



Expert System for Diagnosing Diseases in Cats that Can Contagious to Humans Using the Certainty Factor Method

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ARTICLE INFO

Article history:

Received: 25/01/2020

Revised: 01 / 02/2020

Accepted: 02/04/2020

Keywords:

Certainty Factor, Cats, Diseases, Expert System

ABSTRACT

Cats are one of the most popular pet in the world. In addition to adorable, maintenance is not too much trouble is also a reason that makes this animal rage. However, the way poor maintenance can make a cat exposed to various diseases. Some diseases in cats can even be transmitted to humans. For this reason, research was undertaken to design an expert system to diagnose the disease in cats that can be transmitted to humans using the method of Certainty Factor, so that the cat's owner can recognize the symptoms of the disease in cats peliharaanannya. Black box testing results show that the features of the application has been running well. While the validity of the test showed that the data are in accordance with the reference books.

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1. Introduction

When we decided to adopt a pet, then we are fully responsible for the life of the animal. In the maintenance of a cat, there are times when we feel have good care, but the change of erratic weather, and other factors make us fall ill cats without us realizing the cause. Worse yet, some of the diseases suffered by the cat turned out to be transmissible to humans. The problem is our ignorance of the symptoms of the illness cats. Another problem is sometimes when we get sick pet there are times when we are constrained to see the vet for several reasons such as the distance is too far, limited costs and so forth. However, with the advancement of technology today,

The expert system is used to represent the knowledge of an expert in a computer system that will be used to solve the problems associated with the cat diseases. An expert system contains a set of facts obtained from the literature or information directly from experts. This application design used on Certainty Factor method that can accommodate the uncertainty of thinking of an expert. In this study, used a number of journals as reference in diagnosis expert system application design cat diseases that can be transmitted to humans.

Galuh Gupta in his journal, entitled "Detection Expert System Development of Disease in Cats Case Based Reasoning Methods And Certainty Factor-Based Android", explaining that cat owners are often puzzled about the disease in cats. Therefore made expert system application using Case Based Reasoning and Certainty Factor, so that users can better understand the symptoms in cats. Value test on this application can be as high as 90% [1]. In a journal entitled "Comparison of Certainty Factor and Forward Chaining for Early Diagnosis of Skin Diseases In Cats (Case Study: Veterinary Clinic Bandung UPT)" by Nur Jati noble, et al. explained that the cats were not treated very well be susceptible to skin disease. In this study used the method of Certainty Factor and Forward Chaining to produce conclusions about early diagnosis of skin disease in cats and is showing a certainty of the diagnosis [2]. Ahmad Affan Suprayogi, et al. in his journal titled "Cat Disease Diagnosis Expert System Using Naive Bayes Method - Certainty Factor-Based Android", said that if the health condition uninterrupted cat would adversely affect the keepers because it would be at risk of contracting. The method used in this study is Naive Bayes and Certainty Factor with an accuracy level of 80% [3]. Yoriko Tri Astono B., et al. in the journal "Expert System Virus Feline Cat Disease Diagnosis Method Using Web-Based Certainty Factor" explains





the popularity of cats is not matched by knowledge of maintenance and care measures, as well as the presence of a veterinarian limited. With the expert system designed Certainty Factor metode is expected the public can obtain information about the disease suffered by cats [4]. Rezza Ramadan, et al. in his journal, entitled "Expert System Diagnosis of Skin Disease in Persian Cats Method Using Certainty Factor", said that not a few people who hate the Persian cat because they have a dangerous disease. Applications in this journal is designed using the method of Certainty Factor because it is considered suitable for diagnosing something uncertain.

By using an expert system, the user can diagnose what the disease being suffered by cats peliharaan by adjusting the symptoms seen in these cats.

2. Research Methods

In this study, conducted research to obtain data about symptoms, diseases and relationships. Chronology of the research can be seen in Figure 1.

