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Research paper



Development of Android-based Rabbit Disease Expert System

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Abstract

Many rabbit keepers or breeders are panics when their rabbit has an illness. This paper proposed an expert diagnostic system application for Android-based rabbit disease using the Naïve Bayes method to determine the illness and Certainty Factor for the trust value of the condition by combining the rate of the trust of users and experts due to diagnose the diseases of the rabbit.
The testing was using 65 data learning and 160 data learning to test the naïve Bayes method. Furthermore, the certainty factor is using CF user 1 and its variation.
The results obtained for 65 data learning is 53%, while 160 data learning is 73%. With the naïve Bayes method, it can be concluded that the more data learning, the better and more accurate the system. The results of conformity with the testing data obtained from the variative CF user value, namely 53% accordingly, 13% inappropriate, 33% near. The effect of compliance with the sample data collected from the CF value of user 1 is 53% appropriate, 7% inappropriate, 40% is near. With the certainty factor method, it can be concluded that differences in user input values affect the overall CF value.
Keywords: *expert system, naïve bayes, certainty factor, rabbit disease.*

1. Introduction

Rabbits are mammals from the family of Leporidae, which can be found in many parts of the earth. Today many people cultivate rabbits as pets. Often rabbits are attacked by diseases due to various good factors due to the condition of the cage and food. In this case, many rabbit keepers or farmers panicked when their rabbit was stricken with the disease. It is necessary to create an expert media that can be accessed by rabbit owners who are online as an application which helps to identify rabbits disease and provide first aid to rabbits.

Along with the development of modern science and technology, especially in the field of information technology which is so rapid, computer technology can be used to help humans in various kinds of work, such as health diagnosis. Applications that applied for this need are applications related to intelligent systems, which is an expert system. Before transfer the expertise to the system, it must be known in advance how the expert works. In this paper, experts are veterinarians in an animal clinic. The veterinarian will diagnose the disease suffered based on the symptoms that appear from the rabbit. From the conclusion of the disease, new solutions were given to treat the disease. This expert system is expected to help the rabbit owner get information about the diagnosis of the disease and how to deal with the disease based on the symptoms that appear. An expert or veterinarian will list the symptoms experienced by the animal, and from the list of symptoms can be made a diagnosis process. The disease in rabbits generally has symptoms that are almost the same between one type and the other, so that the signs of X are not necessarily just the symptoms that cause type A disease. Symptoms of X may also cause type B disease and others. With these problems, it is necessary to build an expert system application for diagnosing rabbit disease. Previous research has made this system web-based.

Based on a survey from We Are Social, a social marketing agency, issued a report on the data on the number of mobile users from around the world, and Indonesia is one of the countries who has the largest mobile user in the world[3][9]. The system will be developed into the Android platform. Development of Android-based Rabbit Diagnosis Expert System uses two methods, Naïve Bayes and Certainty Factor. The Naive Bayes method is for the classification process, in the system process requires training data and test data, while the Certainty Factor method is used to deal with problems whose answers are uncertain.

The research objective of the Development of Android-based Rabbit Diagnosis Expert System is to make a rabbit disease classification system using the Naive Bayes method to determine the disease - a certainty factor method to determine the value of trust and test an expert system for diagnosis of rabbit disease and help the first treatment of rabbits.

2. Literature Review

This section discuss about Naïve Bayes, Certainty Factor and related previous study

2.1. Previous Research

Previous research related with expert system are done by some research[1][2][5]. The studies in [1] show that this expert system can help people recognize various symptoms, types of diseases and solutions for how to treat rabbits. For further research can be further developed into android-based applications. The studies based on Forward Chaining method.
Studies in [2] show that the expert system that is built can recognize and know the disease in rabbits using the certainty factor (CF) method and produce solutions to help treat diseases. For future development, it can make a better presentation of symptoms data

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choices to make it easier to use this expert system and can be developed in the latest platform.
And studies in [5] show that the Naïve Bayes expert system of respiratory disorders in children has been able to provide information to the use of the types of respiratory diseases based on the symptoms given. For the subsequent development of the knowledge base to always be updated by the development of science and technology.

