight Belief for Dempster-Shafer methods. These weights are used for calculation step.

Table 5. Methods weights

Diseases code	Name of disease	Symptom code	Name symptoms	Weights CF	Weight Belief
P01	ear mites	G01	Scratching	0.8	0.4
P01	ear mites	G03	scratching the ear area, neck, and head	0.6	0.8
P01	ear mites	G04	often shaking their heads	0.8	0.7
P01	ear mites	G05	blackish brown ear wax and sand	0.9	0.8
P01	ear mites	G06	earwax is dry and not greasy	0.9	0.8
P01	ear mites	G14	skin sores and blisters on the back of the head, ears or neck	0.5	0.4
P02	Flea	G01	Scratching	0.7	0.4
P02	Flea	G07	ruffled feathers	0.7	0.6
P02	Flea	G16	visible brownish red mite runs fast in the body	0.9	0.9
P02	Flea	G17	looks black dirt like sand in the back	0.9	0.9
P03	Ringworm	G07	ruffled feathers	0.9	0.6
P03	ringworm	G09	circular ruffled feathers	0.9	0.9
P03	ringworm	G10	crusty skin	0.8	0.6
P03	ringworm	G11	dry crusty skin	0.8	0.7
P03	ringworm	G15	skin color becomes blackish	0.7	0.7
P03	ringworm	G18	often lick	0.8	0.6
P03	ringworm	G19	sometimes lick the feet and other body areas	0.6	0.4
P04	scabies	G02	excessive scratching	0.9	0.7
P04	scabies	G03	scratching the ear area, neck, and head	0.9	0.8
P04	scabies	G07	ruffled feathers	0.8	0.6
P04	scabies	G08	ruffled feathers on the ear	0.9	0.9
P04	scabies	G10	crusty skin	0.9	0.6
P04	scabies	G12	the skin on the ears, elbows, legs, and stomach crusty	0.9	0.9
P04	scabies	G13	skin redness	0.8	0.7
P04	scabies	G18	often lick	0.7	0.6

4.2 Expert testing

This testing was conducted to compare the results between the Certainty Factor, Dempster-Shafer, and diagnosis by experts. This test can be seen in Table 6. The test is performed to test the diagnosis obtained from interviews and observations with the expert or veterinarian. The number of samples tested were as many as 15 samples of diagnosis.

Table. 6 Expert testing result

The code and rules symptoms	Diagnosis			Result
	System		Expert	
	CF	DS		
U01	Scabies 99.99%	Scabies 99.76%	Scabies	Corresponding
U02	Scabies 99.99%	Scabies 96.25%	Scabies + Flea Allergy	Not corresponding
U03	Ear Mites 99.6%	Ear mites 82.14%	ear Mites	Corresponding
U04	Ear Mites 99.6%	Ear Mites 92%	ear Mites	Corresponding
U05	Ear Mites 99.92%	Ear Mites 94.56%	ear Mites	Corresponding
U06	Ear Mites 99%	Ear Mites 92%	ear Mites	Corresponding
U07	Flea 97%	Flea 39.42%	Flea	Corresponding
U08	Flea 97%	Flea 75.63%	Flea	Corresponding
U09	Flea 97%	Flea 90%	Flea	Corresponding
U10	Ringworm 99.99%	Ringworm 98.01%	ringworm	Corresponding
U11	Ear Mites 99%	Ear Mites 92%	ear Mites	Corresponding
U12	Ear Mites 99.84%	Ear Mites 78.63%	ear Mites	Corresponding
U13	Scabies 99.98%	Scabies 96.74%	Dermatophytosis	Not corresponding
U14	Scabies 99.99%	Scabies 99.88%	Scabies	Corresponding
U15	Flea 99.91%	Flea 97.4%	Flea	Corresponding

Based on the results of the comparison in Table 6. can be concluded as follows:

1. Certainty Factor

   Number of samples = 15 Diagnosis

   The number of samples with results of system diagnosis right = 13 diagnosis

   The number of samples with results of system diagnosis wrong = 2 diagnosis

   System Error: (2/15) x 100 = 13.33%

   Accuracy: (13/15) x 100 = 86.67%

2. Dempster-Shafer

   Number of samples = 15 Diagnosis

   The number of samples with results of system diagnosis right = 13 diagnosis

   The number of samples with results of system diagnosis wrong = 2 diagnosis

   System Error: (2/15) x 100 = 13.33%

   Accuracy: (13/15) x 100 = 86.67%

4.3 Confusion matrix

Further confusion matrix testing is done by comparing the results of diagnosis performed by the CF analysis calculations and DS with expert diagnosis. To test the accuracy of the results, carried out tests on a sample of 15 units. The test results are shown in Table 7.

