International Journal of Basic and Applied Science 9 (2) (2020) 43-49

Published by:IOCSCIENCE

International Journal of Basic and Applied Science

Journal homepage:www.ijobas.pelnus.ac.id

Expert System Diagnosing Diseases of Freshwater Ornamental Fish using Bayes' Theorem Method

Roindah Simalango
Program Studi Teknik Informatika, STMIK Pelita Nusantara, Medan, Indonesia

Article Info

Article history:

Received Jun 18, 30, 2020
Revised Jul 14, 2020
Accepted Aug 04, 2020

***Keywords*:**

Expert system;
Bayes' theorem;
Fish Diseases;
Decorative fish.

ABSTRACT

When a fish is attacked by a disease, it will show physical changes, it can be seen from the symptoms that appear. From the visible symptoms, the type of fish disease can be identified and the treatment stage is immediately carried out so that there is no big loss. Diagnosis is the initial stage to find out the symptoms of a type of ornamental fish disease in order to be able to overcome the disease at an early stage. The purpose of diagnosis using Bayes' theorem is to help the public / ordinary people do the work of experts to diagnose computer-based ornamental fish diseases easily, quickly and the process can be repeated automatically. An expert information system is a software application that has a knowledge base for a particular domain and uses inference reasoning like an expert in solving a problem. In the design of the expert system that was built, the disease code was determined consisting of codes P001 to P0016, used as a reference for diagnosing the disease. Symptom code: G1 to G31, is the type of symptom that appears. In the testing phase, a trial was carried out on the Expert System application with the Bayes Theorem that had been built. The results of the diagnosis and the probability of the disease in ornamental fish will be searched using calculations based on the symptoms experienced by the fish. From the case example, after calculating the Bayes value, the highest cause with a percentage of 86% was caused by Aeromonas sp. and Pseudomonas sp.

Corresponding Author:

Roindah Simalango,
Program Studi Teknik Informatika,
STMIK Pelita Nusantara, Medan, Indonesia
E-mail: roindah.similango@gmail.com

1. INTRODUCTION

Aquaculture is carried out through various means, in 2007, global trade of ornamental fish for marine species was 48% and ornamental fish for freshwater species was 52% [1] [2]. Ornamental fish are mostly kept in aquariums with various aquatic plants added as decoration for people who like to keep fish. Lopes, Goncalves, Fujimoto, and Carvalho developed a system using artificial neural networks to diagnose diseases in fish caused by bacteria and protozoa [3]. In the process of cultivating freshwater fish, freshwater ornamental fish businesses are more in demand than seawater ornamental fish, but at the freshwater fish cultivation level, they often get complaints, namely

ornamental fish experiencing symptoms that sometimes people do not know about the diseases that exist in fish [4] [5]. Basically every disease that attacks ornamental fish must have visible physical symptoms, from these symptoms it can be known what type of disease attacks ornamental fish so that disease management with fish will not suffer big losses [6] [7] [8]. However, the lack of knowledge of ornamental fish breeders makes farmers unable to determine the type of disease that attacks them.

Disease diagnosis is a careful examination of fish affected by disease, considering that the external features that are visible are not sufficient to make definite conclusions about the condition of the fish, the type of disease and its causes. Diagnosis of diseased fish is very important for the success of the next treatment step. Information about fish diseases is still scanty, this causes difficulties in overcoming them and how to treat them. Implementation of an expert system for diagnosing fish diseases can help fish farmers and provide solutions quickly, precisely, and efficiently for the prevention process.

An expert system is a branch of artificial intelligence that uses special knowledge/knowledge to solve problems at the human expert/expert level [9] [10]. Expert systems have been developed in various sciences, one of which is in the field of medicine to diagnose diseases [11] [12]. Expert systems are used to determine the diagnosis of the disease so as to help confirm the diagnosis. The problem of knowledge uncertainty in expert systems is solved by using the Bayes theorem method.

The application of the Bayes theorem method used is a variable based on the uncertainty value of expert diagnosis and then formulated into data [13]. The value of data uncertainty on symptoms and diseases is used as system input when acquiring knowledge, disease by experts becomes system input when acquiring knowledge of disease rules [14] [15] [16]. The implementation of an expert system using the Bayes theorem method aims to help the public / ordinary people do the work of experts to diagnose ornamental fish diseases easily and quickly and the process can be repeated automatically.