2.2. Naïve Bayes

According to Olson and Delen explained Naïve Bayes for each class of decisions, calculating the probability with the condition that the decision class is correct, considering the vector of object information. This algorithm assumes that object attributes are independent. The probability involved in producing the final estimate is calculated as the number of frequencies of the "master" decision table.
Bayes calculation can be done using the following steps:

1. Find the prior value for each class by calculating the average of each class using the equation.

$$P = \frac{X}{A} \quad (1)$$

2. Look for likelihood values for each class using the equation .

$$L = \frac{F}{B} \quad (2)$$

3. Look for the posterior value of each class that exists using the equation

$$P(H|E) = P(H) \times P(E|H) \quad (3)$$

Class classification results using the Naive Bayes method are done by comparing the posterior values of the existing classes. The highest posterior value selected as a result of classification.
Naive Bayes in expert systems has a role as an inference engine. Where the diagnosis process is determined by the input of symptoms by the user, then each symptoms entered is processed by calculating the classification of naive Bayes. Diagnosis results are taken from the maximum value of the disease sought based on the knowledge base.

2.3. Certainty Factor

According to Turban, Certainty Factor is a method used to express trust in an event (facts or hypothesis) based on evidence or expert judgment [8]. Certainty Factor (CF) can occur with a variety of conditions. Among the states that arise is that there are several antecedents (in different rules) with the same consequence.

CF (H,E) = MB (H,E) – MD (H,E) (4)

Explanation :

a. CF (H, E) = Certainty Factor of the H hypothesis which is influenced by the evidence E. The amount of CF ranges from -1 to 1. The value of 1 indicates absolute trust while the value of -1 indicates absolute distrust
b. MB (H, E) = measure of increase in confidence (measure of increased belief) to the hypothesis H which is affected by symptoms of E.
c. MD (H, E) = measure of increase in distrust (measure of increased disbelief) against hypothesis H which is affected by symptoms of E

The CF value (Rule) is obtained from the interpretation of "term" from the expert, which is converted into a specific CF value. There are 2 values of certainty factor, namely:

- The value of certainty factor rules whose values are attached to a certain rule and the value given by the expert.
- The value of the certainty factor provided by the user to represent the degree of certainty/confidence in the premise (e.g., symptoms, conditions, characteristics) experienced by the user.

2.4. System Overview

Android-based Rabbit Disease Expert System is an application which will help the rabbit keepers or breeders in diagnosing the illness of their rabbit by the visible symptoms.
The knowledge representation in this application based on the interviewed veterinarian.
Data collection did by interviewing veterinarian. Observations were carried out at the House of Malang pets, with Hadirotus Okvianty Mustika P. as the veterinarian.

3. Implementation

This research uses the Expert Methodology System Development Life Cycle. The development model uses stages that represent the needs of expert systems for diagnosing rabbits diseases using the Naïve Bayes method and Certainty Factor. The steps of the activities are:

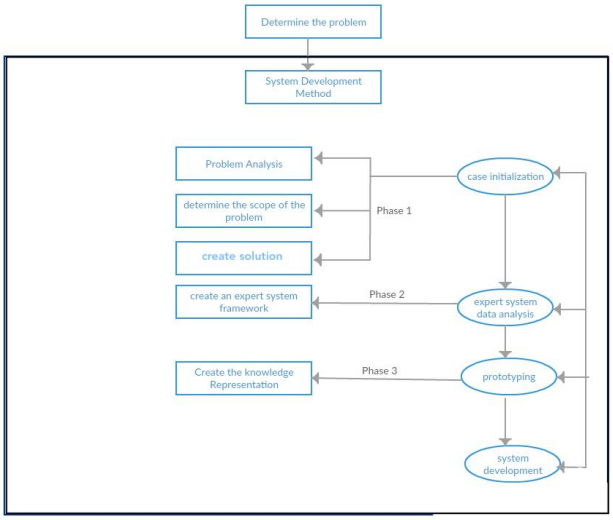


fig. 1 Framework of Thinking

The steps of the expert methodology system development life cycle are :

3.1 Initialization

At this stage, the problem is determined by the diagnosis of disease in rabbits. The observation data is reviewed then define the problem scope. The acquisition of knowledge of disease symptoms is intended to assess the mindset of the system.

3.2 Expert System Data Analysis

In this stage is to determine the Naive Bayes method for the classification process. The system process requires training data and test data, then the Certainty Factor used as a technique used to overcome uncertainty in decision making and show the amount of trust.

3.3 Basic Case Prototype

At this stage knowledge representation is carried out. Knowledge obtained from experts represented in a format that is understood by humans and can be executed by computers.

