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Analysis and Application of the Certainty Factor Method in the Broiler Chicken Disease Diagnosis Expert System

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Abstract

An expert system is a system that uses human knowledge recorded in a computer to solve problems that usually require human expertise. Certainty Factor is a clinical parameter value provided by MYCIN to indicate the amount of confidence. The certainty factor is also a way of combining trust and disbelief in a single number. Certainty factor introduces the concepts of belief and disbelief. In the system analysis stage, the author analyzes to find weaknesses in the system currently running in an organization or company with the aim that improvements to the system can be proposed. To implement the program that has been designed, you need a tool in the form of a computer or laptop, which to operate the computer or laptop itself requires three supporting components such as hardware, software and brainware. The expert system application has been running using the Certainty Factor method and to carry out diagnoses on chickens the user can choose a value according to the Certainty Factor Interpretation that has been given and processed with the expert CF. Based on the tests carried out, the system accuracy values and those of experts are almost the same . And the Inference engine works well, according to the rules that have been programmed previously. After a chicken disease has died, the system will display how to care for and handle sick broiler chickens

Keywords: Expert System, Certainty Factor, Interpretation, Inference, Broiler Chickens.

1. Introduction

Technology has now experienced rapid development to help human activities in everyday life. As technology develops, humans with the knowledge and abilities they possess develop knowledge called artificial intelligence. One part of artificial intelligence is an expert system or expert system. An expert system is a computer-based application that is used to solve problems as thought by experts. .Even though the Expert System was created by storing the expertise of an expert into a computer system, this does not mean replacing the role of experts but rather popularizing expert knowledge and helping the general public in finding solutions to the problems they face [1].

An expert system is a computer application that simulates the way humans think and use knowledge to solve specific problems. One example of its application is in the medical world. [2]. Expert systems are used to diagnose diseases by providing symptoms and test results to the system. The system then uses its knowledge base to match conditions to specific diseases. In addition, expert systems are able to provide descriptions, explanations, reasons and diagnoses, similar to the way an expert does reasoning [3].

So far, diagnosing diseases in broiler chickens in particular is still done by checking symptoms and carrying out tests directly, so that determining and analyzing what types and diseases exist in broiler chickens requires quite a long time and process.

This problem requires a solution by creating an expert system for diagnosing diseases in broiler chickens. The aim of this system is to increase knowledge for broiler chicken business owners to determine the diseases suffered by chickens and their solutions so that they can be treated more quickly. Meanwhile, for the general public, it is used as a guide to take actions or precautions that must be taken with chickens and to know the possibility of diseases that chickens are suffering from.

This expert system for diagnosing diseases in broiler chickens uses the Certainty Factor method with the concept of identifying broiler chicken diseases based on the possibility and symptoms experienced by the chicken. This expert system tries to help overcome the problems that occur above and this system is to provide support and help broiler chicken business owners in analyzing chicken diseases so that it can make it easier for employees who take care of chickens to carry out appropriate treatment for chicken diseases.

The Certainty Factor (CF) method is an approach used in Expert Systems to assess the level of certainty or uncertainty related to a fact. This method is usually used for situations where information or circumstances cannot be ascertained with certainty. In expressing the

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level of confidence, the Certainty Factor (CF) value is used to indicate the level of confidence an expert has in a data [4]. In the Certainty Factor method, the calculation is carried out by multiplying the Certainty Factor (CF) value given by the user with the CF value given by the expert, producing a combined CF value. The final result of the Certainty Factor method calculation is the highest combined CF value [5].

CF is one of many methods that can be used to help the process of solving a problem by working in the form of measuring certainty in facts and rules [6]. CF can prove whether a fact is certain or not certain in metric form. This method is very easy to use because it relies on determining the weight given and calculated based on the facts that appear as symptoms [7]. CF has been used in the process of early diagnosis of the corona virus which helps medical personnel in the first stage of administrative action properly before the examination process is carried out thoroughly and in detail by ensuring whether the patient is positive or negative [8]. Other research is a combination of CF to diagnose Rubella disease . The results are in the form of information about the symptoms of rubella disease based on what they feel [9]. Certainty Factor is also used to identify students' personalities and is able to identify students' personality types according to their level of confidence [10].

