Expert System For Identifying Diseases In Native Chickens Using The Certainty Factor Method

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Abstract— Farming is the business of breeding and raising animals, divided into two groups: large animals (cows, buffaloes, horses) and small animals (chickens, ducks, birds). The demand for livestock, especially poultry like free-range chickens, is on the rise. However, many small to medium-sized free-range chicken farms still rely on conventional methods for disease treatment, which depend on the experience of the farmers. An expert system is a piece of computer software that mimics the choices and behaviors of a person or group with in-depth knowledge and expertise in a certain field. The objective of this study is to enhance the effectiveness of disease treatment for free-range chickens and streamline the diagnosis procedure. Farmers can determine which diseases are harming their free-range hens by using the Certainty Factor approach. Experts were surveyed to provide the data used in this study. Accurate diagnosis of diseases in free-range chickens and suitable treatment recommendations are provided by the system's diagnostic results.

Keywords— System Expert, Certainty Factor, Chicken Disease Village, Disease Diagnosis, Cattle Farm

I. Introduction

Animal husbandry is the activity of raising animals for profit, which includes two groups. The first group is large-scale farming such as cattle, buffalo, horses, and the second group is small-scale farming such as chickens, ducks, birds, etc [1]. Farming is a growing business and its demand is quite high, especially in poultry farming such as village chickens. Especially in poultry farming such as village chickens. Village chickens have advantages in meat flavor, nutritional content, and resistance to certain diseases compared to broiler chickens. However, despite the high demand for village chickens, the main challenge faced by farmers is managing poultry health, which is often influenced by environmental and weather factors.

Currently, most small and medium-scale village chicken farms still apply traditional methods in disease management, such as relying on the farmers' experience for disease management [2]. This traditional method has weaknesses, especially in terms of accurate disease diagnosis, because the symptoms that appear are often similar between diseases. For example, diseases such as colds, snoring, and respiratory disorders often cause similar symptoms, making it difficult for farmers to distinguish and take appropriate preventive or treatment measures. In addition, under certain conditions such as transitional seasons or the rainy season, the risk of chicken mortality due to extreme climate changes increases, leading to a decline in the production and quality of village chickens.

The village chicken farm, which has 18 pens with various functions such as breeding pens, growing pens, and brooding pens, must be well-managed to maintain the health of the chickens. However, the challenge of quickly and accurately identifying diseases causes farmers to incur losses in terms of time and cost, especially if they frequently need to call a veterinarian. In the past year, there have been cases of 6 breeding hens and 10 broiler chickens dying due to a disease suspected to be influenced by weather factors and environmental conditions.

A computer program that possesses knowledge and experience in a specific field and has the ability to simulate the judgment and behavior of individuals or groups is known as an expert system. Several methods used in expert systems include forward chaining, Bayes, Naïve Bayes Classifier, Fuzzy Logic, Backward Chaining, Best First Search, Depth First Search, and Certainty Factor. Other expert systems may use these methods, but this research focuses on the use of the Certainty Factor method to identify diseases in village chickens. The Certainty Factor was chosen because of its ability to describe the level of confidence experts have regarding the problems faced, making it very suitable for expert systems that diagnose uncertain matters [4][5][6][7][8].

The Certainty Factor method is used so that farmers can determine what disease the village chickens are suffering from. The data used for this research is based on surveys of interviewed experts. The Certainty Factor method is used to obtain certainty from the data [9]. For example, doctors often use terms like "maybe," "probably," and "almost certainly" when they analyze current data. This method is very suitable for expert systems that diagnose something uncertain because it reflects the expert's level of confidence in the faced problem [10].

It is expected that the implementation of an expert system using the Certainty Factor method will reduce farmers' dependence on their own experience or feelings when identifying village chicken diseases. In addition, this system is expected to save costs and time because farmers do not need to frequently bring in veterinarians to diagnose diseases. In previous studies, the belief factor has been proven successful in diagnosing diseases in kedu chickens with a fairly high level of user trust [11]. So, this research develops an "Expert System for Identifying Village Chicken Diseases Using the Certainty Factor Method" to assist farmers in diagnosing diseases and improving the efficiency of handling village chicken diseases. Based on the explanation above, it can be concluded that this research uses an expert system to detect village chicken diseases with the title "Expert System for Identifying Village Chicken Diseases Using the Certainty Factor Method."

