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Expert System for Diagnosing Worms in Animal Husbandry using the Bayes Method

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Article Info	ABSTRACT
	Expert systems have been widely used to solve problems in various fields such as medicine, mathematics, engineering, chemistry, pharmacy, computer science, business, law, education, and defense. If the expert system is related to the doctor's ability to diagnose the patient's health, a computer system can be created that can identify and analyze the symptoms that occur in patients and provide suggestions for overcoming them. Worms seem trivial, but if we look closely, it has a serious impact on affecting the health of livestock which in turn will have a direct result in decreased production. Goats that experience worms will experience a lack of nutrition or nutrition, so that their resistance to disease will decrease, so they are prone to other diseases, especially infectious diseases. Bayesian probability theory is a branch of the mathematical-statistical theory that allows us to create a model of the uncertainty of an event that occurs by combining general knowledge with facts from observations.

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1. INTRODUCTION

The advancement and development of increasingly advanced computer technology are needed by computer software makers to process scientific data and business transactions. The software that is made must be able to accommodate the increasing and critical needs of humans, including in terms of presenting information quickly, making decisions, performing complex calculations, presenting animations and simulations, as an expert system to diagnose a disease or disorder and others. -other. The expert system is the main application of artificial intelligence (Artificial Intelligence) which is the most widespread application today. This is due to a lack of experts to solve increasingly complex problems[1].

Expert systems are now widely used to solve problems in various fields such as medicine, mathematics, engineering, chemistry, pharmacy, computer science, business, law, education, and defense. If the expert system is related to the doctor's ability to diagnose the patient's health, a computer system can be created that can identify and analyze the symptoms that occur in patients and provide suggestions for overcoming them[2].

Worms seem trivial, but if we look closely, it has a serious impact on affecting the health of livestock which in turn will have a direct result in decreased production. Goats that experience worms

will experience a lack of nutrition or nutrition, so that their resistance to disease will decrease, making them prone to other diseases, especially infectious diseases. Due to a lack of nutrition, livestock will experience growth and reproduction problems so that livestock will be difficult to become pregnant. There are many methods that build a knowledge base, including through direct interaction with expert/expert knowledge builders through interviews or observations or through case handler notes that have been conducted by an expert. Acquisition of knowledge through case handling notes that have been carried out by experts has many advantages between system development, not needing to deal directly with experts and the acquisition process can be shorter, thus shortening the system development time.

The method used to build a knowledge-based system whose knowledge comes from records of past cases is known as Bayes. In this study, the authors determined the Bayes method to build a system that has the ability to diagnose intestinal worms. The author establishes the Bayes method to build a system that can diagnose intestinal worms. The Bayes Theorem was put forward by an English presbyterian priest in 1763 named Thomas Bayes. Bayes' Theorem is used to calculate the probability of an event occurring based on the effect obtained from the observations. The Bayes method is a good method in machine-based learning training data, using conditional probability as the basis. Bayes is a method part of a decision support system that produces the required solution with equations from previous experience[3].

2. RESEARCH METHOD

To work on the stages in research need to be arranged systematic research methods. As for the stages, it can be arranged in diagram form like Figure 1 below:
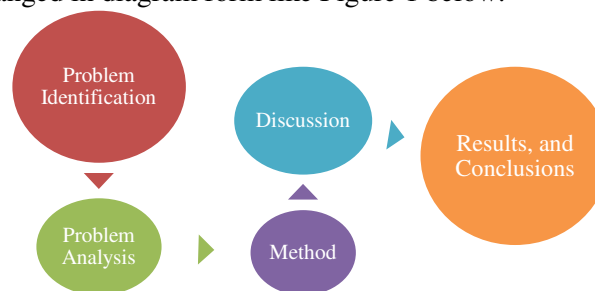

Figure 1. Diagram of Methods and Research Stages

In the stages of the research method, the author conducted interviews with experts to obtain symptoms of worms in livestock.

2.1. Basic theory

A. Expert System

The expert system is a branch of Artificial intelligence (AI) which is quite old because this system was developed in the mid-1960s. The expert system that appeared for the first time was the General-purpose problem solver (GPS) developed by Newell and Simon. The term expert system comes from the Knowledge-based expert system. This term arises because to solve problems, an expert system uses an expert's knowledge that is entered into a computer. Someone who is not an expert uses an expert system to improve problem-solving abilities, while an expert uses an expert system for a knowledge assistant[4].

One artificial intelligence technique that mimics the human reasoning process is the Expert System. In general, an expert system is a system that tries to adopt human knowledge to a computer, so that computers can solve problems as is usually done by experts. A good Expert System is designed to solve a particular problem by imitating the work of the experts. With this Expert System, ordinary people can also solve quite complex problems that actually can only be solved with the help of experts. For experts, this Expert System will also help their activities as highly experienced assistants[5].

B. Diagnosis

Diagnosis is the identification of the characteristics of a disease or condition or differentiating a disease or other self-condition. Assessment can be done by means of a physical examination, laboratory test, or the like and may be assisted by a computer program designed to improve the decision-making process[6].

C. Worm disease

Worms are one of the parasites in humans and animals that are harmful where humans are the host for several types of worms, including intestinal nematodes. Most of these nematodes are still a public health problem in Indonesia. Among the intestinal nematodes, many species are transmitted through soil (Soil-Transmitted Helminths) including the most common Ascaris lumbricoides, Necator americanus, Ancylostoma duodenale and Trichuris trichiura[7].