Table. 7 Confusion matrix

id_uji	Results Calculation Methods				Expert	Accuracy							
	certainty Factor		Dempster Shafer			CF				DS			
	Disease	Score	Disease	Score		a	b	c	d	a	b	c	d
U01	P04	99.99%	P04	99.76%	P04	3	0	0	1	3	0	0	1
U02	P04	99.99%	P04	96.25%	P04, P02	2	1	0	1	2	1	0	1
U03	P01	99.60%	P01	82.14%	P01	3	0	0	1	3	0	0	1
U04	P01	99.60%	P01	92%	P01	3	0	0	1	3	0	0	1
U05	P01	99.92%	P01	94.56%	P01	3	0	0	1	3	0	0	1
U06	P01	99%	P01	92%	P01	3	0	0	1	3	0	0	1
U07	P02	97%	P02	39.42%	P02	3	0	0	1	3	0	0	1
U08	P02	97%	P02	75.63%	P02	3	0	0	1	3	0	0	1
U09	P02	97%	P02	90%	P02	3	0	0	1	3	0	0	1
U10	P03	99.99%	P03	98.01%	P03	3	0	0	1	3	0	0	1
U11	P01	99%	P01	92%	P01	3	0	0	1	3	0	0	1
U12	P01	99.84%	P01	78.63%	P01	3	0	0	1	3	0	0	1
U13	P04	99.98%	P04	96.74%	P05	4	0	0	0	4	0	0	0
U14	P04	99.99%	P04	99.88%	P04	3	0	0	1	3	0	0	1
U15	P02	99.91%	P02	97.40%	P02	3	0	0	1	3	0	0	1
Total						45	1	0	14	45	1	0	14

According to the table confusion in Table 7, Precision accuracy can be calculated using confusion matrix of the accuracy of the disease. Known expert's belief is a reference for comparison with the results of the calculation method Dempster-Shafer and Certainty Factor. So that the accuracy of calculation using the Confusion Matrix calculation results prediction method is the belief system than the belief of experts.

To do this accuracy calculation, predetermined values of a, b, c, and d as presented in Table 7. For example, U01:

- a is 3 for 3 CF predict disease no (negative) and in accordance with the beliefs of experts (negative).
- b is 0 for CF predict 0 other diseases that do not exist (negative) in accordance with the belief of experts (positive).
- c is 0 for CF predict 0 illnesses that do not fit (positive) with the belief of experts (negative).
- d is 1 for CF predict one existing disease (positive) in accordance with the belief of experts (positive).

4.3.1 Certainty factor method result

Table. 8 CF result

		Experts	
		Negative	Positive
Certainty Factor	Negative	45	1
	Positive	0	14

Confusion Matrix on the accuracy of the above diseases, Dempster-Shafer assessment methods taken from the assessment of a, b, c, and d in Table 7 and Table 8. it can be calculated value for Accuracy, recall, and Precision are as follows:

Accuracy $: \frac{a+d}{a+b+c+d} = \frac{45+14}{45+1+0+14} = \frac{59}{60} = 0.9833$

Recall $: \frac{d}{c+d} = \frac{14}{0+14} = \frac{14}{14} = 1$

Precision $: \frac{d}{b+d} = \frac{14}{1+14} = \frac{14}{15} = 0.9333$

On Certainty Factor method, the accuracy of precision disease with the number of all occurrences of 98.33%, a positive predictive accuracy correctly identified 100%, and the accuracy of the positive results that really amounted to 93.33%.

4.3.2 Dempster-Shafer method result

Table. 9 DS result

		Experts	
		Negative	Positive
Dempster-Shafer	Negative	45	1
	Positive	0	14

Confusion Matrix on the accuracy of the above diseases, Dempster-Shafer assessment methods taken from the assessment of a, b, c, and d in Table 7 and table 9. it can be calculated value for Accuracy, recall, and Precision are as follows:

Accuracy $: \frac{a+d}{a+b+c+d} = \frac{45+14}{45+1+0+14} = \frac{59}{60} = 0.9833$

Recall $: \frac{d}{c+d} = \frac{14}{0+14} = \frac{14}{14} = 1$

Precision $: \frac{d}{b+d} = \frac{14}{1+14} = \frac{14}{15} = 0.9333$

On the Dempster-Shafer method, the accuracy of precision disease with the number of all occurrences of 98.33%, a positive predictive accuracy correctly identified 100%, and the accuracy of the positive results that really amounted to 93.33%.