The use of this expert system is expected to reduce the costs that must be incurred by users and with this expert system users can obtain information about diseases and how to treat diseases suffered by broiler chickens. The process used by this expert system to diagnose broiler chicken diseases is by looking at the symptoms in the chicken and the data produced is in the form of a report about the name and type of chicken disease and how to treat the chicken disease.

Based on this explanation, this research will focus on the identification process by adopting the Certainty Factor (CF) method in creating an expert system. It is hoped that this research will make a significant contribution in helping related parties in dealing with disease diagnostic problems in broiler chickens. By using the CF method, this expert system can provide more accurate recommendations based on the level of confidence given by the expert, thereby increasing efficiency in the decision-making process related to the health of broiler chickens.

2. Research methodology

The research framework is the concept or stages that will be carried out in the 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 a clear and easy guide for solving existing problems. The research framework that the author carried out in the research can be depicted in Figure 1.

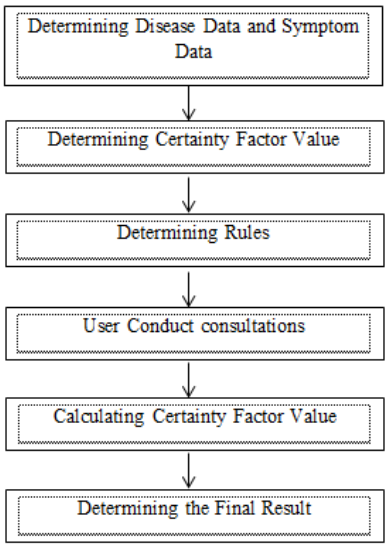

Figure 1. Research Framework

Identifying relevant diseases and symptoms in the Certainty Factor method and using this data to build expert systems or applications that can assist in diagnosis or decision making. Determining the Certainty Factor value is a stage in applying methods in expert systems or knowledge-based decision making. Next, determining the Certainty Factor value reflects the level of confidence or lack of confidence in a hypothesis or event based on existing evidence or information. In a medical or diagnostic context, the Certainty Factor value is used to measure the level of confidence in the possibility of a disease diagnosis based on the symptoms observed. After determining the data that will be used , determining the rules is an important step in developing an expert system or knowledge-based application. These rules help the system to connect existing symptoms, facts, or information with the decisions or recommendations it wants to produce.

The process of calculating the percentage of belief begins with breaking down a rule that has multiple symptoms into rules that have a single symptom. Then each new rule calculates its CF using the equation:

$$CF(H,E) = CF_{(user)} * CF_{(rule)}$$

Among the conditions that occur is that there are several antecendents (in different rules) with the same consequence . In this case, we must aggregate the overall CF value of each existing condition. The following formula is used:

If both CF > 0 , then the formula is:

$$\boldsymbol{CF[H,E] = CF_{[lama]} + CF_{[baru]}\,(1 - CF_{[lama]})}$$

If both CF < 0 , then the formula is:

$$CF[H,E] = CF_{[lama]} + CF_{[baru]}\ (1 + CF_{[lama]})$$

If both CF < 0 , then the formula is:

$$CF[H,E] = CF_{[lama]} + CF_{[baru]} / (1 - min\ CF_{[lama]} | CF_{[lama]})$$

The results of the Pakr system diagnosis are in the form of disease percentages. The percentage of diseases used for diagnosis results is the largest percentage. The percentage of disease is obtained from the results of calculating the *Certainty Factor value* based on the symptoms selected by *the user* .

3. Results and Discussion

3.1 *Certainty Factor* (CF) Method

The success of an expert system lies in knowledge and how to process that knowledge so that conclusions can be drawn. Knowledge obtained from interviews and analysis through books is converted into a table of diseases and symptoms to simplify the process of finding solutions. This table of disease types and symptoms is used as a pattern for matching information entered by the user and the knowledge base .

