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Design of an Expert System for Disease Diagnosis in Chickens using the Certainty Factor Method

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ABSTRACT

Chicken health is very important for the sustainability of the livestock business, considering that chicken meat is a popular and affordable commodity in Indonesia. However, many breeder still face difficulties in accurately diagnosing chicken diseases, especially with limited time and the number of experts in the field. Therefore, a system is needed that can help breeder diagnose diseases more efficiently. To overcome this problem, a web-based expert system was developed that uses the Certainty Factor method to diagnose chicken diseases. This system can be accessed online, allowing breeder to get a diagnosis and treatment advice quickly and easily, without relying on the presence of experts. With this system, it is expected to improve the accuracy of the diagnosis, reduce losses due to chicken diseases, and make it easier for breeder to maintain the health of their livestock. The results of this study indicate that the Certainty Factor method can be used well in detecting diseases in chickens. This is proven by the system's ability to predict chicken diseases according to the symptoms displayed, which have been structured based on predetermined rules.

I. Introduction

Technological developments have recently developed rapidly and human thinking patterns have evolved with the times. This phenomenon is also seen in the field of computer technology, which acts as a general instrument to improve work-related tasks. Computers can help humans solve problems in several ways, such as by using expert system applications. An expert system is a system that uses human knowledge which is entered into a computer and used to solve problems that usually require human expertise or expertise [1]. Diagnosis in the health sector is one of the problems faced by expert systems, including determining chicken diseases that are commonly suffered by livestock [2]. This encourages experts to continue developing computers so that they can help human work, or even surpass human work capabilities by using expert system-based computers.

Chicken commodities in Indonesia have very good market prospects because they are supported by product characteristics that are accepted by all levels of society. Chicken meat is considered to contain lower cholesterol, is relatively more affordable (compared to beef or goat), and is easily accessible because it is spread throughout Indonesia [3]. High accessibility for people in various parts of the country makes the chicken business an attractive and potentially profitable business opportunity. However, success in the chicken farming industry is highly dependent on the ability of breeder to maintain the health of their poultry. This is important because the prime condition of the chicken will directly affect productivity, which ultimately determines the continuity and success of the business. Proper nutrition is essential to maintain chicken production and health, because losses can occur if the quality of the chicken decreases due to disease [4].

Chickens are widely farmed by large entrepreneurs to individuals. Chicken farming is a difficult task because there are many things to consider, such as chicken diseases if not treated immediately, this disease can endanger the chickens and the farmer [5]. One of the causes of losses is the lack of knowledge of breeder about diseases that attack chickens and their treatment. In addition, the limited number and time of experts makes it difficult and expensive to get experts when needed [6].

The problem that was obtained from the previous system before this system was created was the limited ability of chicken breeder to analyze diseases experienced by chickens, where in that system the breeder still used manual analysis by only paying attention to the diseases or symptoms experienced by the chickens directly so that the level of accuracy obtained was very low, therefore we plan to design a system that is able to analyze and provide solutions to problems with diseases experienced by chickens. A web-based expert system has been developed to diagnose chicken diseases using the Certainty Factor method. This system is designed to be accessible online by chicken breeder, making it easier for them to diagnose diseases in their livestock. With this professional system, it is hoped that it can be an effective alternative in replacing the role of chicken disease treatment specialists, allowing breeder to get diagnoses and treatment advice faster and easier.

II. Method

2.1. Research Framework

In this section, the framework is described through the stages of research systematically. This framework serves as a guide for the problem-solving process in the context of research, describing the steps that need to be taken sequentially to achieve the research objectives and find solutions to the problems identified. The stages are as follows:

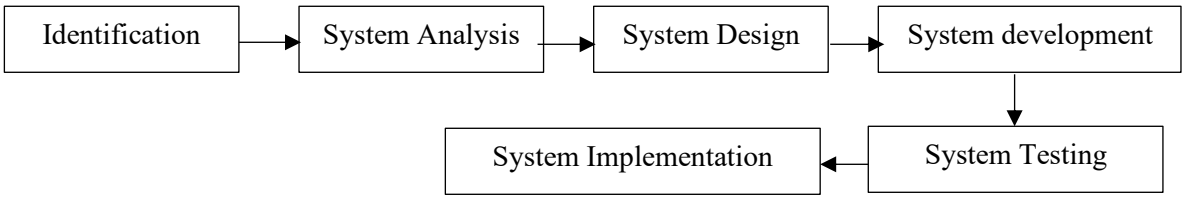


Figure 1. Expert System Stages

Based on Figure 1 above, this study identified challenges in the process of diagnosing disease symptoms that appear in chickens. These difficulties are the main focus of this study, considering the importance of early detection and accurate diagnosis for poultry health and productivity. This problem is of particular concern because it can have a significant impact on chicken farm management and disease control efforts in the poultry industry. In the system analysis stage, an evaluation of the current system is carried out to find existing problems. This makes the process of diagnosing chicken diseases easier with the data collected. System design involves the activity of designing or creating a system with the aim that the system can solve problems and meet user needs for processing, managing, and obtaining the desired information. Data analysis is carried out with a belief factor to produce accurate information. In the system development process, an application program to produce conclusions has been designed. This system is implemented by utilizing the PHP programming language and using it as its database, combining popular web programming technology with a reliable database management system to create an effective solution in processing and analyzing information. After the module creation is complete, the system is tested on the user interface computer to identify bugs and ensure that the system runs according to design and error handling functions properly. System implementation is the process of integrating new information systems into existing infrastructure. In this context, the study will focus on the implementation stages of an expert system designed to improve the effectiveness and accuracy of diagnosing chicken diseases.

The Certainty Factor method is an approach in expert systems that measures the level of confidence of an expert in a problem. This method evaluates the degree of certainty related to a particular fact or rule, allowing experts to express their confidence in the solution of a problem based on the available evidence [7]. The CF method is an approach used to measure the level of confidence of an expert in a problem or uncertain situation [8]. This method allows experts to express their level of confidence in

a conclusion or solution so that they can provide a more accurate picture of their thoughts and judgments in the face of uncertainty [9]. The Certainty Factor (CF) method or confidence factor is one approach to overcoming uncertainty in decision making, with results expressed as a percentage. This method is useful in research to measure the level of certainty of a conclusion based on existing evidence or rules, helping to produce more accurate decisions in uncertain situations. [10].

2.2. Certainty Factor(CF)

Certainty factor is a method that uses numerical values to represent the level of confidence of an expert in information or data in an expert system. The Certainty Factor (CF) formula is as follows [11], [12]:

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

Description:

CF(H,E) = A hypothesis can be determined with certainty when influenced by clear and concrete evidence.

MB(H,E) = Measure of belief in a hypothesis H, based on evidence E (between 0 and 1)

MD(H,E) = Measure of disbelief in a hypothesis H, when given evidence E (between 0 and 1)

Certainty Factor uses a value to combine the Certainty Factor (CF) values of several rules or evidence that support the same hypothesis. The Certainty Factor formula is as follows.

$$CFcombineCF[H,E]1,2 = CF[H,E]1 + CF[H,E]2 * [1-CF[H,E]1] \quad (2)$$

$$CFcombineCF[H,E]old,3 = CF[H,E]old + CF[H,E]\ 3 * (1-CF[H,E]old] \quad (3)$$

2.3. Design Model data

A very important stage is creating a data model. aims to use the belief factor method to determine diseases based on names, symptoms, rules and symptom values [13], [14].

1. Disease Data

The various diseases experienced by chickens can be seen in the table below.

Table 1. Disease Data

Id_Disease	Disease
P01	Gumboro
P02	Mareks
P03	Egg Production
P04	Chicken Typhus
P05	Bloody Feces
P06	Chicken Salesm

2. Symptoms of Chicken Disease

There are several symptoms that can be experienced by chickens which we can see in the table that we have included below.