2. RESEARCH METHODS

2.1 Method of collecting data

The method of data collection is in the form of a question about the nature, circumstances, certain activities and the like. In the preparation of this final project the author took the object of research in the Asui ornamental fish pond located on Jalan. Banyan Vegetable Garden. Data collection in research in Asui ornamental fish ponds uses 4 methods, the following is a description used:

a. Interview

Collecting data by conducting direct questions and answers with sources from the object under study to obtain what is desired. Interviews were conducted in order to get a workflow on the object under study which will be used in determining the features to be built

b. Observation

This data collection method is used to obtain data related to expert systems to diagnose pests and diseases in ornamental fish to form effective inputs and outputs.

c. Literature review

This method is used to obtain additional information used as a reference in the development of an expert system.

3. RESULTS AND DISCUSSION

3.1 Analysis of Application of Bayes' Theorem Method

The algorithm for solving the Bayes Theorem method is as follows:

$$P(H|E) = \frac{P(E|H).P(H)}{P(E)} \text{or} P(H|E) = \frac{P(H \cap E)}{P(E)} \quad \ldots\ldots (1)$$

Description:

P (H | E): the probability of the hypothesis if given evidence E
P (E | H): probability of the emergence of evidence E if the hypothesis H . is known
P(H) : probability H regardless of any evidence
P(E) : probability evidence E

Summing up the probability values of each evidence for each hypothesis based on the sample data.

$$\sum_{Gn}^{n} k = 1 = G1 + \cdots + Gn \quad (2)$$

Looking for the probability value of hypothesis H regardless of any evidence for each hypothesis

$$P(Hi) = \frac{P(E|Hi)}{\sum_{k-n}^{n}} \quad (3)$$

Looking for the probability value of the hypothesis looking at the evidence by multiplying the probability value of the initial evidence with the probability values of the hypothesis without containing evidence and adding up the multiplication for each hypothesis:

$$\sum_{k=1}^{n} = p(H1) * p(E|H1) + \cdots + p(Hi) * p(E|Hi) \quad (4)$$

Look for the value of p(Hi|E) or the probability that Hi is true if given evidence of E

$$P(Hi|Ei) = \frac{P(Hi*p(E|Hi)}{\sum_{k-n}^{n}} \quad (5)$$

Finding the value of the conclusion from Bayes' theorem by multiplying the probability value of the initial evidence or p(E|Hi) with the value of the hypothesis Hi is true if given evidence of E or p(Hi|E) and adding up the multiplication results.

$$\sum_{k=1}^{n} bayes = bayes\ 1 + \cdots + Bayes\ n \quad (6)$$

In the expert system to diagnose disease, it determines the symptoms of the disease that are used as a reference for diagnosing the disease. The identification of diseases in ornamental fish is made in the form of the following table.

2.2 Data analysis

The following is the disease data found in the heart, which contains the disease code and name/type of disease:

Table 1. Disease Data

Code	Name Disease	Explanation
P001	Malnutrition (malnutrition)	Lack of appetite, Poor feed efficiency, Skin discoloration, Bone deformities, Flatulence, Susceptibility to disease, Fin loss, Protruding eyes, Gasping/weakness, Slow growth, Skin bleeding, Irritations
P002	*Neoplasia*	Gasping/weakness, swimming on the surface, lack of appetite, lumps and bleeding
P003	Bacterial Disease Aeromonas sp. and Pseudomonas sp	the presence of ulcers, gasping / weakness, bleeding the color of the surface of the body becomes blood red, the fins fall out
P004	Bacterial Diseases Enterobacter sp., Chromobacter sp., Actinobacter sp	Gasping/weakness, wounds on the body
P005	Fungal Disease Saprolegnia sp	the eggs fail to hatch, the appearance of dots of fine threads on the fish's body, gasping / limp the presence of a layer of lime on the egg,
P006	Fungal Diseases Achliya sp.	The presence of ulcers in fish, the fish loses part of its posterior body, gasping for air