Table 1. Types of Disease

No.	Code	Disease Name
1.	P01	Lime Defecation
2.	P02	Chicken Cholera
3.	P03	Bird flu
4.	P04	Tetelo
5.	P05	Chicken Typhus
6.	P06	Dysentery
7.	P07	Gumboro
8.	P08	Chicken Salesma
9.	P09	Cough Chronic Chicken
10.	P10	Chicken Breasts
11.	P11	Coughing up Blood
12.	P12	Mareks
13.	P13	Egg Production

In Table 1 there are 13 diseases that are given codes P01 to P13. Next, data on symptoms of broiler chicken disease will be described in Table 2 below:

Table 2. Types of Symptoms

No	Code	Symptom Name
1	G01	Decreased appetite
2	G02	Shortness of breath/gasping
3	G03	Snoring's breath is wet
4	G04	Sneezing
5	G05	Cough
6	G06	Feathers are dull and wrinkled
7	G07	Diarrhea
8	G08	Egg production decreases
9	G09	Freezing
10	G10	Looks lethargic
11	G11	Greenish diarrhea
12	G12	Whitish diarrhea
13	G13	Pale face
14	G14	Looks blue
15	G15	Wattle swelling
16	G16	Pale cockscomb
17	G17	Legs and wings paralyzed
18	G18	Discharge from the eyes and nose
19	G19	Swollen head
20	G20	Head turns
21	G21	Swelling of the sinuses and eyes
22	G22	Enlarged stomach
23	G23	Hanging wings
24	G24	There is white dirt attached around the anus
25	G25	Sudden death
26	G26	The egg shell broke
27	G27	Runny egg white
28	G28	Greenish yellow feces
29	G29	Swelling of the facial area and around the eyes
30	G30	Bloody stools or feces
31	G31	Gathered in the corner of the drum
32	G32	Pecking the cloaca area
33	G33	Pale eggshell
34	G34	Eggs are smaller
35	G35	Paralysis of the cache
36	G36	Breathe through your mouth while extending your neck
37	G37	Bleeding cough
38	G38	The beak is placed on the floor
39	G39	Sit in a bent posture
40	G40	He looks sleepy with his hair standing up
41	G41	Thin body
42	G42	There is mucus mixed with blood in the oral cavity
43	G43	Lame leg

In the table above, you can see that there are 43 symptoms of disease in broiler chickens, where each symptom is coded G01 to G43.

The knowledge gained will be presented in the form of rules that are useful for finding conclusions about types of broiler chicken diseases. The way to get the confidence level (CF) of a rule that researchers use is by interviewing an expert. The CF (Rule) value is obtained from the interpretation of the "term" from the expert, which is converted into a certain CF value according to Table 3 below:

Table 3 . *Certainty Factor* Weight Value

No	Information	User Value
1	No	0
2	Don't know	0.2
3	A little sure	0.4
4	Sure enough	0.6
5	Certain	0.8
6	Very confident	1

Based on the results of processing symptom data and disease type data, 13 rules were obtained for diagnosing diseases in broiler chickens which can be seen in Table 4

Table 4 . List of Diagnostic Rules

No.	Rule
1.	**IF** Decreased appetite **AND** Whitish diarrhea **AND** Hanging wings **AND** There is white dirt stuck around the anus **THEN** Chalk stool
2.	**IF** Decreased appetite **AND** Wet snoring breath **AND** Swollen wattles **AND** Swelling of the sinuses and eyes **THEN** Chicken Cholera
3.	**IF** Face Pale **AND** Looks blue **AND** Head is swollen **AND** Death suddenly **THEN** Bird Flu
4.	**IF** Decreased appetite **AND** Sneezing **AND** Greenish diarrhea **AND** Head turning **AND** Shortness of breath / gasping **AND** Looks lethargic **THEN** Tetelo
5.	**IF** Reduced appetite **AND** Pale comb **AND** Hanging wings **AND** Greenish yellow droppings **THEN** Chicken Typhoid
6.	**IF** Feathers are dull and wrinkled **AND** Looks lethargic **AND** Bloody droppings or feces **AND** Clusters in the corner of the cage **THEN** Bloody stools
7.	**IF** Sit in a hunched posture **AND** Peck the area cloaca **AND** Appetite reduced **AND** Sleeping beak placed on the floor **THEN** Gumboro
8.	**IF** Shortness of breath / gasping **AND** Fluid discharge from the eyes and nose **AND** Swelling of the facial area and around the eyes **THEN** Salesma Ayam
9.	**IF** Decreased appetite **AND** Coughing **AND** Chills **AND** Looks sleepy with hair standing **THEN** Chronic Chicken Cough
10.	**IF** Shortness of breath/gasping **AND** Decreased appetite **AND** Stomach enlarges **AND** Body thin **THEN** Chicken breasts
11.	**IF** Shortness of breath / gasping for air **AND** Breathing through the mouth while stretching the neck **AND** Coughing up blood **AND** There is mucus mixed with blood in the oral cavity **THEN** Coughing up blood
12.	**IF** Decreased appetite **AND** Paralyzed legs and wings **AND** Lame legs **AND** Paralysis of the crop **THEN** Mareks
13.	**IF** Diarrhea **AND** Decreased egg production **AND** Pale egg shells **AND** Rough egg shells **AND** Watery egg whites **AND** More eggs small **THEN** Egg Production (*Egg Drop Syndrome* 76)