II. THEORETICAL FRAMEWORK

A. Expert System

A computer program that uses the knowledge and experience of experts in a specific field is known as an expert system [12]. An expert system can also solve problems in the same way as experts [3]. Expert systems allow people to share and exchange knowledge [13], and due to various socio-economic factors, including: difficulty in accessing experts in certain areas; the availability for storing and formalizing knowledge from several experts; the possibility of using tools to support experts in decision-making or for professional training; and the high costs and long time required for professional specialization [14].

B. Inference Engine

The inference engine serves as the expert system's brains [15]. To direct the reasoning process toward a condition the inference engine makes use of the body of current information. They alter and guide the facts, models, and rules found in the knowledge base to arrive at answers or conclusions. The inference engine uses control strategies, which serve as guidelines for the reasoning process [16]. Forward chaining, the strategy used in this system, starts from the data of symptoms provided by the user and then matches them with the rule base to determine the disease.

C. Chicken Diseases

Chickens are one of the most commonly kept poultry in society, whether raised traditionally, commonly referred to as village chickens, or raised on a large scale, consisting of broilers or layers [17]. Chickens are one type of poultry that are susceptible to diseases. Diseases can be caused by various types of infections, such as viruses, bacteria, microbes, and parasites. The following are diseases experienced by village chickens.

Tabel 1. Expert Weighting Village Chicken Diseases

No	Code	Disease	Explanation
1	P1	Bird Flu	This disease is caused by a virus and is very dangerous for chickens.
2	P2	Pullorum	The disease known as "white diarrhea" is caused by the bacterium Salmonella Pullorum and affects the digestive system of chickens.
3	P3	Newcastle Disease	It is a quite dangerous disease due to its high mortality rate.
4	P4	Infectious Bursal Disease	Infectious Bursal Disease is caused by the Avibirnavirus type of virus. This disease attacks the bursa and thymus of chickens, reducing the chicken's antibody response to vaccination. As a result, chickens become more susceptible to diseases.
5	P5	Fowl Pox	The fowl pox virus causes chickenpox in poultry, consisting of two types of diseases, namely wet pox and dry pox. Both types of diseases result in lumps on the chicken's comb and face.

D. Chicken Diseases

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Tabel 2. Symptoms of Village Chicken Diseases

No	Symptom Code	Symptoms of Chicken Diseases
1	G1	Breathing difficulty
2	G2	Gasping
3	G3	Watery eyes and nose
4	G4	Sudden death
5	G5	Foaming at the mouth
6	G6	Convulsions
7	G7	Paralysis
8	G8	Nasal discharge
9	G9	Dull feathers
10	G10	White-colored chicken droppings
11	G11	Red lumps on mucous membranes
12	G12	Lethargy and weight loss
13	G13	Head held up
14	G14	Green-colored droppings
15	G15	Formation of skin warts
16	G16	Sores in the mouth and throat
17	G17	Disturbances in the trachea
18	G18	Loss of appetite
19	G19	Stiff legs and wings
20	G20	Decreased body weight

21	G21	Unsteady head position
22	G22	Listlessness
23	G23	Red lumps on the skin
24	G24	Decreased egg production
25	G25	Drowsy appearance
26	G26	Vomiting
27	G28	Skin wounds
28	G29	Diarrhea
29	G30	Decreased appetite

E. Certainty Factor

Expert systems [18] that are based on rules with certainty factors require experts to generate only a small number of numbers (one for each rule). The Certainty Factor allows for quick answer calculations [19] so that it can accommodate expert analysis to obtain the expert's level of confidence on the problem being solved [20]. Here is the general calculation formula for the certainty factor method [21].

$$CF(H.E) = MD(H,E) - MB(H,E) \quad (1)$$

- *CF(H.E)* : Certainty Factor in hypothesis H influenced by fact *E*.
- *MD(H,E)* : Measure of Disbelief, the level of disbelief in hypothesis *H* based on fact *E*.
- *MB(H,E)* : Measure of Believe, the level of belief in hypothesis *H* based on fact *E*.
- E : Fact or evidence.
- H : Assumption or hypothesis.

