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The Use of Naive Bayes for Broiler Digestive Tract Disease Detection

Christian Cahyaningtyas [1], Hindriyanto Dwi Purnomo [2], Budhi Kristianto[2]

[1] *Dept. of Information Technology, Satya Wacana Christian University, Dr. O. Hamidjojo St, No 1, Salatiga, Indonesia*
[2] *Dept. of Information Technology, Satya Wacana Christian University, Dr. O. Hamidjojo St, No 1, Salatiga, Indonesia*

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CORRESPONDENCE

Phone: +62(298)321212
E-mail: hindriyanto.purnomo@uksw.edu

A B S T R A C T

Broiler chicken is a species of chicken that have high productivity. In order to get a good quality of chicken, good treatments of the breeding factors is needed, so the chicken will not easily infected by diseases. Gastrointestinal diseases are common disease that infects chickens. The mortality level caused by gastrointestinal diseases is considered high. This study is designed to address the problem by developing a system using the Naive Bayes algorithm. 60 chicken data samples were used, and the result shows that Naive Bayes might be used to detect gastrointestinal diseases among chickens with accuracy level of 93.3%. The number was confirmed by using confusion matrix evaluation method, and gave same level of accuracy compared to the expert judgments.

INTRODUCTION

Broiler chicken is a kind of chicken that have high productivity in the chicken meat industry. Broiler chickens which are the results of cross breeding and sustainable system have better genetic quality to be breed. A good genetic quality will appear maximally if the chicken is given supportive environmental factors. Broiler chickens are the most economical species when compared with other, which have the advantages of fast growth and production of meat. Within 4-5 weeks the chickens can be sold and consumed. The consumption level of chicken meat is so high and drives rapid development of the broiler to supply the needs [1]. Gastrointestinal diseases are common disease that infects chickens. The mortality level caused by gastrointestinal diseases is considered high. The breeders face difficulties to detect the infection among the hennery, so detection methods to prevent the diseases is needed to address the problem.

The Naive Bayes algorithm is a classification method using the probability and statistical methods proposed by British scientist Thomas Bayes. The Naive Bayes algorithm predicts future opportunities based on previous experiences known as Bayes Theorem. The main feature of the Naive Bayes classifier is a very strong assumption of the independence of each condition or event. Naive Bayes classifier works very well in comparison with other classifier models. The advantage of using this method is that it requires only a small amount of data trainers to determine the estimated parameters required in the clarification process. It is assumed to be an independent variable, so only the variance of a variable in a class is needed to determine the classification, not the whole of the covariance matrix. It makes the Naive Bayes algorithm easy to form and the result is considered good [2].

This study is designed to address the problem by developing a system using the Naive Bayes algorithm to detect gastrointestinal diseases including Infectious Bursal Disease (IBD), Pullorum, Avian Influenza, and Newcastle disease.

LITERATURE REVIEW

Research on Naive Bayes methods has been published before. Alfah Saleh [3] predicts the magnitude of the use of household electricity to easily regulate the electricity usage. The Naive Bayes method correctly classified 47 from 60 tested data, then the level of accuracy is 78.3%. Laily Hermawati [4] detects the presence of E-coli bacteria. The E-coli bacteria dataset used is the UCI Dataset Repository. The attribute of the E-coli bacteria on the UCI repository dataset is sequence name, mcg, gvh, lip, chg, aac, alm1 and alm2. This research resulted in a high accuracy rate in detecting E-coli bacteria using Naive Bayes algorithm with an accuracy level of 98.18% and Area Under

