

Implementation of a Rabbit Disease Diagnosis Expert System using the Forward Chaining and Certainty Factor Method

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Abstract

An expert system is a system that adopts the expertise of an expert in a particular field into the system. Rabbits are one of the animals that are close to humans and have high body adaptability. However, rabbits are not free from the threat of disease. Treatment requires more costs so we need a way to find out the disease and the solution so that we can take the necessary actions. To overcome this, an expertise media was created that can be accessed by rabbit owners online using the Forward Chaining and Certainty Factor methods. The expert system must be able to work under uncertainty, so the Forward Chaining (FC) and Certainty Factor (CF) methods were added to overcome this problem. Forward Chaining is a decision making method that is commonly used in expert systems and the Certainty factor method is a method to prove the uncertainty of an expert's thinking. The system diagnosis results display possible diseases suffered by rabbits and provide treatment solutions for diseases with the largest CF values. With the calculation results, the level of confidence information based on the table is Definitely Yes. The accuracy of the system output is proven from the results of system validity with experts.

Keywords: Expert System, Forward Chaining, Certainty Factor, Disease, Rabbit, Website.

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1. Introduction

Rabbits are livestock and herbivorous pets that can grow and reproduce quickly so that they can be developed as meat producers, wool producers, or as pets, so it is not surprising that many people in Indonesia and throughout the world decide to care for and raise rabbits. . Seeing the large population of rabbits in Indonesia, it will definitely present various significant problems and of course rabbits are also one of the living creatures that are not immune from disease due to the lack of knowledge of the public or rabbit owners regarding the diseases that attack the bodies of their pet rabbits.

Rabbit disease certainly attacks the rabbit's immune system. Where rabbits who are infected with the disease will experience very drastic changes in activity. Limited information from rabbit owners or breeders regarding diseases in rabbits can accelerate the decline in rabbit resistance.

To overcome this problem, the author took the initiative to make a breakthrough in identifying rabbit diseases by utilizing one of the branches of Artificial Intelligence, namely the Expert System, through various conveniences provided by the web program that the author created, which includes Related solutions for rabbit diseases have also been presented and what rabbit owners should do if their rabbits are exposed to disease using the Forward Chaining and Certainty Factor methods.

An expert system is a system whose performance adopts the expertise possessed by an expert in a particular field into a computer system or program that is presented with a display that can be used by users who are not experts [1]. An expert system is a system that uses human knowledge, then this knowledge is input into a computer and then used to solve problems that require human expertise or expertise [2].

Artificial intelligence is the study of how to make computers perform actions better than humans do. Artificial intelligence (artificial intelligence) is a part of computer science that studies how to make computer machines do things like and as well as humans do, even better than what humans do [3].

Artificial intelligence itself is defined as a machine or program that has intelligence in it to complete a job [4].

The Forward Chaining method is a decision making method that is commonly used in expert systems. The search process using the Forward Chaining method goes from left to right, namely from the premise to the final conclusion. This method is often called data driven, namely the search is controlled by the data provided [5].

Forward Chaining can be a form of thinking that will or needs to start from actuality to draw conclusions from that actuality. Forward Chaining can be said to be a form of various deduction procedures that start with a known truth [6].

Forward Chaining is also called reasoning that starts from the bottom up because reasoning is based on facts at the lower level leading to conclusions at the upper level which are based on facts. A search technique that starts with known facts, then matches the facts with the IF from the IF-THEN rule, if there are facts that match the IF, then the rule is executed. When a rule is executed, a new fact (THEN) is entered into the database [7].

Certainty factor or often called CF is a method used to measure the value of expert confidence [8]. Certainty factor is a method to prove the uncertainty of an expert's thinking, where to accommodate this someone usually uses a certainty factor to describe the level of expert confidence in the problem being faced [9].

Unified Modeling Language (UML) is a tool for visualizing and documenting the results of analysis and design which contains syntax for modeling systems visually [10]. The definition of Unified Modeling Language (UML) is a standardized modeling language for software development built using object-oriented programming techniques [11].