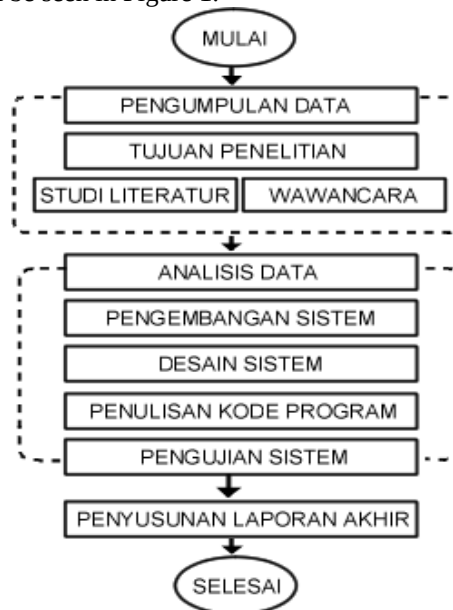


Fig 1. Methods

Figure groove research above can be described as follows:

- Data collection**
Methods of data collection in this research is to study the literature using journals of high peguruan national, private and books related to the disease in cats. As for the interview stage is done by a veterinarian.
- Data analysis**
Data and information obtained from reference journals were later processed and adapted to the case to be examined which health problems in cats. In this second phase is also done designing the system and writing program code then also conducted testing of the system ..
- Preparation of the Final Report**
Once the system has been designed and tested, the next step is to write down the results of the research that has been done.

Here is a design flow of the system being designed:

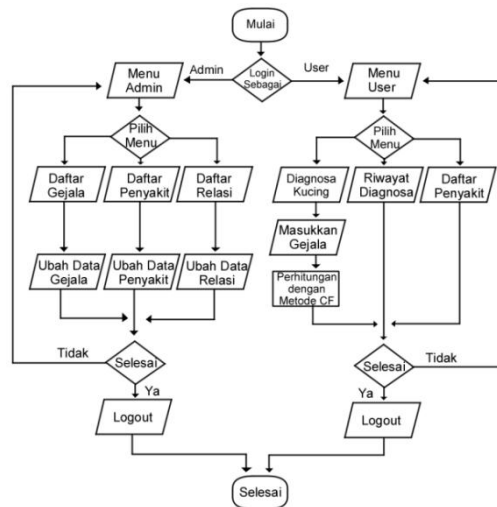


Fig 2. System Overview

A description of the image above is as follows:

- Main course**
On the main page, the user will be given two options, that is logged in as administrator or logged in as a normal user.
- Admin menu**
On the main page of the admin menu, there are several options List of Symptoms, Disease List and List Relationships. In the admin menu CRUD menu also provided for ease of data management. In relation menu, the admin can change the data relationships and disease symptoms and determine the weight of each relationship.
- User menu**
On the main page of the user menu will appear instantly cat diagnostics menu. Then the user enters the symptoms and the level of user confidence in the symptoms that are inserted which will then be processed by the calculation method of CF. Other menu available to the user a list of cat diseases, and diagnostic history has ever done in the application.

3. Results and Discussion

The main elements of the expert system to diagnose the cat is described as follows:

A. Knowledge base

Knowledge Base is the core of an expert system, which is a good representation of knowledge derived from experts or from books, journals, articles and so forth. The knowledge base consists of the fact of an object that is dynamic, so it can be changed or updated to be more sophisticated. Here is the information used in this study.

Table 1.
Table Cat Disease Symptoms

Symptoms Code	Symptom
G-01	Fever
G-02	Gag
G-03	fell dizzy
G-04	Diarrhea
G-05	Caucasian / White Eye Area Yellowing
G-06	Mouth Color Yellowish
G-07	Rash
G-08	Konjungtivis (Inflammation of the Eye)
G-09	Thin body
G-10	Sluggish
G-11	agitated
G-12	Aggressive



Symptoms Code	Symptom
G-13	Hyperactive
G-14	Hypersaliva
G-15	Blank stares
G-16	Eye Bead distention
G-17	Being happy in Dark Places
G-18	Excessive reactions on the Light and Sound
G-19	fur Loss
G-20	Fur Fractures
G-21	There are remnants of Dry Skin As Dandruff
G-22	Some Hardened Skin Section
G-23	Some portions Scaly Skin
G-24	Baldness in Several Parts Body
G-25	Excessive scratching
G-26	Red Spotted Skin Inflammation
G-27	Crusty skin
G-28	There Wound Bleeding Due to Scratching
G-29	There is Luka Bernanah
G-30	Scrape the Agency on the Object Around
G-31	There are worms Color Yellow / Beige on vomit / stool
G-32	Distended stomach

The symptoms listed in Table 1 is a symptom that can be seen without using a medical device. These symptoms come from several books on animal health has been included in the reference list.