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Curve (AUC) value of 0.871. Achmad Syarifudin, Nurul Hidayat and Lutfi Fanani [5] diagnose diseases carried out on corn plants using the Naive Bayes method. Variables used in the study were symptoms of leaves, stems and cobs of corn plants. The results of this study show all valid functional requirements, system accuracy of 96% with 48 of 50 tested data, and the usability testing is very good. Juli Sulaksono and Darsono [6] determine the disease of heart failure using Naive Bayes classifier method. To determining the disease of heart failure, 16 symptoms and 4 diseases of heart failure are needed. This study concluded that the higher amount the tested data the more accurate the results, proven by 3 times of trials using different tested data. The study generated the highest accuracy in the first trial with an accuracy level of 86% with 134 testes data compared to 66 tested data. Garuda Ginting, Siska Subuh Hati Tarigan, and Fadlina [7] diagnosed Infectious Bursal Disease (IBD) in broiler chicken with certainty factor method. This study resulted in a conclusion that building an expert system can assist users in diagnosing and providing solutions. The certainty factor method of diagnosing is done by interviewing the users. This study shows that certainty factor value of 0.9924 which means the combination of the entire rules of training will produce 99% Infectious Bursal Disease (IBD). Andry Sandjaja, Andi Wahju Rahardjo Emanuel, and Maresha Caroline Wijianto [8] detected chicken disease with interactive media. The research has been successfully created an expert system of chicken disease that can help users by providing information about chicken diseases as well as ways of prevention and treatment of diseases. This system applies forward chaining method in diagnosing disease. The Naive Bayes classifier is a simple probability classifier based on Bayes' theorem. Bayes' theorem is combined with Naive which means any attribute or variable is independent. Naive Bayes classifier can be trained efficiently in supervised learning. The advantage of classification is that it requires only a small amount of training data to estimate the parameters (means and variances of the variables) required for classification. Since the independent variable is assumed, only variations of the variables for each class must be determined, not the entire covariance matrix [9].

Broiler chickens are also simply called broiler, is a leading species of the chicken breed that have high productivity, especially in producing chicken meat. Actually broiler chicken is popular in Indonesia since the 1980s as the government encourage people to consume meat which hard to afford that time. With a relatively short of breeding time, many new breeders and seasoned farmers are emerging in various areas of Indonesia [10].

Productivity of broiler chickens affected by 3 factors: seeds, feed and breeding management. Therefore, these three factors need to be considered. The breeding management is including the preparation of the cage and well planned feeding and vaccination. Diseases control, cage maintenance, and well harvest handling also important. Those factors determine production optimization, increasing profit, and keep the capital flow efficient [11].

Nutrition sufficiency has big effect towards productivity and it is closely related to the function of the digestive tract of the chicken. The optimal functioning digestive tract of the chicken has direct effects on the process of digestion and absorption of nutrients. Disturbance on digestive and gastrointestinal organs of the chicken will create strong growth barrier. This may cause by bacterial infection and will increases chicken morbidity and mortality.

During 2010, gastrointestinal tract cases towards chicken skyrocketed. Diseases such as Necrotic Enteritis mainly affect the chicken intestine, whereas other bacterial diseases such as Colibacillosis, Cholera and Pullorum damage almost all the organs of the chicken, including the digestive organs. Medion's technical service team reported that Colibacillosis, Cholera and Pullorum diseases are still common at farms [12]. Some cases of digestive diseases are opportunistic. This means that normally the disease-causing microorganisms are in the intestine in controlled amounts, but when the chicken condition decreases due to stress etc., the microorganism may develop into a pathogen.

While the weather conditions drastically changed, the chicken health condition tends to decline due to stress and the immune defense system is not optimal, increasing diseases cases. During brooding, where breeders pay less attention to the dynamic changes of temperature, the case number may increase. Rainy season also play role on bacterial spreading through litter, feces and contaminated drinking water in the farm.

THE DETECTION OF DISGESTIVE TRACT DISEASE

Notation used in research:

V_{MAP} : The highest probability of broiler chicken disease.

$a_1, a_2, a_3, \dots a_n$: Attribute input in the form of symptoms of the disease.

B : The chicken hypothesis is exposed to certain diseases.

A : Symptoms of the disease.

P(B|A) : Probability of hypothesis type of disease based on symptoms.

P(A|B) : Probability of disease symptoms based on conditions of the type of hypothesized disease.

P(B) : Probability of hypothesized type of disease.

P(A) : Probability of symptoms of the disease.

$P(v_j)$: Opportunities of gastrointestinal diseases.