3.4 System Design

After the information needed has been represented, then the next step is making a design system. The designs are :

a. Use Case

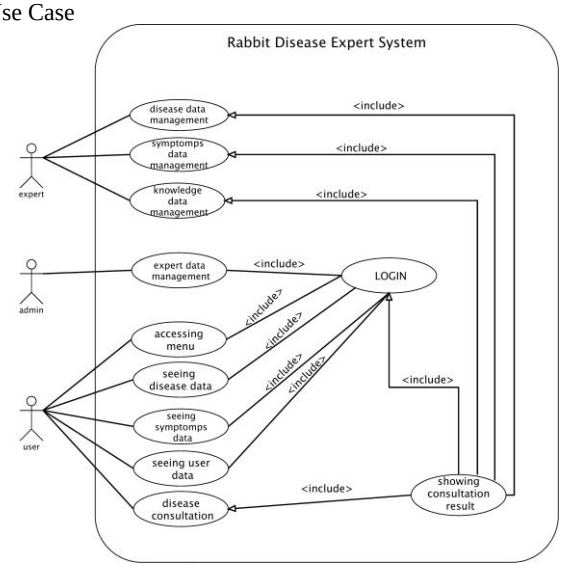


fig 2. Use case diagram

From the use case diagram, this system has 3 users i.e expert, admin and user. Expert manages disease data, symptom data, and knowledge data, while users can consult and produce consultation results in expert knowledge data, then admin manages expert data.

b. Flowchart

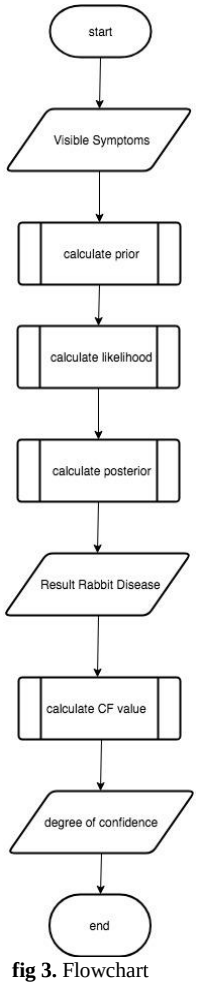


fig 3. Flowchart

The algorithmic flow of the Naive Bayes method determines the type of disease by calculating prior values, likelihood values, and posterior values then produce the result of the disease, then Certainty Factor determines the degree of trust by combining expert and user trust values which can be seen in Figure 3.

3.5 System Development

The following is a little excerpt from the observations at the House Of Pets Malang in the form of a medical record list. In the table 2.1 there is list for the kind of disease.

Table 2.1 The Disease

List of Disease	
Code	**Name**
P1	scabies
P2	malocclusion
P3	earmites
P4	furmites
P5	dhiarrea
P6	flu
P7	wormy
P8	coccidiosis
P9	eye inflammation
P10	hairball

In the table 2.2 is the list of the symptoms and their codes.

Table 2.2 List of Symptoms

List Of Symptoms			
Code	**Name of Symptoms**	**Code**	**Name of Symptoms**
G1	there is scab / crust	G19	Watery eyes
G2	scratching in certain parts of its body	G20	The eyes look red
G3	Hair loss/alopecia	G21	There are traces of dirt in the eyes
G4	dirty ear section	G22	Empty stomach
G5	pain on the ear	G23	Rocking teeth
G6	reddish	G24	Body temperature rises
G7	fleas	G25	Erratic body temperature
G8	mushy feces	G26	Slimy feces
G9	weak	G27	Bloody dirt
G10	blown	G28	Dull fur
G11	Runny nose	G29	The anus is dirty
G12	sneezing	G30	Fever
G13	elongated teeth	G31	Do not want to eat
G14	swollen gums	G32	Little appetite
G15	bloated / enlarged stomach	G33	Appetite goes down
G16	Stress	G34	Itchy
G17	Weight loss	G35	The face looks pale
G18	Thin body	G36	Scratching the body
		G37	There is fur in the feces

In table 2.3 is a list of medical records of some rabbits and what symptoms they experience and their disease.

Table 2.3 some sample data of the medical records in the clinic

No	Rabbit Name	Symptoms	Disease Name
1	CIMO	thin scabs on the ears and fingers, scratching the scabs part.	Scabies
2	NN	long section right incisors, rocking teeth. (can cut only the lower teeth), it wants to eat a little amount	malocclusion
3	Enci	there is crust, itching, hair loss	Scabies
4	NN	dirty ears, it always scratches the ears, if ears held then the rabbit feels pain	Earmites
5	Linlin	thick crust, crust on the eyelids & nose	Scabies
6	NN	hair loss + redness on the four legs starts to bite up to the top. back crust. reddish nose. dental norm	Scabies
7	Yessie	hair loss, there are active fleas (some move in rabbit hair)	Furmites

8	Sandra	mushy dirt, lack of appetite, lethargy	diarrhea
9	Moly	there is crust / dandruff in the foot	Scabies
10	Gendut	there is a severe crust	Scabies
11	Popi	There is a crust on the ears and feet, alopexia. Eat normal	Scabies
12	Xingxing	The incisors are elongated, appetite decreases.	Maloklusi
13	Monyo	Anorexia, runny nose, weakness, decreased appetite, mushy feces	Flu
14	Cifewy	Temperature up and down, last meal in the morning, mushy dirt (smelly, green) bloated, lethargic, dirty part of the anus	diarrhea

There are 65 examination datas from medical record in the clinic, tabel 2.4 shows the summary of the examination data.

