Diagnosing chicken diseases using fuzzy Tsukamoto web-based expert system

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Abstract. Chicken is one source of protein favored by the community. One of the benefits we can take on chicken is meat and eggs. But chicken disease becomes one of the problems that are very detrimental to chicken farmers. This was assessed because of the lack of knowledge of farmers in handling conditions that occur in chicken. Accurate information about handling chicken disease among farmers is still difficult to obtain. Therefore, it is necessary to design an expert system application in detecting diseases that are experienced by chickens based on the symptoms shown and how to handle them. The method used is fuzzy Tsukamoto as an inference engine to determine the disease based on its symptoms and use the PHP programming language in making applications and MySQL as its database. Based on the results of the diagnosis in the sample taken showed the results of the fuzzy Tsukamoto diagnosis were 97.97% (very good) with the type of disease: typhoid chicken based on the symptoms seen. The solution given is isolation of chickens that show symptoms and give disinfectant water, spray disinfectant, replace all water and feed, clean the entire cage, and destroy dead chickens.

1. Introduction
Along with the rapid development of technology, and has an important role for humans in all aspects of life. Technology certainly cannot be separated for humans. Technology can provide beneficial information to humans, such as expert system. Expert system is a computer program that delivers and transmits knowledge from an expert in a subject with the aim of solving problems or giving advice [1].

Chicken is one source of protein favored by the community. One of the benefits we can take on chicken is meat and eggs. But chicken disease becomes one of the problems that are very detrimental to chicken farmers. This was assessed because of the lack of knowledge of farmers in handling conditions that occur in chicken. Accurate information about handling chicken disease among farmers is still difficult to obtain. Some of the things that make chickens affected by the disease include negligence in giving vaccines, lack of nutritional intake, and also the lack of maintaining the cleanliness of the chicken coop
and the rapid spread of the virus. Farmers sometimes do not know that their livestock are attacked by disease, but cannot know what type of disease is attacking the chicken. One of the last options for farmers, if they cannot cure the chicken, the farmer will meet directly with the veterinarian. To find out what type of disease is experienced by the chicken. However, the limited number of veterinarians has become an obstacle for farmers [2].

By looking at the sources of the above problems, an expert system was developed because of its application in various fields of science, business and health which proved to be very helpful in making decisions to deal with the identification of chicken diseases based on symptoms, which were expected to provide information fast about the disease suffered and how to overcome it. Expert systems are branches of artificial intelligence or artificial intelligence used to take and apply knowledge from experts. By applying knowledge derived from experts, expert systems can help solve problems in the real world at a relatively low cost.

In a previous study conducted by Putri Abdullah Puja in 2016 entitled "Expert system to diagnose disease in chickens using the Android-based certainty factor method". Where the results of the diagnosis of the disease there are several groups of research results show 3 groups with a good preference for the application of expert systems with a range of values of 63% to 82%, said good and very good categories. In previous studies also "Expert System for Detecting Chicken Disease with Media Interactive, by giving a good assessment. [3-5].

2. Method
The expert system is a computer program designed to simulate - solving human behavior problems that are experts in narrow domains or disciplines. Expert systems usually consist of knowledge bases (information, heuristics, etc.), machine conclusions (basic knowledge analysis), and end-user interfaces (receive input, produce output). Knowledge of the expert system is taken from someone who is an expert in these problems or commonly referred to as an expert. the expert system was built to solve a problem by imitating the work of experts. The expert system also helps experts carry out their activities as experienced assistants.

The expert system is a system that has the most applications in solving problems in the real world. This expert system has many choices in running it such as on personal computers or personal mobile devices. Expert systems can be done easily and have affordable costs [6]. The concept of a fuzzy system can also be interpreted as approximate reasoning. Fuzzy models are based on the rules of an inference composition, starting with the introduction of conditional (if-then) fuzzy rule ideas. Another rule also with If-Then which formulates a knowledge base called official representing a knowledge to be processed as long as there is still an estimate of reason, where the data is qualitative, inaccurate and ambiguous. Each rule is represented by a fuzzy set called fuzzification. Where the result of the output of each rule is a value, and based on the predicate value or minimum value of each rule and will give the final results obtained based on the average defuzzification weighted average. The result of each rule is given as an α-predicate. The end result is using a weighted average defuzzification. In the inferior process, the Fuzzy Tsukamoto method has several stages, namely:

1. Fuzzification
   Fuzzification is the process of changing the input system that has a strict value or crisp into a fuzzy set and determines the degree of membership in the fuzzy set.

2. Formation of IF-THEN rules
   The process for forming Rules to be used in the form of IF-THEN stored in the fuzzy membership base.

3. Inference engine
The process for converting fuzzy inputs to fuzzy output by fuzzification of each defined Rule (IF-THEN Rules). Use the MIN implication function to get an alpha-predicate value for each Rule. Then each alpha-predicate value is used to calculate the output of each Rule (\( z \) value).

4. Defuzzifikasi
Changing the fuzzy output obtained from the inference engine becomes a firm or crisp value. The final result is obtained by using the weighted average equation using the average method of Weight Average [7-10].

\[
 z = \frac{\alpha_1 z_1 + \alpha_2 z_2}{\alpha_1 + \alpha_2}
\]  

(1)

Block diagrams of expert system structures have two main parts, such as a development environment, which is the part used to incorporate expert knowledge into the expert system environment and the consultation environment (consultation environment), the part used by the expert user to gain knowledge. The structure of the expert system can be seen in Figure 2.