Here are some calculation formulas for the certainty factor method as follows:

For the rule of single symptoms

$$CF[H,E] = CF[user] * CF[expert] \quad (2)$$

- *CF(H.E)* : Certainty Factor in hypothesis *H* influenced by fact *E*.
- *CF[user]* : Certainty Factor obtained from the user's assessment
- *CF[expert]*: Certainty Factor obtained from the expert's assessment.

For calculations based on more than one symptom and the same conclusion.

$$CF_{combine} = CF_{old} + \left(CF_{new} * (1 - CF_{old})\right) \quad (3)$$

- $CF_{combine}$: Certainty Factor in hypothesis *H* influenced by fact *E*.
- CF_{old} : Certainty Factor that already exists, reflecting confidence before the emergence of new symptoms.
- CF_{new} : Certainty Factor that already exists, reflecting confidence before the emergence of new symptoms.

To calculate the percentage of the disease

$$CF_{combine} * 100\% = percentage\ result \quad (4)$$

- $CF_{combine}$: Combined Certainty Factor that has been calculated previously.
- Percentage Result : The level of confidence expressed as a percentage, indicating the likelihood that the hypothesis *(H)* is true based on the evidence *(E)*.

III. METHODOLODY

This research aims to address the lack of knowledge among farmers in diagnosing chicken diseases by developing a diagnostic aid system. The process begins with the identification and formulation of the problem, followed by needs analysis, knowledge base, and process. Data was collected through interviews with experts and literature studies. The system was designed and implemented through database design, UML diagrams, and interfaces, ending with system coding. Conclusions and recommendations are provided for further development.

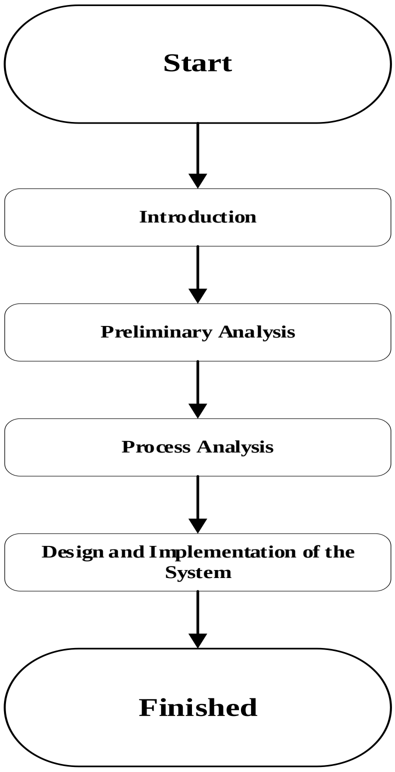

Figure 1. Methodology

IV. ANALYSIS AND RESULT

This section discusses the research findings. The results are evaluated and compared with similar research in previous journals or conferences.

A. Preliminary Analysis

The certainty factor method allows expert systems to solve problems in the same way as experts, and the certainty factor addresses uncertainty issues. As a result, the expert system will find conclusions and solutions to the problem. To start the system, some input data such as disease symptom data. The inference process uses this data stored in the knowledge base. To determine the initial diagnosis of disease in village chickens, user responses are used and the certainty factor is used to determine the likelihood of the diagnosis. The results will determine the type of disease suffered by the village chickens.

B. Data Collection

The knowledge sources used in the system development come from experts through interviews as the primary source. In addition, knowledge is also derived from books, scientific articles, and scientific journals. This system requires knowledge such as disease data and recommendations, disease symptom data, and certainty factor weight values.

C. Determining the Certainty Factor Value

After collecting data on disease symptoms, the certainty factor weight data is obtained from expert analysis based on the confidence value of a symptom towards a disease. The weight data used is sourced from experts. This weight data serves as a reference for calculating the certainty factor in the system to be developed. The determination of certainty values for each symptom of the disease in village chickens was conducted by the animal expert Drh. Fuadatussa'adah. The weighting results by the expert are shown in the table below.