Table 2,
Table Disease Cats

No.	Diseases Code	Disease Name
1	P-01	leptospirosis
2	P-02	rabies
3	P-03	Ringworm / Skin Fungus
4	P-04	Scabies
5	P-05	Toxocariasis / Stomach Worms

Diseases in Table 2 is a cat disease that can also infect humans on the application will be described in greater detail.

B. Rule Base System

Formation Rule Base also called RBS (Rule Base System), which is perangkat software delivering an expert knowledge or expertise in the form of rules to solve a problem. RBS is a simple model that can be adapted to a variety of problems. In this study, RBS used are as follows:

Table 3.
Rules Diseases and Symptoms

Relation Code	Diseases Code	Symptoms Code
R01	P-01	G-01, G-02, G-03, G-04, G-05, G-06, G-08, G-09, G-10
R02	P-02	G-11, G-12, G-13, G-14, G-15, G-16, G-17, G-18
R03	P-03	G-19, G-20, G-21, G-22, G-23, G-24
R04	P-04	G-19, G-22, G-25, G-26, G-27, G-28, G-29, G-30
R05	P-05	G-02, G-04, G-09, G-10, G-31, G-32

Table 3 contains about the rules of the disease and symptoms, in which the rules of data taken from reference books.

C. Certainty Factor

certainty factor(CF) is a method proposed by Shortlife and Buchanan in 1975 to accommodate the uncertainty of thinking of an expert. An expert often provide information with the phrase "may", "likely" and "almost certainly". That's why the certainty factor method is used to accommodate the level of confidence the expert. When this model is most commonly used to get the value of Certainty Factor (CF) is:

- Model 'Net Belief' proposed by EH Shortlife and BG Buchanan. As shown in equation (1).

$$CF(\text{Rule}) = MB(H, E) - MD(H, E) \quad (1)$$

Where :

CF (Rule): certainty factor

MB (H, E): Measure of Belief (measure of confidence) against the hypothesis H, if given evidence

E (between 0 and 1)





MD (H, E): Measure of Disbelief (a measure of distrust) towards evidence-H, if given evidence E (between 0 and 1)

- b. The second model is to use the results of the expert interviews. The results of the interview changed to CF in accordance with Table 4.

Table 4.

Value Confidence level Expert Evidence	
Value CF	Phrases
-1	definitely not
-0.8	Almost certainly not
-0.6	Unlikely
-0.4	Probably not
-0.2	Do not know
0.4	Maybe
0.6	Most likely
0.8	almost certainly
1	Certainly

Value Certainty Factor No 2, namely:

- a. Value Certainty Factor whose value attached to a rule / specific Rule and the value given by experts.
- b. Certainty Factor value given by the user to represent the degree of certainty / confidence on the premise (eg, symptoms, conditions, characteristics) experienced by the user.

The combination Certainty Factor used to mengdiagnosis disease are:

- a. *certainty Factor* to rule with a premise / single symptom (single premise Rules):
 $CF_{gejala} = C[user] \times CF[pakar]$ (2)
- b. If there are rules to similar conclusions (similiary concluded Rules) or more than one symptom, then the next CF calculated by the equation:
 $CF_{combine} = CF_{old} + CF_{gejala} \times (1 - CF_{old})$ (3)
- c. As for calculating the percentage of disease, use the equation:
 $CF_{persentase} = CF_{combine} \times 100$ (4)

Here is an example of manual calculations using the method of Certainty Factor on cat diseases.