Table 2.4 Sum of The Disease

Disease	Total
scabies	33
malocclusion	11
earmites	1
furmites	3
dhiarrea	11
flu	2
wormy	1
coccidiosis	1
eye inflammation	1
hairball	1

With Naïve Bayes classification, the result of each step will be shown in the table 2.5 until 2.8.
Table 2.5 shows the result of normalization. Normalization is sum of the total amount of each disease with total amount of symptoms

Table 2.5 Normalization

Disease	Total	Normalization
scabies	33	70
malocclusion	11	48
earmites	1	38
furmites	3	40
dhiarrea	11	48
flu	2	39
wormy	1	38
coccidiosis	1	38
eye inflammation	1	38
hairball	1	38

Table 2.6 shows the prior value of each disease.

Table 2.6 Prior Value

Disease	Total	Normalization	Prior
scabies	33	70	1,0769
malocclusion	11	48	0,7385
earmites	1	38	0,5846
furmites	3	40	0,6154
dhiarrea	11	48	0,7385
flu	2	39	0,6000
wormy	1	38	0,5846
coccidiosis	1	38	0,5846
eye inflammation	1	38	0,5846
hairball	1	38	0,5846

New input data will be used to count the likelihood value. Tabel 2.7 shows the new input data and its trust value.

Table 2.7 New Input Data

Symptoms input	Trust Value for CF
G8	0,6
G9	0,8
G24	0,6
G36	0,4

Table 2.8 is the result of posterior value after each likelihood for each symptom of each disease was multiplied. The highest posterior value is the disease based on Naïve Bayes calculation. So, for the new data input in Table 2.7 the disease will be wormy. And trust value in table 2.7 is used for calculation in Certainty Factor to see if the result is suitable with the trust value from the experts.

Table 2.8 Posterior Value

Disease	Prior	Likelihood	Posterior
scabies	1,0769	0,06	0,06
malocclusion	0,7385	0,26	0,19
earmites	0,5846	0,83	0,49
furmites	0,6154	0,66	0,41
dhiarrea	0,7385	0,38	0,28
flu	0,6000	0,77	0,46
wormy	0,5846	0,88	0,51
coccidiosis	0,5846	0,83	0,49
eye inflammation	0,5846	0,81	0,47
hairball	0,5846	0,83	0,49

The results of observations at Malang House of Pets in the form of a list of CF values or belief values per symptom in each disease according to experts is in table 2.9

Table 2.8 Trust Value

Symptoms Code	Trust Value from experts per disease									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
G1	0.6		0.4							
G2	0.6		0.8	0.8						
G3	0.6		0.4	0.6	0.4	0.4	0.4	0.4	0.4	0.6
G4	0.4		0.6	0.4						
G5	0.4		0.6							
G6	0.6		0.6	0.4		0.4			0.4	0.6
G7			0.4	0.4						
G8		0.4			0.4	0.4	0.6	0.6	0.4	0.4
G9	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
G10						0.4	0.4	0.4		0.4
G11						0.6	0.4	0.4	0.4	
G12				0.4		0.6			0.4	
G13		0.8			0.4	0.4	0.4	0.4	0.4	0.4
G14		0.6				0.4		0.4		
G15		0.4			0.4	0.4	0.4	0.4	0.4	0.4
G16	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
G17	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.4	0.4
G18	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.4	0.4
G19	0	0.4	0	0	0.4	0.4	0.4	0.4	0.4	
G20		0.4			0.4	0.4	0.4	0.4	0.6	
G21						0.4			0.6	
G22	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.4	0.4
G23		0.4								
G24										
G25										

G26		0.4			0.4	0.4	0.4	0.6		0.6
G27					0.4		0.4	0.6		
G28	0.4	0.4		0.4	0.4	0.4	0.4	0.4		0.6
G29	0.4				0.4	0.4	0.4	0.6		0.4
G30										
G31	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.4	0.4
G32	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.4	0.4
G33	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.4	0.4
G34	0.6		0.6	0.6					0.4	
G35		0.4			0.4	0.4	0.4	0.6	0.4	0.4
G36	0.6		0.6	0.6						
G37					0.2					0.8

3.6 Mobile application implementation

This section will show about screen captured of mobile application rabbit disease expert system. Figure 1 is user interface for user registration. Figure 2 shows how user input the symptoms of the disease. Figure 3 shows the result of the disease.