An information system is a combination of various information technology components that work together and produce information in order to obtain a single communication channel within an organization or group [12]. Information systems are an organized combination of people, hardware, software, communication networks, resources in the form of data, as well as policies and procedures that store, retrieve, change and disseminate information within an organization [13] . An Information System is a series of interconnected components that collect or obtain data, process, store and distribute information to support decision making within an organization so that the organization's goals are achieved [14].

PHP is interpreter programming, namely the process of translating lines of source code into machine code that the computer understands directly when the code is executed. PHP is a language with open copyright or also known as Open Source, meaning that users can develop PHP function codes according to their needs [15].

A database is a collection of data that forms a file or files that are interconnected using certain procedures to form new data or information. Or it can be interpreted as a database or database as a collection of data that are interconnected with each other and organized based on a certain scheme or structure. MySQL is software that is classified as a database server and is open source. Open Source states that this software is equipped with source code (the code used to create MySQL), apart from that, of course, the code can be run directly in the operating system, and can be obtained by downloading it on the internet for free . MySQL can run on various operating systems. Accessing data in the database can

be done easily using SQL (Structure Query Language) [16].

HTML, which is an abbreviation for Hyper Text Markup Language, is a series of program code which is the basis for the visual representation of a website page. CSS is a way to make the format or layout of website pages more attractive and easy to manage. A website or site page can be defined as a collection of pages that can display information, images, animation, text, sound or a combination of all of them, either in the form of static and dynamic which form a series of buildings that are interconnected and connected by a network of courtyards [17].

2. Research methodology

A research framework is a concept or stages that will be carried out in a research. So that the steps taken by the author in this design do not deviate from the main discussion and are easier to understand, the sequence of research steps will be made systematically so that it can be used as an easy and clear guide for solving existing problems. The research framework used is as shown in Figure 1 below:

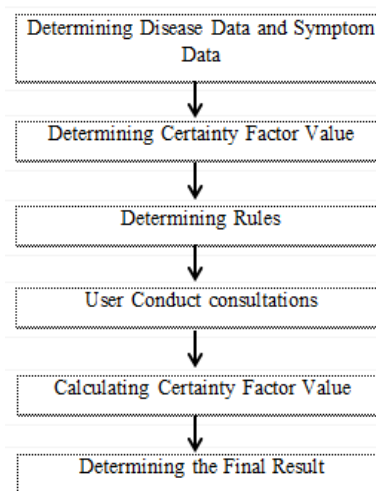


Figure 1. Research Framework

The Certainty Factor method was introduced by Shortliffe Buchanan in the creation of MYCIN. Certainty Factor is a clinical parameter value provided by MYCIN to indicate the level of confidence. Certainty Factor introduces the concept of belief and disbelief which is formulated in the following basic formula :

$$CF[H, E] = MB[H, E] - MD[H, E]$$

Information :

- CF [H ,E] : Certainty Factor
- MB [H ,E] : Measure of confidence in hypothesis H, given evidence E (between 0 and 1)
- MD [H ,E] : Measure of disbelief in hypothesis H, given Evidence e (between 0 and 1)
- E : Evidence (events or facts)

H : Hypothesis (conjecture)

Certainty Factor with one premise

$$CF[H, E] = CF[E] * CF[rule] \\ = CF[user] * CF[pakar]$$

Certainty Factor with more than one premise

$$CF[A \wedge B] = \text{Min}(CF[a], CF[b]) * CF[rule]$$

$$CF[A \vee B] = \text{Max}(CF[a], CF[b]) * CF[rule]$$

Certainty Factor with similar conclusions

$$CFgabungan[CF1, CF2] = CF1 + CF2 * (1 - CF1)$$

Certainty Factor Process Algorithm

1. Data
2. Initialization of disease symptoms in rabbits
3. Show disease symptoms in rabbits and Certainty factor (CF) values
4. Process of disease symptoms in rabbits
5. CF combination disease in rabbits
6. CF combination value results (CF Combine)

Rule process algorithm in forward chaining:

1. Data
2. Determining the symptoms of disease in rabbits
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

Lack of public knowledge about rabbit diseases can increase the death rate of rabbits. To increase and increase knowledge of rabbit diseases , the author created a system that can help the public in terms of handling and knowledge of rabbit diseases.