$P(\alpha_1 \alpha_2 \dots \alpha_n \mid v_j)$: Opportunity attributes input form of symptoms of disease if the state of the disease type is known.

$P(\alpha_1 \alpha_2 \dots \alpha_n)$: Opportunity attributes input form of symptoms of disease.

n_c : Amount of symptoms of each disease.

p : 1/ number of diseases.

m : Number of symptoms.

n : The amount of disease data in each class.

Naive Bayes formula:

At the time of classification, the Naive Bayes approach will result in the highest category label labeling the probability of V_{MAP} by entering the attributes $\alpha_1, \alpha_2, \alpha_3, \dots \alpha_n$.

$$V_{MAP} = argmax_{vj \in V}\, P(V_j | a_1, a_2, a_3, \dots a_n) \quad (1)$$

Naive Bayes theorem:

$$P(B|A) = \frac{P(A|B)P(B)}{P(A)} \quad (2)$$

Using this Naive Bayes theorem, equation (1) can be written as follows:

$$V_{MAP} = Aargmax_{vj \in V} \frac{P(a_1 a_2 \dots a_n | v_j) P(v_j)}{P(a_1 a_2 \dots . a_n)} \quad (3)$$

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Since the p values (α_1, α_2, α_3, ... α_n.) are constant values for all v_j so this equation is written:

$$V_{MAP} = argmax_{vj \in V} P(a_1 a_2 \dots . a_n \mid v_j)\, P(v_j) \qquad (4)$$

The calculation of Naive Bayes classifier is to calculate P (a_i | a_j) by the formula:

$$P(a_i | v_j) = \frac{n_c + m.p}{n + m} \qquad (5)$$

Equation (5) is solved by the following calculation:

a) Specifies the nc value for each class
b) Calculating values P (a_i|v_j) and calculate the value of P (v_j)
   $V_{MAP} = argmax_{vj \in V}\, P(v_j)\Pi_i P(a_i|v_j)$
   When : $P(a_i|v_j) = \frac{n_c + m.p}{n+m}$
c) Calculating P (a_i|v_j) x P (vj) for every V
d) Determining the classification result v that has the greatest multiplication result

RESULTS AND DISCUSSION

This study involves 60 cases of gastrointestinal disease, 26 symptoms and 4 types of diseases. Symptoms data of chicken samples are noted and compared with symptoms data caused by gastrointestinal tract diseases. A calculation example using Naive Bayes can be applied to the 1st chicken's data sample experiencing symptoms number 1, 2, 3 and 4.

Symptom description:

1. Dilute white shit
2. Lethargic
3. Curl up
4. No appetite

The steps can be described as follow:

1. Specify the nc value for each class
   1st gastrointestinal disease: Infectious Bursal Disease (IBD)
   N = 1
   P = ¼ = 0.25
   M = 26
   1.nc = 1
   2.nc = 1
   4.nc = 1
   3.nc = 1
   2nd gastrointestinal tract diseases: Pullorum
   N = 1
   P = ¼ = 0.25
   M = 26
   1.nc = 0
   2.nc = 1
   4.nc = 0
   3.nc = 1
   3rd gastrointestinal disease: Avian Influenza
   N = 1
   P = ¼ = 0.25
   M = 26
   1.nc = 0
   2.nc = 1
   4.nc = 0
   3.nc = 1
   4th digestive tract disease: Newcastle Disease
   N = 1
   P = ¼ = 0.25
   M = 26
   1.nc = 0
   2.nc = 1
   4.nc = 0
   3.nc = 1
2. Calculating values P (a_i|v_j) and calculate the value of P ($_{vj}$)
   1st gastrointestinal disease: Infectious Bursal Disease (IBD)
   $P(1|G) = \frac{1 + 26x0,25}{1 + 26} = 1,24074$
   $P(2|G) = \frac{1 + 26x0,25}{1 + 26} = 1,24074$
   $P(4|G) = \frac{1 + 26x0,25}{1 + 26} = 1,24074$
   $P(3|G) = \frac{1 + 26x0,25}{1 + 26} = 1,24074$
   P(G) = ¼ = 0,25
   2nd gastrointestinal tract diseases: Pullorum
   $P(1|BK) = \frac{0 + 26x0,25}{1 + 26} = 0,24074$
   $P(2|BK) = \frac{1 + 26x0,25}{1 + 26} = 1,24074$
   $P(4|BK) = \frac{0 + 26x0,25}{1 + 26} = 0,24074$
   $P(3|BK) = \frac{1 + 26x0,25}{1 + 26} = 1,24074$
   P(BK) = ¼ = 0,25
   3rd gastrointestinal disease: Avian Influenza
   $P(1|FB) = \frac{0 + 26x0,25}{1 + 26} = 0,24074$
   $P(2|FB) = \frac{1 + 26x0,25}{1 + 26} = 1,24074$
   $P(4|FB) = \frac{0 + 26x0,25}{1 + 26} = 0,24074$
   $P(3|FB) = \frac{1 + 26x0,25}{1 + 26} = 1,24074$
   P(FB) = ¼ = 0,25
   4th digestive tract disease: Newcastle Disease
   $P(1|T) = \frac{0 + 26x0,25}{1 + 26} = 0,24074$
   $P(2|T) = \frac{1 + 26x0,25}{1 + 26} = 1,24074$
   $P(4|T) = \frac{0 + 26x0,25}{1 + 26} = 0,24074$
   $P(3|T) = \frac{1 + 26x0,25}{1 + 26} = 1,24074$
   P(T) = ¼ = 0,25
3. Calculating P (a_i|v_j) x P (vj) for every V
   1st gastrointestinal disease: Infectious Bursal Disease (IBD)
   P(G) x [P(1|G) x P(2|G) x P(4|G) x P(3|G)]
   = 0,25 x 1,24074 x 1, 24074 x 1,24074 x 24074
   = 0,59247
   2nd gastrointestinal tract diseases: Pullorum
   P(BK) x [P(1|BK) x P(2|BK) x P(4|BK) x P(3|BK)]
   = 0,25 x 0,24074 x 1, 24074 x 0,24074 x 24074
   = 0,0223
   3rd gastrointestinal disease: Avian Influenza
   P(FB) x [P(1|FB) x P(2|FB) x P(4|FB) x P(3|FB)]
   = 0,25 x 0,24074 x 1, 24074 x 0,24074 x 24074
   = 0,0223
   4th digestive tract disease: Newcastle Disease
   P(T) x [P(1|T) x P(2|T) x P(4|T) x P(3|T)]
   = 0,25 x 0,24074 x 1, 24074 x 0,24074 x 24074
   = 0,0223
4. Determining the clarification result v that has the greatest multiplication result.

The result of *v* that has the largest multiplication is found in Table 1.

Table 1. Value Comparison V

Disease	Value v
Infectious Bursal Disease (IBD)	0,59247
Pullorum	0,0223
Avian Influenza	0,0223
Newcastle Disease	0,0223

Since the value of 0.59247 is the largest, then the example of the case of the 1st chicken is classified as Infectious Bursal Disease (IBD) disease.

The results of Naive Bayes algorithm for all the data set is then compared with the diagnosis of the real expert. Comparison of the results is shown in Table 2.