D. Bayes method

The Bayes Theorem was put forward by an English presbyterian pastor in 1763 named Thomas Bayes. Bayes' Theorem is used to calculate the probability of an event occurring based on the effect obtained from the observations[8]. Bayesian probability is an interpretation of calculus which contains the concept of probability as the degree to which a statement is believed to be true. Bayesian theory can also be used as a decision-making tool to update the confidence level of information. Bayesian probability theory is a branch of the mathematical-statistical theory that allows us to create a model of the uncertainty of an event that occurs by combining general knowledge with facts from observations[9].

In general terms, Bayes' theorem is expressed as[10]:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

In this notation P(A|B) means chance of occurrence A when B happen and P(B|A) chance of occurrence B when A happen.

3.   RESULTS AND DISCUSSION

The analysis is useful for knowing the software requirements in an expert system that is built. In this stage, a search and collection of data and knowledge required by the expert system are carried out. So that in the end the results of the analysis are obtained in the form of a system whose structure can be well and clearly defined. Worms disease is fast inbreeding and spreading which is usually due to, among other things, the condition of the livestock pen which is dirty, wet, and damp, and the surrounding environment that is a slum, or the worms can be brought into the cage accidentally due to the grass that is scattered from the land where it contains worm larvae.

Table 1. Common Symptoms of Worms

Kode Penyakit	Gejala Umum Penyakit Cacingan	Probabilitas Penyakit Cacingan	
		Tanpa Memperhatikan Penyakit	Dengan Memperhatikan Penyakit
A1	Perut Membesar	0.02	0.5
A2	Kurus	0.2	0.5
A3	Lemah Dan Lesuh	0.06	0.5
A4	Bulu Kusam	0.09	0.5
A5	Anemia	0.5	0.5
A6	Rahang Membengkak	0.4	0.5
A7	Susah Buang Kotoran	0.2	0.5
A8	Nafsu Makan Berkurang	0.3	0.5

Application of the Bayes method if the probability of symptoms regardless of the disease is:

Enlarged Stomach : 0.02
Skinny : 0.2.

If the probability of the symptoms about the disease occurring is:

Enlarged Stomach : 0.5
Jaw Swelling: 0.5
Bayes value calculation:

$$P(\text{Penyakit Cacingan}|\text{Perut Membesar}) = \frac{P(\text{Perut Membesar}|PC)*P(PC)}{P(\text{Perut Membesar}|\text{Penyakit Cacingan}) + P(\text{Rahang Membengkak}|\text{Penyakit Cacingan})}$$

$$P(\text{Penyakit Cacingan}|\text{Perut Membesar}) = \frac{(0.5)*(0.02)}{(0.5)+(0.5)}$$

$$= \frac{0.01}{1}$$

$$P(\text{Penyakit Cacingan}|\text{Perut Membesar}) = 0.01$$

This rule is synonymous with: If the patient has dull hair, then the probability (probability) of getting worms is 0.01

$$P(\text{Penyakit Cacingan}|\text{Kurus}) = \frac{P(\text{Kurus}|PC)*P(PC)}{P(\text{Kurus}|\text{Penyakit Cacingan}) + P(\text{Perut Membesar}|\text{Penyakit Cacingan})}$$

$$P(\text{Penyakit Cacingan}|\text{Perut Membesar}) = \frac{(0.5)*(0.2)}{(0.5)+(0.5)}$$

$$= \frac{0.1}{1}$$

$$P(\text{Penyakit cacingan}|\text{Rahang Membengkak}) = 0.1$$

This rule is defined as: If the patient is thin, then the probability (probability) of getting worms is 0.1. Bayes value calculation :
Total Bayes = bayes 1+ bayes 2 + ... bayes n; = 0.01 + 0.1 = 0.11
So the total intestinal worms disease is 0.11
This rule is defined as:
If the patient has an enlarged stomach, is thin, and the total probability of bayes is 0.1 to 0.2, the probability (possibility) of getting worms is positive and is at a low level.
Rule :
Based on the Bayes calculation above, 3 rules will be determined, namely as follows:
1. Wormy disease at a mild level
        IF Stomach Enlarged
        And skinny
        And Anemia
        And Weak And Weaky
        And Total Bayes = 0.13
        THEN **Mild Worms**
Solution:
        A. Do not herd goats in waterlogged fields
        B. Clean the cage every day

C. Give worm medicine every 2-3 months, namely:
  Dry season once every three months, Rainy season once every two months.
2. Wormy disease at a quite serious level
  Light IF
  And Swollen Jaws
  And Dull Fur
  And Total Bayes = 0.38
  THEN **Serious Worms**
Solution:
  1. Do not herd goats in waterlogged fields
  2. Clean the cage every day
  3. Give worm medicine every 2-3 months, namely:
   Dry season once every three months
   Rainy season once every two months.
3. Worms at the Chronic level
  And light
  And Hard to Remove Dirt
  And Decreased Appetite
  And Total Bayes = 0.96
  THEN **Chronic Worms**
Solution:
  1. Do not herd goats in waterlogged fields
  2. Clean the cage every day
  3. Give worm medicine every 2-3 months, namely:
   Dry season once every three months
   Rainy season once every two months.

4. CONCLUSION

From the results of the system testing that has been done, the following conclusions can be given Diagnosis of worms in goats is carried out by means of data provided by the user and can be assisted by a computer program designed to improve the decision-making process. Application of the Bayes Method for mathematical calculations and the value of each expert system criterion to diagnose intestinal worms in goats.

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