3.1 Disease and Symptom Analysis

The problem discussed in this research is rabbit disease . The symptoms of disease in rabbits can be seen in Table 1 :

No	Symptom Code	Symptom
1	G01	Appetite is lost
2.	G02	Weight loss
3	G03	Reddish skin
4	G04	Body full of scabs
5	G05	Hair loss
6	G06	Itching on the body
7	G07	Difficulty getting pregnant/miscarriage
8	G08	Reddish ear skin

No	Symptom Code	Symptom
9	G09	The area around the eyes is red
10	G10	Body Lethargy
11	G11	Diarrhea
12	G12	Vomit
13	G13	High body temperature
14	G14	Scratching the earlobe
15	G15	Fluid comes out in the ear canal
16	G16	Itching and pain in the ear
17	G17	Purulent discharge from the eyes
18	G18	Inflamed red eyelids
19	G19	Leg bones are weak and bent
20	G20	Likes to eat feathers
21	G21	Cannibal
22	G22	Not strong enough to hold weight
23	G23	Fluid discharge in the nose
24	G24	Out of breath

Several diseases in rabbits discussed in the research can be seen in Table 2 :

No	Disease Code	Disease
1	P01	Scabies
2	P02	Gastroenteritis
3	P0 3	Inflammation of the ear
4	P04	Eye Inflammation
5	P05	Hypocalcium
6	P06	Pneumonia

Based on the table above, the experts determine the CF value for each symptom of each disease, namely in table 3 :

No	Disease Name	Symptom	CF value
1	Scabies	Appetite is lost	0.8
		Weight loss	0.8
		Reddish skin	1
		Body full of scabs	1
		Hair loss	1
		Itching on the body	1
		Difficulty getting pregnant/miscarriage	0.6
		Reddish ear skin	1
		The area around the eyes is red	1
		Body Lethargy	0.8
2	Gastroenteritis	Appetite is lost	1
		Weight loss	1
		Diarrhea	1
		Vomit	1
		High body temperature	0.6
		Appetite is lost	0.6
3	Inflammation of the ear	Weight loss	0.6
		Hair loss	0.8
		Scratching the earlobe	1
		Fluid comes out in the ear canal	1
		Itching and pain in the ear	1
		Body lethargic	0.8

No	Disease Name	Symptom	CF value
4	Eye Inflammation	Appetite is lost	0.6
		Weight loss	0.6
		Purulent discharge from the eyes	1
		Inflamed red eyelids	1
		Body Lethargy	0.6
		Appetite is lost	1
5	Hypocalcium	Weight loss	1
		Hair loss	1
		Likes to eat feathers	1
		Cannibal	1
		Difficulty getting pregnant/miscarriage	1
		Diarrhea	0.8
		Body Lethargy	1
6	Pneumonia	Appetite is lost	1
		Weight loss	1
		Out of breath	1
		Fluid discharge in the nose	0.6
		Body Lethargy	0.6

Calculations of CF were obtained from interviews with rabbit experts, with CF values obtained from experts and converted into CF values which can be seen in Table 4 below:

Table 1CF Value

No	Uncertain Term	CF value
1	Definitely Not	-0.1
2	Almost Certainly Not	-0.8
3	Most likely not	-0.6
4	Probably not	-0.4
5	Don't know	-0.2 to 0.2
6	Maybe yes	0.4
7	Most likely yes	0.6
8	Almost Certainly Yes	0.8
9	Definitely Yes	1.0

As example case is a giving process FC value on each symptom disease rabbit :

Rule 1: *Scabies*
 IF Appetite is lost
 AND Weight loss
 AND Reddish skin
 AND Body full of scabs
 AND Feather Loss
 AND Itching on the body
 AND Difficulty getting pregnant/miscarriage
 AND Reddish ear skin
 AND The area around the eyes is red
 AND Body Lethargy
 THEN *Scabies*

The first step, the expert determines the CF value for each symptom. The CF value is given expert for example:

Expert CF (G01)	=	0.8
Expert CF (G02)	=	0.8
Expert CF (G03)	=	1

Expert CF (G04)	=	1
Expert CF (G05)	=	1
Expert CF (G06)	=	1
Expert CF (G07)	=	0.6
Expert CF (G08)	=	1
Expert CF (G09)	=	1
Expert CF (G10)	=	0.8

Suppose the user chooses answer as following:

G01	=	Most likely yes	=	0.8
G02	=	Most likely yes	=	0.8
G03	=	Most likely yes	=	0.8
G04	=	Most likely yes	=	0.8
G06	=	Most likely yes	=	0.8
G07	=	Most likely yes	=	0.8
G08	=	Most likely yes	=	0.8
G09	=	Most likely yes	=	0.8
G10	=	Most likely yes	=	0.8

The initial rule (rule 1) has 10 symptom broken down become rules that have symptom single, so become:

Rule 1.1:	IF Loss of appetite (G01)	THEN <i>Scabies</i> .
Rule 1.2:	IF Weight loss (G02)	THEN <i>Scabies</i> .
Rule 1.3:	IF Reddish skin (G03)	THEN <i>Scabies</i> .
Rule 1.4:	IF Body full of scabs (G04)	THEN <i>Scabies</i> .
Rule 1.5:	IF Hair loss (G05)	THEN <i>Scabies</i> .
Rule 1.6:	IF Itching of the body (G06)	THEN <i>Scabies</i> .
Rule 1.7:	IF Difficulty getting pregnant/miscarriage (G07)	THEN <i>Scabies</i> .
Rule 1.8:	IF Reddish ear skin	THEN <i>Scabies</i> .
Rule 1.9:	IF The area around the eyes is red	THEN <i>Scabies</i> .
Rule 1.10	IF Lethargic Body (G10)	THEN <i>Scabies</i> .

Manual calculation process for rule 1.1:

$$CF_{G01} = CF(\text{user}) * CF(\text{expert})$$

$$= 0.8 * 0.8$$

$$= 0.64$$

Manual calculation process for rule 1.2:

$$CF_{G02} = CF(\text{user}) * CF(\text{expert})$$

$$= 0.8 * 0.8$$

$$= 0.64$$

Manual calculation process for rule 1.3:

$$CF_{G03} = CF(\text{user}) * CF(\text{expert})$$

$$= 0.8 * 1$$

$$= 0.8$$

Manual calculation process for rule 1.4:

$$CF_{G04} = CF(\text{user}) * CF(\text{expert})$$

$$= 0.8 * 1$$

$$= 0.8$$

Manual calculation process for rule 1.5:

$$\begin{aligned} CF_{G05} &= CF(\text{user}) * CF(\text{expert}) \\ &= 0.8 * 1 \\ &= 0.8 \end{aligned}$$

Manual calculation process for rule 1.6:

$$\begin{aligned} CF_{G06} &= CF(\text{user}) * CF(\text{expert}) \\ &= 0.8 * 1 \\ &= 0.8 \end{aligned}$$

Manual calculation process for rule 1.7:

$$\begin{aligned} CF_{G07} &= CF(\text{user}) * CF(\text{expert}) \\ &= 0.8 * 0.6 \\ &= 0.48 \end{aligned}$$

Manual calculation process for rule 1.8:

$$\begin{aligned} CF_{G08} &= CF(\text{user}) * CF(\text{expert}) \\ &= 0.8 * 1 \\ &= 0.8 \end{aligned}$$

Manual calculation process for rule 1.9:

$$\begin{aligned} CF_{G09} &= CF(\text{user}) * CF(\text{expert}) \\ &= 0.8 * 1 \\ &= 0.8 \end{aligned}$$

Manual calculation process for rule 1.10:

$$\begin{aligned} CF_{G10} &= CF(\text{user}) * CF(\text{expert}) \\ &= 0.8 * 0.8 \\ &= 0.64 \end{aligned}$$