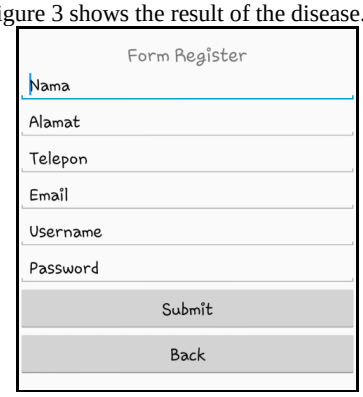


fig 1. User Registration

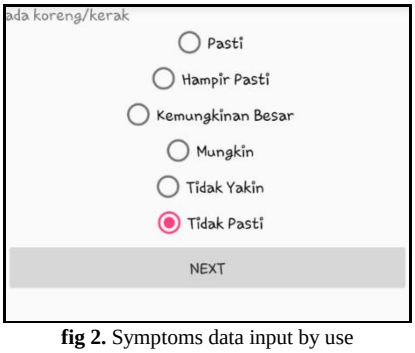


fig 2. Symptoms data input by use



fig 3. Consultation result

4. Result and Discussion

System testing is testing the methods used in this system. Tests were carried out using inputted 15 sample data with symptoms. It ranges from 1 to 8 symptoms and disease. Table 4.1 shows the testing data to test the system.

Table 4.1 testing data

No	Symptoms	Disease
1	G1, G2, G3, G6, G7	furmites
2	G1, G3	scabies
3	G13, G14	malocclusion
4	G11, G12	flu
5	G8, G9, G26, G27, G33	coccidiosis
6	G3, G8, G9, G25, G26	diarrhea
7	G8, G9, G16, G17, G26, G29	diarrhea
8	G37	Hairball
9	G11, G12	flu
10	G19, G20, G21	eye inflammation
11	G28, G29, G37	Hairball
12	G8, G9, G19, G22, G32	coccidiosis
13	G1	scabies
14	G2, G3, G6, G7	furmites
15	G2, G4, G5, G9	earmites

Testing of 15 testing data with 65 learning data in the expert system of diagnosing disease in rabbits and compared with the results of experts with the Naïve Bayes method. 65 learning data used to test 15 testing data, comparison of system tests with the expert have the following results:

a. There are 8 data from 15 sample data that match :
   8 / 15 x 100 % = 53 %
b. there are 7 data from 15 sample data does not match :
   7 / 15 x 100 % = 47 %

Testing of 15 testing data with 160 learning data in the expert system of diagnosing diseases in rabbits and compared with the results in experts with naïve Bayes method. 160 learning data used to test 15 testing data, comparison of system tests with the expert have the following results:

a. There are 11 data from 15 sample data that match :
   11 / 15 x 100 % = 73 %
b. there are 4 data from 15 sample data does not match :
   4 / 15 x 100 % = 27 %

Testing with CF

Tests are carried out using 15 testing data with inputted symptoms ranging from 1-8 symptoms with variative CF values from user, used only to compare the results of user and expert trust. With 15 testing data comparison system tests with experts have the following results:

a. there are 8 data from 15 sample data that match :
   8 / 15 x 100 % = 53 %
b. there are 2 data from 15 sample data does not match :
   2 / 15 x 100 % = 13 %
c. there are 6 data from 15 sample data does not match :
   5 / 15 x 100 % = 33%

Tests are carried out using 15 testing data with inputted symptoms ranging from 1-8 symptoms with certain CF values (1), used only to compare the results of user and expert trust. With 15 testing data comparison system tests with experts have the following results:

a. there are 8 data from 15 sample data that match :
   8 / 15 x 100 % = 53 %
b. there are 1 data from 15 sample data does not match :
   1 / 15 x 100 % = 7 %
c. there are 6 data from 15 sample data does not match :
   6 / 15 x 100 % = 40 %

5. Conclusion

From the results of design and development until the testing of the expert systems development programs for disease diagnosis in rabbits based on Android, conclusions obtained for further program development: from 15 sample data tested with Naïve Bayes method from 65 learning data compare with 160 learning data, the data produce different results, because the machine learns better.
The more learning data, the results will be more accurate. And from the 15 sample data tested by the certainty factor method, the CF value of the user combined with the expert CF value = 1 compared to the data tested with the variative CF user value, resulting in different results due to differences in values affecting the overall CF value.

Acknowledgement

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