Users have the following symptoms appear on a pet cat with a confidence level as follows:

- a) Excessive scratching (0.6)
- b) There Bernanah Luka (0.4)
- c) Crusty skin (0.8)
- d) Red Spotted Skin Inflammation (0.8)

Unknown value CFpakar (MB - MD) provided an expert on user perceived symptoms are as follows:

- a) Excessive Scratching: CFpakar (0.4)
- b) Luka Bernanah: CFPakar (0.8)
- c) Crusty Skin: CFPakar (1)
- d) Red Spotted Skin Inflammation: CFPakar (0.8)

From these data is then calculated CFgejala expert and user using equation 2.

- a) CFgejala 1: CFuser (0.6) * CFpakar (0.4) = 0:24
- b) CFgejala 2: CFuser (0.4) * CFpakar (0.8) = 0:32
- c) CFgejala 3: CFuser (0.8) * CFpakar (1) = 0.8
- d) CFgejala 4: CFuser (0.8) * CFpakar (0.8) = 0.64

The last step is to calculate the value CFpenyakit by combining CFgejala values have been obtained for each rule using equation 3.

- a) CFcombine (CF 1, CF 2) = $0.24 + 0.32 \times (1 - 0:24) = 0483$
- b) CFcombine (CF1, CF 2 CF 3) = $0483 + 0.8 \times (1-0.483) = 0896$
- c) CFcombine (CF 1, CF 2, CF 3, CF 4) = $0.896 + 0.64 \times (1-0.896) = 0962 \times 100\% = 96.2\%$

D. Implementation

Before the implementation of the system, perform the expert interviews in advance to get the weight or value of CF symptoms and diseases that have been mentioned, with the conviction based on the evidence table expert. This process is very important to establish the rule or rule.





In cats the disease diagnosis expert system that can be transmitted to humans, users are required to login as a user first. The login process is done so that the user diagnostics activities can be stored in the history column later. Some application menu on the display can be seen in the following pictures.



Fig 3. menu Home

When opening the application, users will be faced with the choice login as admin or as a user.

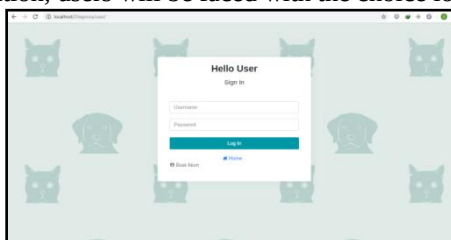


Fig 4. Menu User Login

If the user chooses to log in as a user, it will appear to the user login.

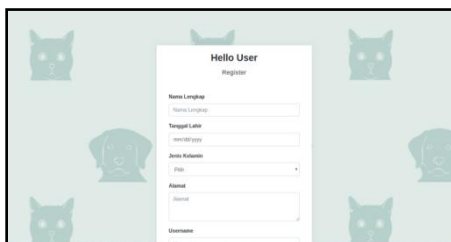


Fig 5. Menu Register

If users do not already have an account, the user can create an account first via the registration menu.

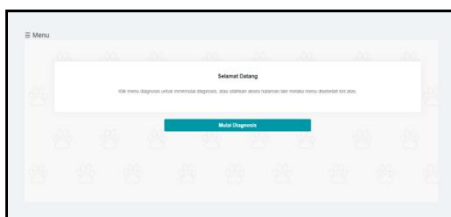


Fig 6. Main Menu User

After having an account, the user can simply log in and go to the main menu. On the main menu, there are cat illness diagnosis menu.



Fig 7. menu Diagnosis

Cats diagnosis menu contains a list of symptoms, along with the level of user confidence in these symptoms.

Fig 8. Results of Diagnosis

After the user enters the symptoms along with the level of confidence in these symptoms, then the data that has been entered will be calculated using the method of Certainty Factor will then be shown the possibility of the disease suffered by the cat, and how prevention and treatment.

Fig 9. History Diagnosis

Another menu that can be accessed by the user is the history menu, which will display the diagnostic history has ever done in this application.