Tabel 3. Expert Weighting

Disease Code	Disease Name	Symptom Code	Symptom Name	Expert
P1	Bird Flu	G3	Watery eyes and nose	0.8
		G1	Breathing difficulty	1
		G4	Sudden death	1
		G2	Gasping	0.8
		G6	Convulsions	0.2
		G7	Paralysis	0.6
		G5	Foaming at the mouth	0.6
		G9	Dull feathers	0.4
		G20	Decreased body weight	0.6
		G17	Tracheal disturbances	0.8
		G29	Diarrhea	1
		G26	Vomiting	0.4
		G19	Stiff legs and wings	0.2
		G25	Drowsy appearance	0.2
		G8	Nasal discharge	0.4
		G21	Unsteady head position	0.2
		G14	Green-colored droppings	0.8

After obtaining the certainty of symptoms from the expert, the certainty value from the user is also needed. In this case, the person referred to is the one who manages the village chicken coop. The results of the certainty value weighting by the user for each disease symptom are shown in the table below.

Tabel 4. User Weighting

Disease Code	Disease Name	Symptom Code	Symptom Name	Expert
P1	Bird Flu	G3	Watery eyes and nose	0.2
		G1	Breathing difficulty	0.6
		G4	Sudden death	1
		G2	Gasping	0.2
		G6	Convulsions	1
		G7	Paralysis	0.2
		G5	Foaming at the mouth	02
		G9	Dull feathers	0.2
		G20	Decreased body weight	0.2
		G17	Tracheal disturbances	0.2
		G29	Diarrhea	0.2
		G26	Vomiting	0.2
		G19	Stiff legs and wings	0.2
		G25	Drowsy appearance	0.2
		G8	Nasal discharge	0.2
		G21	Unsteady head position	0.2
		G14	Green-colored droppings	0.2

D. Certainty Factor Calculation

Below are the results of the certainty factor value calculations by experts for each symptom.

Tabel 5. Determining the Certainty Factor value from experts and users

Symptoms	CF Expert (CF[H])	CF User (CF[E])	CF[H.E] (CF[H] x CF[E])
G3	0.8	0.2	0.16
G1	1	0.6	0.6
G4	1	1	1
G2	0.8	0.2	0.16
G6	0.2	1	0.2
G7	0.6	0.2	0.12
G5	0.6	0.2	0.12
G9	0.4	0.2	0.08
G20	0.6	0.2	0.12
G17	0.8	0.2	0.16
G29	1	0.2	0.2
G26	0.4	0.2	0.08
G19	0.2	0.2	0.04
G25	0.2	0.2	0.04
G8	0.4	0.2	0.08
G21	0.2	0.2	0.04
G14	0.8	0.2	0.16

Table 6. Determining the combination of symptoms

Combination Step	Formula	Result
CF[H.E]G3.G1	0.16 + 0.6 x (1 – 0.16)	0.664
$CF[H.E]_{old1}$.G4	0.664 + 1 x (1 – 0.664)	1
$CF[H.E]_{old2}$.G2	1 + 0.16 x (1 – 1)	1
$CF[H.E]_{old3}$.G6	1 + 0.2 x (1 – 1)	1
$CF[H.E]_{old4}$.G7	1 + 0.12 x (1 – 1)	1
$CF[H.E]_{old5}$.G5	1 + 0.12 x (1 – 1)	1
$CF[H.E]_{old6}$.G9	1 + 0.08 x (1 – 1)	1
$CF[H.E]_{old7}$.G20	1 + 0.12 x (1 – 1)	1
$CF[H.E]_{old8}$.G17	1 + 0.16 x (1 – 1)	1
$CF[H.E]_{old9}$.G29	1 + 0.2 x (1 – 1)	1
$CF[H.E]_{old10}$.G26	1 + 0.08 x (1 – 1)	1
$CF[H.E]_{old11}$.G19	1 + 0.04 x (1 – 1)	1
$CF[H.E]_{old12}$.G25	1 + 0.04 x (1 – 1)	1
$CF[H.E]_{old13}$.G8	1 + 0.08 x (1 – 1)	1
$CF[H.E]_{old14}$.G21	1 + 0.04 x (1 – 1)	1