Due there is more from One symptoms, then For determine CF disease furthermore used equality 1.5 :

$$\begin{aligned} CF_{combine}(CF_{G01}, CF_{G02}) &= CF_{G01} + CF_{G02} * (1 - CF_{G01}) \\ &= 0.64 + 0.64 * (1 - 0.64) \\ CF_{old} &= 0.8704 \end{aligned}$$

$$\begin{aligned} CF_{combine}(CF_{old}, CF_{G03}) &= CF_{old} + CF_{G03} * (1 - CF_{old}) \\ &= 0.8704 + 0.8 * (1 - 0.8704) \\ CF_{old} &= 0.97408 \end{aligned}$$

$$\begin{aligned} CF_{combine}(CF_{old}, CF_{G04}) &= CF_{old} + CF_{G04} * (1 - CF_{old}) \\ &= 0.97408 + 0.8 * (1 - 0.97408) \\ CF_{old} &= 0.994816 \end{aligned}$$

$$\begin{aligned} CF_{combine}(CF_{old}, CF_{G05}) &= CF_{old} + CF_{G05} * (1 - CF_{old}) \\ &= 0.994816 + 0.8 * (1 - 0.994816) \\ CF_{old} &= 0.9989632 \end{aligned}$$

$$\begin{aligned} CF_{combine}(CF_{old}, CF_{G06}) &= CF_{old} + CF_{G06} * (1 - CF_{old}) \\ &= 0.9989632 + 0.8 * (1 - 0.9989632) \\ CF_{old} &= 0.99979264 \end{aligned}$$

$$\begin{aligned} CF_{combine}(CF_{old}, CF_{G07}) &= CF_{old} + CF_{G07} * (1 - CF_{old}) \\ &= 0.99979264 + 0.48 * (1 - 0.99979264) \\ CF_{old} &= 0.99989217 \end{aligned}$$

$$\begin{aligned} CF_{combine}(CF_{old}, CF_{G08}) &= CF_{old} + CF_{G08} * (1 - CF_{old}) \\ &= 0.99989217 + 0.8 * (1 - 0.99989217) \\ CF_{old} &= 0.99997843 \end{aligned}$$

$$\begin{aligned} CF_{combine}(CF_{old}, CF_{G09}) &= CF_{old} + CF_{G08} * (1 - CF_{old}) \\ &= 0.99997843 + 0.8 * (1 - 0.99997843) \\ CF_{old} &= 0.99999568 \end{aligned}$$

$$\begin{aligned} CF_{combine}(CF_{old}, CF_{G10}) &= CF_{old} + CF_{G08} * (1 - CF_{old}) \\ &= 0.99999568 + 0.64 * (1 - 0.99999568) \\ CF_{old} &= 0.9999984 \end{aligned}$$

Information :

CF_{old} (old CF) is a CF disease, based on results CF calculation above, then CF disease *Scabies* in rabbits is 0.9999984

Furthermore count *percentage* confidence to disease with equality :

$$\begin{aligned} \text{Percentage} &= CF_{disease} * 100 \\ &= 0.9999984 * 100 \\ &= 99.99\% \end{aligned}$$

Based on results calculation, then information level confidence based on table is Definitely Yes .

4. Conclusion _

This expert system makes it easier for rabbit owners to carry out consultations by implementing a web-based system which is implemented using forward chaining and certainty factor methods by selecting the symptoms experienced according to the rabbit's condition so that a diagnosis of disease can be produced in rabbits, making it easier for rabbit owners to check for disease. suffered by their pet rabbits effectively and efficiently. To handle the dangerous phase, the system will issue an output containing a recommendation to immediately send the rabbit to the UPTD of the West Sumatra Animal Hospital.