E. Examination

To produce reliable systems, black box testing needs to be done, testing the validity of the data and testing the reliability of the system.

Table 5.
Black Box Testing

Scenario Testing	Testing Forms	Expected Results	Test Result
Test the function button on the main page	Pressing the "Admin" and "User"	Log into admin and user login menu	succeed
Test menu User Registration	Input data and press the button "Register"	New user is registered and can be logged	succeed
Test menus in the navigation-bar user	Pressing the "Dashboard", "Disease," History ", " About Applications ", and " Logout "	Go to the menu in accordance with the selection.	succeed
Doing Disease Diagnosis	Input symptoms and pressing the button "Submit"	Illness appear along with how likely.	succeed
Operators Menu Function test Diagnosis	Input less than 2 Symptoms	Warning to input at least 2 symptoms	succeed
Test the menu button in the admin dashboard.	Pressing the button "Symptoms Cat", "Cats Diseases", "Relationships" and "Logout"	Go to the menu in accordance with the selection.	succeed
Navigation-test menu in the admin bar.	Pressing the menu "Data Symptoms", "Disease Data",	Go to the menu in accordance with the selection.	succeed





Scenario Testing	Testing Forms	Expected Results	Test Result
	"Data Relationship" and "Logout"		
Test the CRUD feature on the menu of disease	Entering a new disease data, edit data and delete data illness disease.	Data successfully entered, modified and then deleted.	succeed
Test the CRUD feature on the menu of symptoms	Entering a new symptom data, edit data and delete data symptoms symptoms.	Data successfully entered, modified and then deleted.	succeed
Test the CRUD feature on the menu relations	Entering new data relationships, edit data relationships and data relationships.	Data successfully entered, modified and then deleted.	succeed

Black box testing is done by examining the main features of this application. This test is used to test the reliability and ease of system when accessed by the user.

Table 6.
Validity Testing Data

Disease	Symptom	Source
leptospirosis	Fever	book C
	Gag	book C
	fell dizzy	book C
	Diarrhea	book C
	Caucasian / White Eye Area Yellowing	book C
	Mouth Color Yellowish	book C
	Konjungtivitis (Inflammation of the Eye)	book C
	Thin body	book C
	Sluggish	book C
rabies	agitated	Book A, book B, book C
	Aggressive	Book A, book B, book C, D Books
	hyperactive	Book A, book B, book C
	Hypersaliva	A book, a book C
	Blank stares	Book A, book B, book C
	Eye Bead distention	Book A, book B, book C
	Being happy in Dark Place / Silent	Book A, book B, book C
	Excessive reactions on the Light and Sound	A book, a book C
ringworm	fur Loss	A book, a book C, D Books
	Fur Fractures	book D

Table 6.
Advanced

	There are remnants of Dry Skin As Dandruff	book D
	Some portions Skin Hardened / thicken	book D
	Some portions Scaly Skin	A book, a book C, D Books
	Baldness / Pitak in Several Parts Body	A book, a book C, D Books
Scabies	fur Loss	Book A, Book B, D Books
	Some portions Skin Hardened / thicken	Book A, book B, book C, D Books
	Excessive scratching	Book A, book B, book C, D Books
	Red Spotted Skin Inflammation	books A
	Crusty skin	Book A, Book B, D Books
	There Wound Bleeding Due to Scratching	A book, a book C, D Books
	There is Luka Bernanah	books A
Toxocariasis / Stomach Worms	Gag	Book C, D Books
	Diarrhea	Book C, D Books
	Thin body	Book C, D Books
	There are worms Color Yellow / Beige on vomit / stool	Book C, D Books
	Distended stomach	book D

Testing the validity of the data in the table, there are four (4) books referenced in this study. Among them is the book entitled "Manual of Animal Diseases Mammals" by Pujiatmoko, et al. [6], "Textbook of Zoonoses: Diseases Transmitted from Animals to Humans" by I Wayan Suardana [7], "Book Smart Healthy Cat Race" by Wheindrata [8], and "The Complete Guide to Cats" by Muhammad A. Suwed [9].