Table 2. Chicken Disease Symptoms Data

ID_ Symptom	Symptom
G01	Decreased appetite
G02	Looks lethargic
G03	Whitish diarrhea
G04	Sleeping with beak on the floor

G05	Sits in a hunched position
G06	Rapid breathing
G07	Pale face
G08	Stumbling
G09	Limping legs
G10	Hanging wings
G11	Egg production decreases
G12	Poor egg quality
G13	Greenish diarrhea
G14	Dull and shriveled feathers
G15	Diarrhea
G16	Looks sleepy and feathers stand up
G17	Thin body
G18	Blood-tinged diarrhea
G19	Sneezing
G20	Red eyelids
G21	Pus discharge from the eyes
G22	Swelling of the sinuses and eyes

3. Disease rules

Based on the table showing the rules related to diseases in livestock chickens, we can compile six analysis rules, namely:

a. Rule 1 : IF G01 AND G02 AND G03AND G04 AND G05 THEN P01
b. Rule 2 : IF G06 AND G07 AND G08AND G09 AND G10 THEN P02
c. Rule 3 : IF G11 AND G12 AND G13 THEN P03
d. Rule 4 : IF G14 AND G15 AND G16 THEN P04
e. Rule 5 : IF G17 AND G18 THEN P05
f. Rule 6 : IF G19 AND G20 AND G21 AND G22 AND THEN P06

2.4. Software Design

1. Us*ecase* Diagram

In the chicken disease expert system, there are two actors, namely admin and user. Admin can enter the system to manage disease data, symptoms, and certainty factor method rules. The use case diagram can be seen in Figure 2 below.

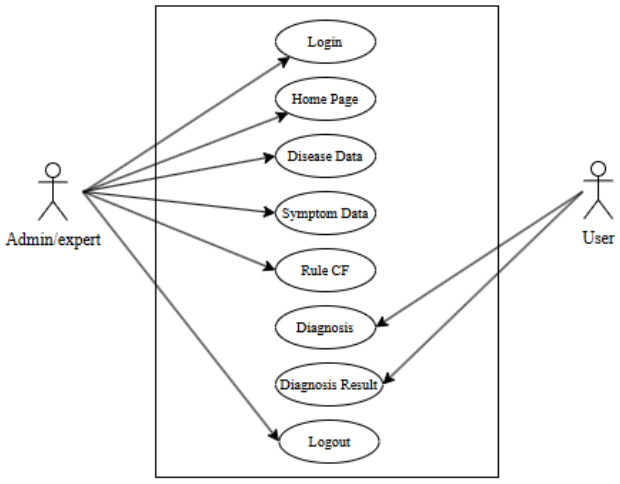


Figure 2. Use Case Diagram

2. Context Diagram

To show how data flows into input, process, and output, a context diagram is a common way to illustrate the system design process. In a chicken disease diagnosis application, there are three entities: breeder, administrators, and experts. Breeder can only make diagnoses, while the system answers all questions asked by breeder. Administrators are responsible for entering, changing, and deleting data such as chicken diseases, symptoms, and symptom values. Experts only check the data entered by administrators to ensure accuracy. The context diagram of an expert system for diagnosing chickens using the certainty factor method can be seen in Figure 3.