In this use case diagram shows the sequence of activities that can be done by the user, namely opening the application, logging in, selecting symptoms and then diagnosing chicken disease, then the system will display the results of the diagnosis as shown in Figure 3. Based on expert knowledge regarding chicken diseases, there are 20 diseases that can be identified as per stated in Table 1. While the symptoms, can be categorized in 51 types for the chicken diseases as per Table 2.

![Figure 1. Structure of Expert System](image-url)
Table 1. List of Chicken Diseases

| No | Code (Disease) | Name of the Disease          | No | Code (Disease) | Name of the Disease          |
|----|----------------|-------------------------------|----|----------------|-------------------------------|
| 1  | PO01           | Lime Dust                     | 11 | PO11           | Coughing up blood             |
| 2  | PO02           | Cholera Chicken               | 12 | PO12           | Mareks                        |
| 3  | PO03           | Bird Flu                      | 13 | PO13           | Egg production                |
| 4  | PO04           | Tetelo                        | 14 | PO14           | Initial Production            |
| 5  | PO05           | Chicken typus                 | 15 | PO15           | Complex nerves                |
| 6  | PO06           | Dysentery                     | 16 | PO16           | Chicken anemia                |
| 7  | PO07           | Gumboro                       | 17 | PO17           | Chicken depression            |
| 8  | PO08           | Salesma                       | 18 | PO18           | Neck nerve                    |
| 9  | PO09           | Chronic bathing               | 19 | PO19           | Knee joint                    |
| 10 | PO10           | Chicken down                  | 20 | PO20           | Chicken pox                   |

Table 2. List of Chicken Symptoms

| No | Code (Symptoms) | Symptoms          | No | Code (Symptoms) | Symptoms          |
|----|-----------------|-------------------|----|-----------------|-------------------|
| 1  | GO01            | Diarrhea          | 27 | GO27            | Reddish eyelids   |
| 2  | GO02            | Shortness of breath| 28 | GO28            | Out foaming fluid from the eyes |
| 3  | GO03            | Breath snoring    | 29 | GO29            | Discharge from the eyes and nose |
| 4  | GO04            | Breath fast       | 30 | GO30            | Pus out of eyes and smell |
| 5  | GO05            | Sneezing          | 31 | GO31            | Head swelling      |
| 6  | GO06            | Cough             | 32 | GO32            | Head and neck stiff |
| 7  | GO07            | Thin body         | 33 | GO33            | Watery eyes        |
|   | GO     | Description                                           |
|---|--------|-------------------------------------------------------|
| 8 | GO08   | Dull and wrinkled fur                                 |
| 9 | GO09   | Decreased appetite                                     |
| 10| GO10   | Egg production declines                               |
| 11| GO11   | Egg quality is ugly                                    |
| 12| GO12   | Drowsiness and feathers standing                       |
| 13| GO13   | Cold                                                   |
| 14| GO14   | Looked lethargic/ weak/ lazy to move                   |
| 15| GO15   | Diarrhea greenish greenery                             |
| 16| GO16   | Diarrhea whitish whitish                              |
| 17| GO17   | Diarrhea mixed with blood                              |
| 18| GO18   | Many drink                                             |
| 19| GO19   | Pale face                                              |
| 20| GO20   | Looks blue                                             |
| 21| GO21   | Stagger and lazy to move                               |
| 22| GO22   | Red swollen comb                                       |
| 23| GO23   | Pale comb                                              |
| 24| GO24   | Swollen foot                                           |
| 25| GO25   | Inflamed feet                                          |
| 26| GO26   | Legs limp                                              |
| 34| GO34   | Swelling of the sinuses and eyes                       |
| 35| GO35   | Abdomen enlarged                                       |
| 36| GO36   | Wings hanging                                          |
| 37| GO37   | There is white dirt sticking around the anus           |
| 38| GO38   | There is mucus in the oral cavity                      |
| 39| GO39   | Its beak is placed on the floor                        |
| 40| GO40   | Sitting with a bow                                     |
| 41| GO41   | Die suddenly                                           |
| 42| GO42   | Growth is hampered                                     |
| 43| GO43   | Depressed chicks                                       |
| 44| GO44   | Paralysis of the wings and feet                        |
| 45| GO45   | Tumors under the skin and muscles                      |
| 46| GO46   | Dead chickens quickly rot                              |
| 47| GO47   | Abdomen enlarged                                       |
| 48| GO48   | Enlargement of the wing and leg bones                  |
| 49| GO49   | Experiencing cataract symptoms even blindness          |
| 50| GO50   | Liver enlarged                                         |
| 51| GO51   | A smallpox on the surface of the skin and head         |

3. Result and Discussion

Views obtained after the design of expert systems performed can be seen in Figure 3 to Figure 6. In Figure 6, can be seen database results obtained from expert systems that have been designed and simulated so as to obtain results that can be used by farmers in taking the necessary action on the chicken sick.

![Figure 3. Designed Login Page](image3.png)

![Figure 4. Designed Main Menu](image4.png)
Figure 5. Diagnosis form
As shown in the pictures above, the expert system is able to show the required treatment depending on the appearance of symptoms in the chicken. The test results obtained a better response from expert chicken disease with a score of 82.27 % (categorized good).

4. Conclusion
Based on the results of diagnosis carried out on several samples of chicken diseases. Based on the results of the diagnosis in the sample taken showed the results of the fuzzy Tsukamoto diagnosis were 97.97% (very good) with the type of disease: typhoid chicken based on the symptoms seen. The solution given is isolation of chickens that show symptoms and give disinfectant water, spray disinfectant, replace all water and feed, clean the entire cage, and destroy dead chickens.

Figure 6. Diagnosis Report
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