Table 5 . *Certainty Factor* Calculation Process

No.	Selected Symptoms	User Value	Rule Value
1.	Decreased appetite	0.8	0.2
2.	Whitish diarrhea	0.6	0.8
3.	Hanging wings	0.8	0.4
4.	There is white dirt stuck around the anus	0.2	1.0

The table above is a symptom of lime defecation (*Pullorum Disease*), which will be completed manually.

CF(H,E) = CF(user)1*CF(rule)1
= 0 .8*0.2
= 0.16

CF(H,E) = CF(user)2*CF(rule)2
= 0.6*0.8
= 0.48

CF(H,E) = CF(user)3*CF(rule)3
= 0.8*0.4
= 0.32

CF(H,E) = CF(user)4*CF(rule)4
= 0.2*0.1
= 0.02

The final step combines all CFs using the first formula as follows:

CFcombine CF[H,E]1,2
CF[H,E] = CF[old]1 + CF[new]2(1 - CF[old]1)
= 0.16 + 0.48 (1-0.16)
= 0.16 + 0.48 (0.84)
= 0.16 + 0.40
= 0.56 (1)

CFcombine CF[H,E](1),3
CF[H,E] = CF[old](1) + CF[new]3(1 - CF[old](1))
= 0.56 + 0.32 (1-0.56)
= 0.56 + 0.32 (0.44)
= 0.56 + 0.14
= 0.70 (2)

CFcombine CF[H,E](2),4
CF[H,E] = CF[old](2) + CF[new]4(1 - CF[old](2))
= 0.70 + 0.02 (1-0.70)
= 0.70 + 0.02 (0.30)
= 0.70 + 0.006
= 0.706

CF[H,E]old4 * 100 = 0.706 * 100 = 70.6%

Certainty Factor calculation for chalky diarrhea have a confidence level of 70.6%.

3.2 System Testing

In the testing section of this program, the use of the application created will be explained. An explanation of the application created includes the appearance of the application, control functions in the application, and how to use it. In the sub- chapter, we will explain how to use the application per menu system, starting from the main menu display, functions and how to use it until completion.

1. User Home Page

The user's home page is the page that appears when the Chicken Disease Diagnosis Expert System *website is activated by typing localhost/spkayam, so it appears as* Figure 2.

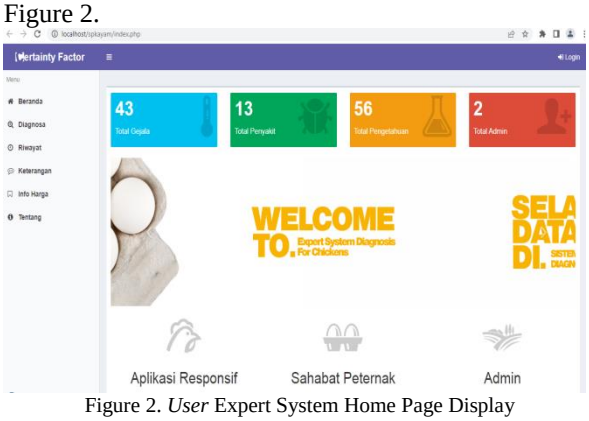

Figure 2. *User* Expert System Home Page Display

2. Admin Home Page

This admin home page is the admin's home page when *logging in* , different from the previous home menu display on the admin home page with a different *user* , so it appears as Figure 3.