References

- [1] Gusman, AP, Maulida, D., & Rianti, E. (2019). Expert System for Diagnosing Ovarian Cyst Disease Using the Forward Chaining Method. *KomtekInfo Journal*, 6(1), 8-18. <https://doi.org/10.35134/komtekinfo.v6i1.37>
- [2] Handoko, MR, & Neneng, N. (2021). Expert System for Diagnosing Diseases During Pregnancy Using Web-Based Naive Bayes Method. *Journal of Information Technology and Systems*, 2(1), 50-58. <https://doi.org/10.33365/jtsi.v2i1.739>
- [3] Susatyono, JD (2021). *ARTIFICIAL INTELLIGENCE, Study of Concepts and Applications*. Prima Agus Teknik Foundation Publisher, 1-151.
- [4] Wihartiko, FD, Nurdianti, S., Buono, A., & Santosa, E. (2021). Blockchain and Artificial Intelligence in Agriculture: A Literature Study. *J. Technol. Inf. and Computer Science*, 8(1), 177. <https://doi.org/10.25126/jtiik.202184059>
- [5] Amelia, D. (2022). Determining violations of the narcotics article using the forward chaining method and certainty factor. <https://doi.org/10.29210/30032024000>
- [6] Utami, YP, Triayudi, A., & Handayani, EE (2021). Diabetes Mellitus (DM) Disease Detection Expert System uses Android-based Forward Chaining and Certainty factor methods. *JTIK Journal (Journal of Information and Communication Technology)*, 5(1), 49-55. <https://doi.org/10.35870/jtik.v5i1.200>

- [7] Firdaus, MB, Habibie, DS, Suandi, F., Anam, MK, & Lathifah, L. (2021). OTW GRADUATE Game Design Using the Forward Chaining Method. *Journal of Information Systems and Computer Systems*, 6(2), 66-74. <https://doi.org/10.51717/simkom.v6i2.56>
- [8] Dian, R., Sumijan, S., & Yuhandri, Y. (2020). Expert System for Identifying Tooth Decay in Children Using Forward Chaining and Certainty Factor Methods. *Journal of Information Systems and Technology*, 65-70. <https://doi.org/10.37034/jsisfotek.v2i3.24>
- [9] Azis, N., Darmawan, R., & Hery, J. (2021). Design and Build an Android-Based Laptop Device Repair Application Using the Certainty Factor Method. *Journal of Information Systems*, 1(1), 6-11.
- [10] Ulhusna, M., Yetrina, M., & Harma, B. (2021). Designing Sales Applications and Stock Data Collection Using the PHP Programming Language and MySQL Database. *Tambusai Education Journal*, 5(3), 11210-11215. <https://doi.org/10.31004/jptam.v5i3.2793>
- [11] Son, USA (2021). Customer service management system using PHP and MySQL (case study at Surya Shop). *Scientific Journal of Informatics Engineering (TEKINFO)*, 22(1), 100-116.
- [12] Lim, M., & Ridho, MR (2021). Design and Build a Point of Sale Information System Using the CodeIgniter Framework on CV Powershop. *Computer And Science Industrial Engineering (COMASIE)*, 4(2), 46-55.
- [13] Yanuarsyah, MR, Muhaqiqin, M., & Napianto, R. (2021). Information Architecture in Inventory Management Systems (Case Study: Upt Pardasuka Pringsewu Inpatient Health Center). *Journal of Information Technology and Systems*, 2(2), 61-68. <https://doi.org/10.33365/jtsi.v2i2.869>
- [14] Reza, F., & Putra, AD (2021). E-Smile Information System (Electronic Service Mobile)(Case Study: Population and Civil Registration Service of Tulang Bawang Regency). *Journal of Information Technology and Systems*, 2(3), 56-65. <https://doi.org/10.33365/jtsi.v2i3.909>
- [15] Rifqo, MH, Prabowo, DA, & Haura, M. (2019). Comparison of the Certainty Factor and Dempster-Shafer Methods in the Expert System for Diagnosing Dental and Oral Diseases. *Uppgris Journal of Informatics*, 5(2). <https://doi.org/10.26877/jiu.v5i2.4225>
- [16] Apyliyana, I., Munti, NYS, & Adeswastoto, H. (2021). Design of Information Database System for Mapping School Bus Routes and Bus Stops in the Bangkinang Central Business District (CBD) (Case Study at the Kampar Regency Transportation Service). *Journal of Information Engineering Innovation*, 5(2), 16-22.
- [17] Sidiq, RM, & Ramdhani, Y. (2021). DECISION SUPPORT SYSTEM FOR RECIPIENTS OF THE FAMILY HOPE PROGRAM FOR THE CIKADUT VILLAGE COMMUNITY USING THE SIMPLE ADDITIVE WEIGHTING METHOD. *eProceedings of Informatics Engineering (PROTECTIVE)*, 2(1), 354-365.