Table 7. Percentage of certainty

Percentage of Certainty	Formula	Result
$CF_{combined}$ x 100%	1 x 100%	100%

E. Implementation

The interface shown in Figure 2 is a tool designed to facilitate users in the diagnostic process. At this stage, users are given the opportunity to describe the symptoms they are experiencing. After describing their symptoms, the application will ask them to select the most appropriate symptom condition from the various options provided.

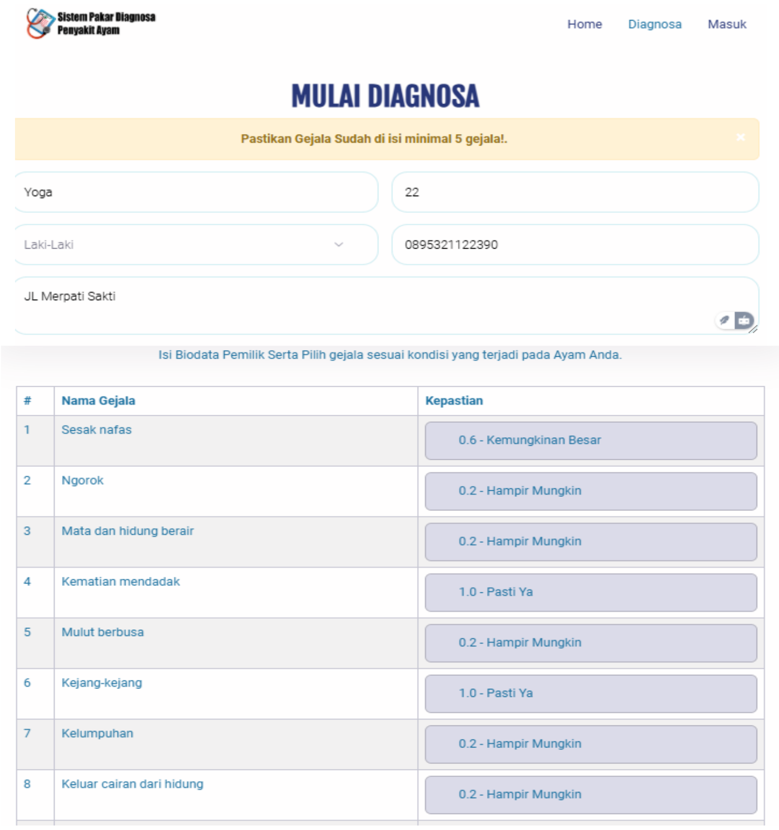

Figure 2. Symptom Input Display

This interface plays a crucial role in ensuring that the information collected is relevant and accurate, so that the resulting diagnosis is more precise. Users can select symptoms based on severity, duration, or other details that support the diagnostic process. The interface displaying the diagnosis results can be seen in Figure 3, which shows the diseases identified based on the symptoms previously entered.

V. Conclusion And Suggestions

This section discusses the research findings, evaluating the results and comparing them with similar studies from previous journals or conferences. The research successfully implemented and tested an expert system using the Certainty Factor method to diagnose diseases in village chickens. The system provides accurate diagnoses, with knowledge derived from expert interviews, scientific articles, and journals, ensuring reliable and useful information. This expert system offers significant benefits by helping farmers diagnose chicken diseases efficiently, saving time and costs without requiring a veterinarian. The findings highlight the system's potential in improving disease management in poultry farming.To build on this research, several recommendations can be considered. Future development could include expanding the system to diagnose more types of diseases and symptoms, enhancing its versatility. Incorporating advanced technologies like machine learning could further improve diagnostic accuracy and broaden the system's capabilities. Additionally, conducting extensive field testing at various farm locations is recommended to ensure the system’s reliability and effectiveness in real-world conditions. These enhancements would strengthen the system's impact and utility for farmers, supporting more sustainable and efficient poultry farming practices.

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