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Mobile Expert System Using Fuzzy Tsukamoto for Diagnosing Cattle Disease

Suharjito[a], Diana[b], Yulyanto[a], Ariadi Nugroho[a]

[a]Computer Science Department, BINUS Graduate Program - Master of Computer Science, Bina Nusantara University, Jl kebon jeruk RayaNo 27, Jakarta 11480, Indonesia
[b]Computer Science Department, School of Computer Science - Bina Nusantara University, Jl KH Syahdan 9, Jakarta 11480, Indonesia

Abstract

Handling reproductive disorders in the cattle farming businesses is still ineffective due to a lack of information about the treatment of cattle, which has led to a significant decline in meat production. To reduce the impact of reproductive disease, it is necessary to perform detection and early treatment to prevent significant losses and a wider spread of the disease. This article explains the application of an expert system that provides a means of consultation imitating the reasoning process of an expert in solving complex problems concerning the health of cows reproduction. We will apply Fuzzy Tsukamoto method to help diagnose the level of risk of disease in cattle based on six clinical symptoms. The result of this research is a mobile expert system that will conclude the level of risk of endometritis disease in cattle. This mobile application is developed based on android, for ease of use, and can be used by farmers in making the diagnosis by themselves. The validation results of this expert system show that the system is able to determine the level of risk of endometritis for cow's reproduction disease.

Keywords: Expert system, fuzzy logic tsukamoto, cattle disease

* Corresponding author. Tel.: +62-812-840-0536
  E-mail address: suharjito@binus.edu

1. Introduction

Reproductive success will contribute greatly to the increase of cattle population. However, it is observed that cattle in the livestock business often suffers from reproductive disorders characterized by low fertility, which consequently lead to a decrease in pregnancy rate and the number of born calf. As such, reproductive disorders in cattle would harm farmers and will hamper the growth of cattle population in the country. Animal health is a state or condition in which the body of an animal with whole cells that make up and body fluids that contain normal physiological function [1]. Local cattle productivity is still low. Because of the inefficient livestock management, mortality rate is still high, reaching 10-40% [2].

Creating a mobile application with the capability to diagnose diseases in cattle will help farmers in detecting early diseases affecting cattle without having to rely on the vet. Equipping the mobile application with Fuzzy Inference System (FIS) Tsukamoto is expected to help improve its diagnosis effectiveness. Tsukamoto fuzzy logic was chosen because it provides crisp individual rule outputs, which lead to relatively easy identification of functional relationship between the input vector and system output.

2. Related Work

Expert system is a branch of artificial intelligence that makes extensive use of specialized knowledge to solve problems at the level of human experts. An expert is a person who has expertise in a certain area. The expert has knowledge or special skills that are not known or available to most people [3]. Expert system is defined as intelligent computer programs that mimic human experts' problem solving capabilities. Turban [4] has conducted several studies using Fuzzy to the problem of diagnosis. Setyarin [5], using Dempster-Shafer and Certainty Factor, has diagnosed the disease in dogs. Dempster-Shafer method is better than Certainty Factor for calculation because it produces a value that is more varied and more accurate. Munirah [6] creates a system that can help identify diseases of dogs and suggest treatments using forward chaining. Forward chaining method searches a solution to a problem. If the clause is the premise according to the situation (TRUE), then the process will be to assert conclusions.

Another research focuses on developing a web based intelligent diagnosis system for fish diseases. Diagnosing fish diseases is a complicated process and requires high level of expertise. These system diagnoses nine freshwater fish species consisting of 126 fish types. The knowledge base consists of all the rules for symptoms and diseases of fish [7].

Tsukamoto method was first introduced by Tsukamoto in 1979. It is a method of decision-making that is applicable to any monotone reasoning rule. The intention is to use a system with only one rule. The implications of each rule is in the form of implication "Cause and Effect" or implication "Input-Output" in which the antecedent and the consequence has to be correlated. Each rule is represented using fuzzy associations, with a monotonous membership function. To determine the outcome of a firm solution (Crisp Solution), formulas assertion (defuzzyfication) called "centered average method" is used [8].

In the Tsukamoto fuzzy models, the consequent of each fuzzy if-then rule is represented by a fuzzy set with a monotonically membership function, as shown in Figure 1. As a result, the inferred output of each rule is defined as a crisp value induced by the rule's firing strength. The overall output is taken as the weighted average of each rule's output. Figure 1 illustrates the reasoning procedure for a two-input two-rule system [9].
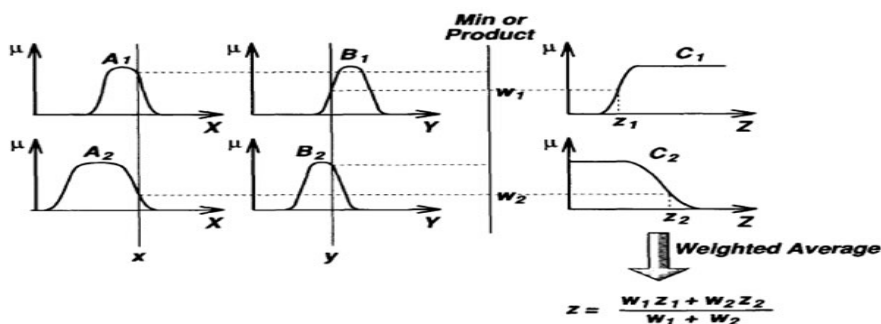

Fig 1. The Tsukamoto fuzzy