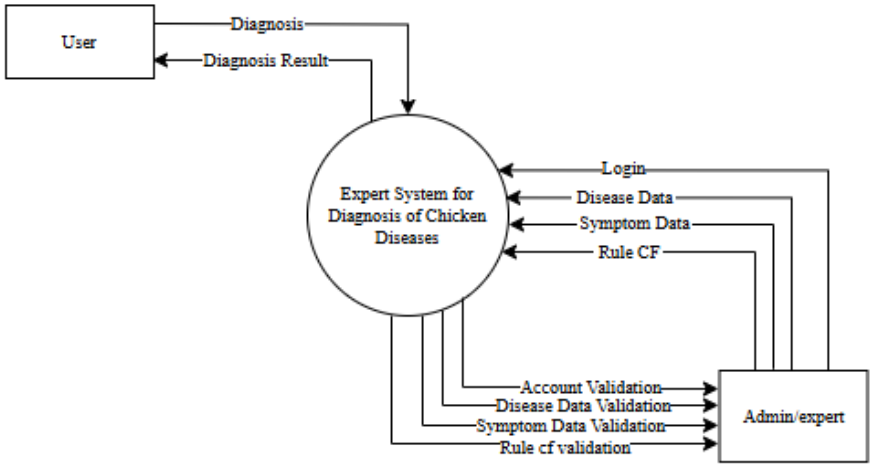
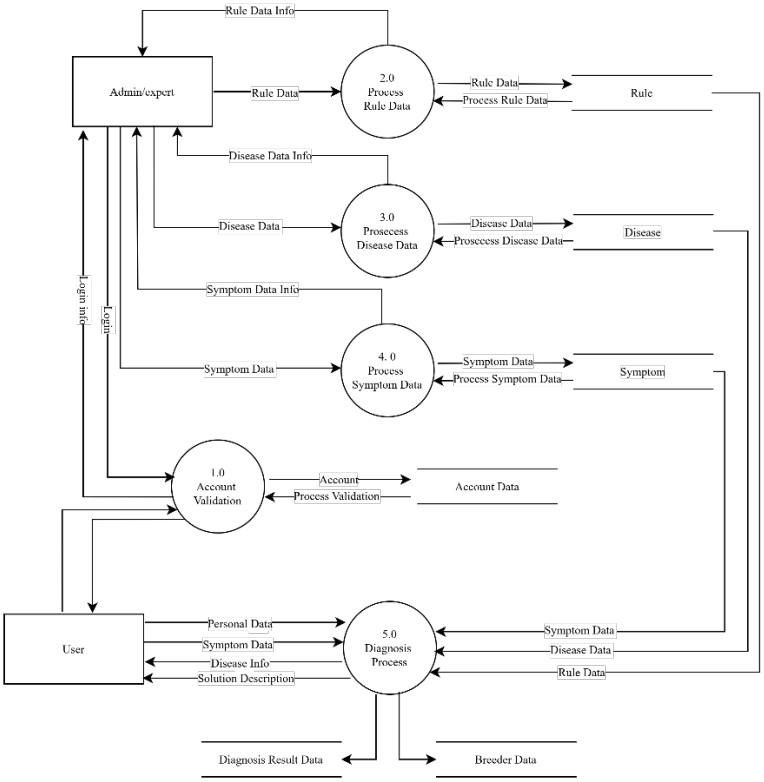


Figure 3. Context Diagram

3. Diagram level

Figure 4 shows the level data flow diagram (DFD) of the expert system for diagnosing chicken diseases that applies the belief factor method.



Gambar 4. DFD level

III. Results and Discussion

This chicken disease diagnosis expert system website is designed to help chicken breeder identify chicken diseases online quickly and accurately. Using the Certainty Factor (CF) method, this system measures the level of confidence in the diagnosis based on the symptoms that appear in chickens, which are then compared with the rules that have been structured. Each symptom entered will be calculated for its level of certainty, providing disease diagnosis results with different levels of confidence, which is useful in dealing with uncertainty in medical diagnosis. The results of the study showed that the CF method is effective in diagnosing chicken diseases, providing reliable results with high accuracy, and helping breeder reduce losses and take faster and more appropriate handling actions. The trial results that have been obtained are in line with the findings made by other researchers, namely the system can show the maximum prediction value [15], and and the certainty factor method so that it is easier for small-scale breeders and can save time and money [16]. With this system, breeder can obtain information related to the prevention and treatment of chicken diseases, which improves their understanding of overall livestock health.

IV. Conclusion

This system is designed to help chicken breeder diagnose chicken diseases online. The Certainty Factor method is used to measure the level of expert confidence in a disease based on the symptoms experienced by the chicken. The results of this study indicate that the Certainty Factor method can be used well in detecting diseases in chickens. This is proven by the system's ability to predict chicken diseases according to the symptoms displayed, which have been structured based on predetermined rules.

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