4.4 Result analysis

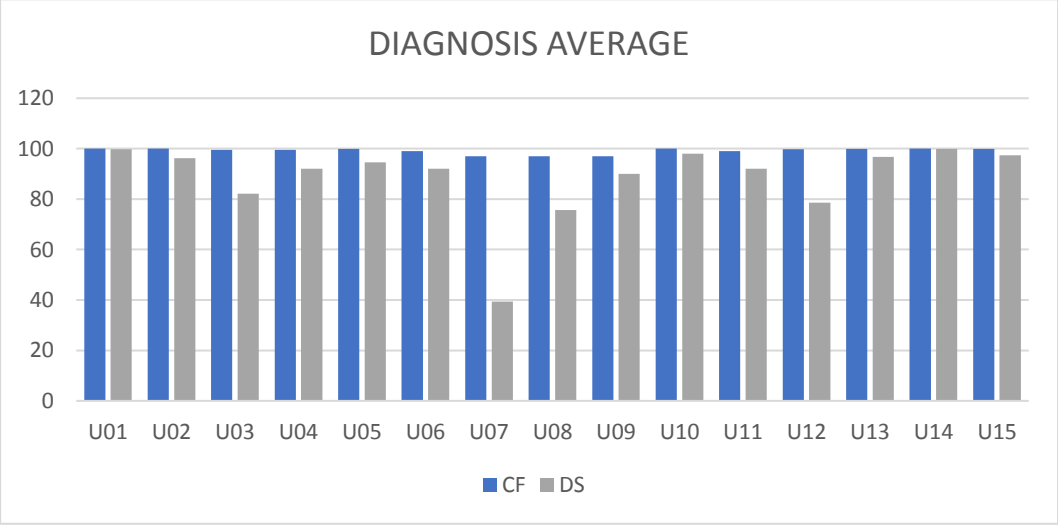

Figure. 5 Average result

However, in both methods found the value of different beliefs. In the belief certainty factor value is found that the result is higher than the value of the Dempster-Shafer belief. The average difference of 15 test samples is 10.9%. Can be seen in Figure 4.3., Look where the value of trust in the method of Certainty Factor had an average higher than the value of trust on Dempster Shafer method.

For ease in understanding the results and make a decision on the process of analysis and testing carried out, the results of a comparative analysis of the methods of this expert system can be seen in Table 10.

Table. 10 Summary results of comparative analysis expert system method

Method	Expert Testing		Average (%)	Confusion Matrix		
	Accuracy (%)	Error (%)		Accuracy	Precision	recall
Certainty Factor	86.67	13:33	99.2	0.9833	1	0.9333
Dempster-Shafer	86.67	13:33	88.3	0.9833	1	0.9333
Difference (%)			10.9			

From the results of which can be seen in Table 10. can be concluded that:

a) Certainty Factor Method and Dempster Shafer method has the result accuracy and error are the same value, is 86.67% of the value of accuracy and 13:33% to the value of a system error. It can be said that both methods are able to do the diagnosis quite well, because it has the results of accuracy above 80%.
b) Based on testing, showed that the certainty factor method has an average value that is higher than the Dempster Shafer method with an average difference of 10.9%. where the certainty factor has an average value of 99.2% and Dempster Shafer has an average value of 88.3%. This means that the certainty factor method has a better result than the method of Dempster Shafer if seen from the average value. However, this can be caused by the administration of the trust value of the symptoms, as well as from the process flow and the calculation of each method.
c) In testing the certainty factor confusion matrix method and Dempster Shafer had the same amount. That has a value of 0.9833 Accuracy, Precision 1 and Recall 0.9333. this can be caused because of the 15 samples tested, both methods issued the same diagnosis results, causing these two methods produce the same test value anyway.

5. CONCLUSSION

In this research, comparative analysis of the methods of the expert system Certainty Factor and Dempster-Shafer in case of skin disease in cats. A comparative analysis was conducted as a development of the previous writer's research in the form of a thesis entitled "Feline Dermatology Expert System for Diagnosis Using Certainty Factor Forward Chaining and Methods "in 2017.

The conclusions that can be given to research in are:

i) Comparative analysis of Certainty Factor method and Dempster-Shafer method for the diagnosis of skin disease in cats has been done.
ii) Based on the manual calculations and used program with the Python programming language compiler pick the same results. So that the accuracy of the results is as expected by the researcher.
iii) This study provides the results of comparative diagnosis of skin diseases in cats for Certainty Factor method and Dempster-Shafer with the results of each percentage.
iv) This study uses sample of 15 units of data samples obtained from PDHB Amore Animal Clinic Jakarta and DVM Rasi Sadra Rausanfikri as an expert.
v) Accuracy of the comparative analysis from expert system in this study has been done by expert testing, testing of confusion matrix, and testing Accuracy, Precision, Recall. Based on the 15 data that were tested, the results obtained accuracy of 86.67% and system errors at 13:33% for testing expert and the average difference between the method of Certainty Factor and Dempster-Shafer amounted to 10.9%, whereas the average yield method Certainty Factor higher than with an average yield of Dempster-Shafer method.

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