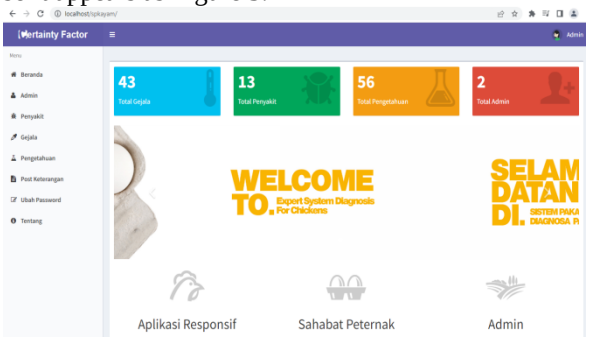

Figure 3. Appearance Admin Expert System Home Page

3. Display Diagnostics Page

The diagnosis page is a diagnosis selection, there is a choice of symptoms and the user must choose the symptoms found in the field, the condition has 6 (six) choices, namely: very sure, sure, quite sure, a little sure, don't know and not, so it appears as Figure 4 .

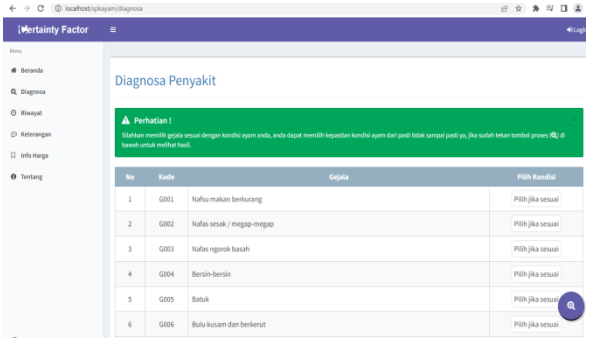

Figure 4. Appearance Expert System Diagnostics Page

4. Diagnostic Results Page Display

The diagnosis results page is a continuation of the diagnosis page where the results of the selected symptoms will display the disease that attacks the chicken in the form of CF values and % (percent), then the user presses the process button so that it appears as in Figure 5.

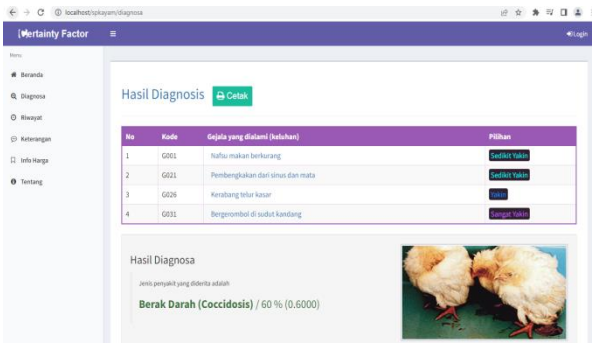

Figure 5. Appearance Diagnostic Results Page

5. Diagnostic Results Print Page Display

This diagnostic results print page is useful for printing the results of the diagnosis carried out by the visitor, then *the user* wants to display the diagnosis results then click the print action *button and the results* will automatically be displayed, so they appear as Figure 6.

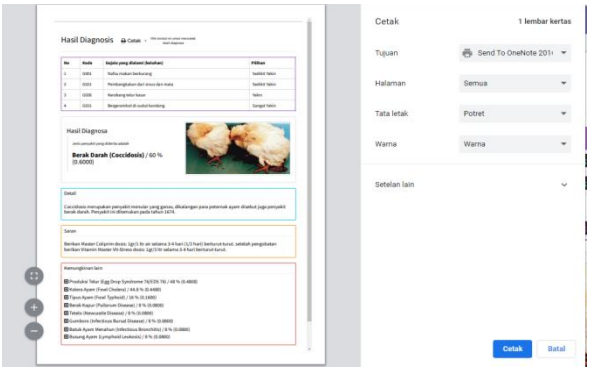

Figure 6. Diagnostic Print Page Display

4. Conclusion

Based on the results of the discussion on designing a chicken expert system application using the Certainty Factor method, it has been running by analyzing the symptoms and being able to determine what types and diseases exist in broiler chickens. And being able to provide disease information and solutions doesn't take a long time.

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