The reference books each written on the validity of the test chart data sequentially as "Book I", "Book II", "Book III" and "Book IV".

The next test is testing the reliability of the system. In testing the reliability of this system will be tested in the form of simulated virtual users ranging from 50 to 3000 within 60 seconds. This test was conducted to determine the reliability of the system when accessed by many users at the same time. Here are the test results.

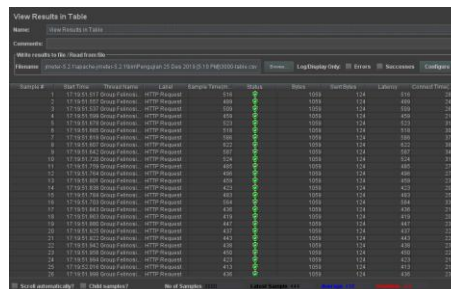


Figure 10. Testing with Jmeter

Figure 10 is a view results of tests performed using the Apache application Jmeter. The test is performed using the laptop with 4GB RAM (Gigabyte) and AMD A6-6310 APU.

Table 7.
Testing Reliability Systems

Thread (User)	Throughput (/ sec)	Average	Std. Deviation
50	0.84684	436	50.7
500	8.28679	436	44.52
1000	16.56452	483	187.6
1500	24.84884	486	190.44
2000	32.98044	495	195.49
2500	41.4017	492	194.48
3000	49.65325	498	324.08

In the above table Thread (User) is the number of virtual users to simulate a request to the server. Throughput is is the number of requests processed per unit of time (seconds, minutes, hours) by the server. Average is the average time it takes to respond to the request. Standard Deviation is a measure of how much variation in the response time is about average, the smaller the value, the more consistent the data anyway.

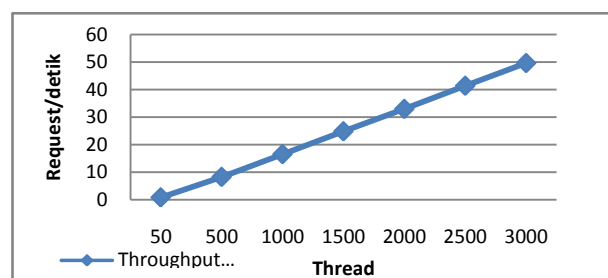


Fig 11. Throughput graph

The formula is the number of requests throughput divided by the total time of the test. [10] Figure 11 shows the throughput of each test is from 50 threads to 3000 threads. Pada images showed that the higher the thread count is entered, the higher the number of requests processed per second.

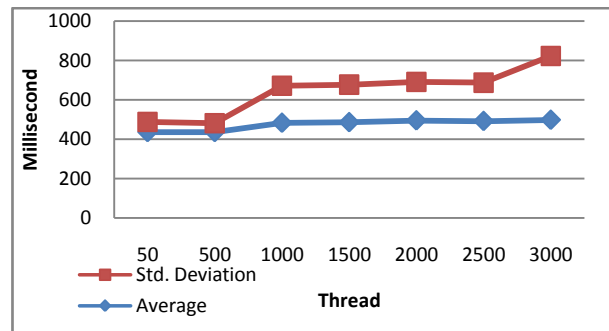


Fig 12. Deviation and Average

In figure 12 it can be seen that the higher the thread count the higher the standard deviation and the average time required to respond to the request.

Standard Deviation tolerance limit value should be less than or equal to half the value of Average [11]. In the last test we can see that the value of Standard Deviation Average exceeds half of the value so that the data is less consistent.

4. Conclusion

Based on the test results and analysis in this study it can be concluded that:

- This system can implement method of Certainty Factor nicely into an expert system for diagnosis of the disease in cats.
- This application can perform diagnosis of diseases other than cats, also provides information on prevention and treatment for the illness so that these applications can be used as an interim alternative if the user can not go to see the vet.
- After testing the validity of the black box and test it can be concluded that the application is reliable with the content of information that can be trusted. Besides reliability testing also showed that the system can work well in dealing with a large number of users up to 3000 users.

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