Code	Name Disease	Explanation
P007	Protozoa disease Ichthyophthirius multifiliis (white spot)	Lack of appetite, weakened condition, often rubbing his body on the edge or bottom of the pool
P008	Diseases of the Protozoa Trichodina sp	Gasping for breath/weakness, pale body color, often rubbing his body on the bottom of the pool, appetite, eating less, his body becomes thin, white spots appear
P009	Diseases of the Protozoa Henneguya sp.	Gasping/weakness, white cysts appear on the skin and gills of the fish, the fish looks deprived of oxygen
P010	Diseases of the Protozoa Spistylis sp	there are patches like cotton sticking to the skin, scales, or fins, ulcers occur, gasping/weakness
P011	Diseases caused by Trematodes Dactylogyrussp	Fish swim on the surface, gasp/weak, fish appear to lack oxygen, Bleeding occurs
P012	Diseases caused by Trematodes Gyrodactylus sp	fish swimming on the surface, the presence of spots on the body of the fish, fins fall out
P013	Diseases caused by nematodes	lack of appetite, inflammation occurs, hemorrhagic (bleeding), swelling in the stomach, gasping/weakness
P014	Diseases caused by copepods Argulus sp	Gasping/weakness, bleeding occurs.
P015	Diseases caused by Lernea sp.	puncture marks, bleeding occurs
P016	Diseases caused by viruses	bleeding occurs, white spots, pale eyes, ulcers occur on the fish's body, gasping/weakness

Based on the data obtained by analyzing the existing problems, below has been made a grouping where the symptoms of the disease into a table which is given a code for each symptom that exists and how to overcome the type of disease in ornamental fish.

Table 2. Symptom Data

Symptom Code	Symptom Name
G01	Lack of appetite
G02	Poor feed efficiency
G03	Skin Color Change
G04	Bone deformity
G05	Bloated
G06	susceptible to disease
G07	Falling fins
G08	Protruding eyes
G09	Gasping / limp
G10	Slow growing
G11	Skin bleeding
G12	Irritation
G13	wounds on the body
G14	swim on the surface
G15	there is a lump and bleeding
G16	there are ulcers
G17	eggs fail to hatch
G18	the appearance of dots of fine threads on the body of the fish
G19	the presence of a layer of lime on the egg
G20	Fish lose part of their posterior body
G21	weakened condition
G22	often rub his body on the edge or bottom of the pool
G23	her body is thin

Symptom Code	Symptom Name
G24	white spots appear
G25	white cysts appear on the skin and gills of fish
G26	Fish appear deprived of oxygen
G27	there are patches like cotton that stick to the skin, scales, or fins
G28	The presence of spots on the body of the fish
G29	inflammation occurs
G30	swelling in the stomach
G31	pale eyes

The next step is to determine the weight/probability value based on the cases obtained, the following is the weight/probability value of each symptom to the disease.

Table 3. Probability Value

Code	Disease Name	Symptom	Probability
P001	Malnutrition (malnutrition)	G01	**Database**
		G02	**Probability**
		G03	0.89
		G04	0.87
		G05	0.84
		G06	0.84
		G07	0.79
		G08	0.89
		G09	0.79
		G10	0.79
		G11	0.79
		G12	0.89
P002	*Neoplasia*	G09	0.88
		G14	0.68
		G01	0.7
		G15	0.8
	Bacterial Disease Aeromonas sp. and	G16	0.8
P003	Pseudomonas sp	G09	0.8
		G11	0.71
		G12	0.72
		G07	0.72
P004	Bacterial Diseases Enterobacter sp.,	G09	0.5
	Chromobacter sp., Actinobacter sp	G13	0.86
		G17	0.4
P005	Fungal Disease Saprolegnia sp	G18	0.5
		G09	0.54
		G19	0.71
		G16	0.71
P006	Fungal Diseases Achliya sp.	G20	0.64
		G09	0.75
P007	Protozoa disease Ichthyophthirius multifiliis (white spot)	G01	0.5
		G21	0.75
		G22	0.75
		G09	0.75
		G03	0.5
P008	Diseases of the Protozoa Trichodina sp	G22	0.6
		G01	0.8
		G23	0.8
		G24	0.6

Code	Disease Name	Symptom	Probability
P009	Diseases of the Protozoa Henneguya sp.	G09	0.8
		G25	0.6
		G26	0.46
P010	Diseases of the Protozoa Spistylis sp	G27	0.54
		G16	0.35
		G09	0.67
P011	Diseases caused by Trematodes Dactylogyrussp	G14	0.67
		G09	0.67
		G26	0.5
P012	Diseases caused by Trematodes Gyrodactylus sp	G11	0.75
		G14	0.75
		G28	0.75
		G07	0.67
P013	Diseases caused by nematodes	G01	0.67
		G29	0.83
		G11	0.8
		G30	0.8
P014	Diseases caused by the copepod Argulus sp	G09	0.8
		G09	0.6
		G11	0.6
P015	Diseases caused by Lernea sp.	G13	0.67
		G11	0.67
P016	Diseases caused by viruses	G11	0.67
		G24	0.67
		G31	0.83
		G16	0.83
		G09	0.67

4. CONCLUSION

Based on the analysis of the problems that occurred in the case raised about diagnosing freshwater ornamental fish diseases using the Bayes theorem method, it can be concluded that; To diagnose fish disease based on the symptoms that appear using the Bayes Theorem method, it is done by looking for the probability values of each existing symptom and then calculating the probability of each hypothesis based on the existing evidence.

In designing and applying the Bayes Theorem method to become an Expert System application using Visual Basic 2008, it is done by designing a system concept that will be built first using UML modeling, then designing a database that will be used, after that coding in Visual Basic 2008 to form expert system application.

A computer expert system is used as a suggestion to store expert knowledge by using a database and inference as a reservoir for expert knowledge, which later the system can be used as a tool to diagnose fish diseases according to expert knowledge.

REFERENCES

[1] I. B. Priono, *Ikan Hias Laut Bisnis Menggiurkan Bagai Buah Simalakama*. Penebar Media Pustaka.
[2] B. E. Ratnawati, "Keanekaragaman Ikan Hias pada berbagai ekosistem: studi kasus di kawasan perairan Gili Kondo kecamatan Sambelia kabupaten Lombok Timur." UIN Mataram, 2016.
[3] S. Island, "DEXA MEDICA, KPI WINNER2005," *Daft. ISI*, vol. 102, no. 1, p. 200678, 1994.
[4] Y. Bachtiar, *Budi daya ikan hias air tawar untuk ekspor*. AgroMedia, 2004.
[5] A. S. R. M. Sinaga, "Bayes Diagnosa Penyakit Ikan Hias Air Tawar Dengan Teorema Bayes," *Sink. J. dan Penelit. Tek. Inform.*, vol. 3, no. 1, pp. 43–50, 2018.
[6] D. Hoole, D. Bucke, P. Burgess, and I. Wellby, "Diseases of carp and other cyprinid fishes," 2001.
[7] P. S. Dewi, R. D. Lestari, and R. T. Lestari, "Sistem Pakar Diagnosis Penyakit Ikan Koi Dengan Metode Bayes," *Komputa J. Ilm. Komput. dan Inform.*, vol. 4, no. 1, pp. 25–32, 2015.
[8] W. Fahrozi, "PENERAPAN METODE DEMPSTER SHAFER UNTUK MENDIAGNOSA PENYAKIT IKAN

KOI," *J. Sist. Inf. dan Ilmu Komput. Prima (JUSIKOM PRIMA)*, vol. 2, no. 1, 2018.
[9] V. P. Dewa, A. Pujianto, and M. H. Putra, "Sistem Pakar Diagnosa Penyakit Buah Nanas Menggunakan Algoritma Bayes Berbasis Web," *SEMNASTEKNOMEDIA ONLINE*, vol. 5, no. 1, pp. 3–6, 2017.
[10] G. Anggara, G. Pramayu, and A. Wicaksana, "Membangun sistem pakar menggunakan teorema bayes untuk mendiagnosa penyakit paru-paru," *SEMNASTEKNOMEDIA ONLINE*, vol. 4, no. 1, pp. 3–5, 2016.
[11] J. Durkin, "Research review: Application of expert systems in the sciences," 1990.
[12] A. K. Nugroho and R. Wardoyo, "Sistem Pakar Menggunakan Teorema Bayes untuk Mendiagnosa Penyakit Kehamilan," *BIMIPA*, vol. 23, no. 3, pp. 247–254, 2013.
[13] H. Atmajaya, "APLIKASI SISTEM PAKAR IDENTIFIKASI HAMA DAN PENYAKIT PADA TANAMAN KEDELAI MENGGUNAKAN METODE TEOREMA BAYES."
[14] D. Daifiria and M. B. Akbar, "PENERAPAN METODE TEOREMA BAYES UNTUK MENDIAGNOSA PENYAKIT PARU OBSTRUKTIF KRONIK (PPOK)," *IT (INFORMATIC Tech. J.*, vol. 5, no. 2, pp. 185–195, 2018.
[15] R. RUSDIYANTO, "Sistem Pakar Diagnosa Penyakit Akibat Gigitan Nyamuk Dengan Metode Bayes Berbasis Web," *JUTIM (Jurnal Tek. Inform. Musirawas)*, vol. 3, no. 1, pp. 30–40, 2018.
[16] S. Yakub, "Sistem pakar deteksi penyakit diabetes mellitus dengan menggunakan pendekatan Naïve Bayesian berbasis web." Universitas Islam Negeri Maulana Malik Ibrahim, 2008.