Table 2. Comparison of Diagnostic Results between Expert and Naive Bayes

Data to-	Infectious Bursal Disease (IBD)	Pullorum	Avian Influenza	Newcastle Disease	Expert	Naive Bayes	Error
1	0,59247	0,02230	0,02230	0,02230	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
2	0,73510	0,00537	0,00104	0,00104	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
3	0,91207	0,03433	0,00025	0,00025	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
4	0,59247	0,00433	0,00433	0,00433	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
5	0,73510	0,00537	0,02767	0,14263	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
6	0,59247	0,00433	0,00433	0,02230	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
7	0,73510	0,00537	0,14263	0,14263	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
8	0,47751	0,01798	0,09265	0,09265	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
9	0,73510	0,00537	0,00537	0,02767	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
10	0,38486	0,01449	0,07467	0,07467	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
11	0,91207	0,00129	0,00129	0,00129	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
12	0,47751	0,01798	0,00349	0,00349	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
13	0,47751	0,01798	0,01798	0,09265	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
14	0,59247	0,00433	0,02230	0,59246	Infectious Bursal Disease (IBD)	Undetected	Yes
15	0,47751	0,00349	0,00349	0,01798	Infectious Bursal Disease (IBD)	Infectious Bursal Disease (IBD)	No
16	0,11496	0,59247	0,02230	0,02230	Pullorum	Pullorum	No
17	0,02767	0.73510	0,00104	0,00104	Pullorum	Pullorum	No
18	0,09265	0,47751	0,00349	0,00349	Pullorum	Pullorum	No
19	0,09265	0,47751	0,01798	0,01798	Pullorum	Pullorum	No
20	0,09265	0,47751	0,01798	0,01798	Pullorum	Pullorum	No
21	0,00666	0,91207	0,00129	0,00666	Pullorum	Pullorum	No
22	0,00537	0,73510	0,00020	0,00104	Pullorum	Pullorum	No
23	0,02767	0,73510	0,00537	0,00537	Pullorum	Pullorum	No
24	0,00537	0,73510	0,00104	0,00537	Pullorum	Pullorum	No
25	0,14263	0,73510	0,00104	0,00104	Pullorum	Pullorum	No
26	0,01449	0,38486	0,01449	0,07467	Pullorum	Pullorum	No
27	0,00433	0,59247	0,00084	0,00433	Pullorum	Pullorum	No
28	0,01798	0,47751	0,00349	0,00349	Pullorum	Pullorum	No
29	0,00104	0,73510	0,00020	0,00104	Pullorum	Pullorum	No
30	0,17697	0,03434	0,00129	0,00129	Pullorum	Infectious Bursal Disease (IBD)	Yes
31	0,00537	0,00537	0,73510	0,00537	Avian Influenza	Avian Influenza	No
32	0,02767	0,00537	0,73510	0,02767	Avian Influenza	Avian Influenza	No
33	0,00433	0,00084	0,59247	0,00433	Avian Influenza	Avian Influenza	No

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34	0,09265	0,09226	0,47751	0,01798	Avian Influenza	Avian Influenza	No
35	0,01449	0,01449	0,38486	0,01449	Avian Influenza	Avian Influenza	No
36	0,00433	0,00433	0,59247	0,00433	Avian Influenza	Avian Influenza	No
37	0,02230	0,00433	0,59247	0,02230	Avian Influenza	Avian Influenza	No
38	0,00537	0,00104	0,02767	0,14263	Avian Influenza	Newcastle Disease	Yes
39	0,00537	0,00104	0,73510	0,00537	Avian Influenza	Avian Influenza	No
40	0,09265	0,09265	0,47751	0,09265	Avian Influenza	Avian Influenza	No
41	0,00537	0,00104	0,73510	0,02767	Avian Influenza	Avian Influenza	No
42	0,01449	0,01449	0,38486	0,01449	Avian Influenza	Avian Influenza	No
43	0,09265	0,01798	0,47751	0,09265	Avian Influenza	Avian Influenza	No
44	0,14263	0,00537	0,14263	0,02767	Avian Influenza	Undetected	No
45	0,01449	0,01449	0,38486	0,01449	Avian Influenza	Avian Influenza	No
46	0,09265	0,09265	0,09265	0,47751	Newcastle Disease	Newcastle Disease	No
47	0,00537	0,00537	0,00104	0,73510	Newcastle Disease	Newcastle Disease	No
48	0,02767	0,00537	0,02767	0,73510	Newcastle Disease	Newcastle Disease	No
49	0,00537	0,00104	0,00537	0,73510	Newcastle Disease	Newcastle Disease	No
50	0,11496	0,00433	0,02230	0,59247	Newcastle Disease	Newcastle Disease	No
51	0,00537	0,00104	0,00537	0,73510	Newcastle Disease	Newcastle Disease	No
52	0,01505	0,01449	0,01449	0,38486	Newcastle Disease	Newcastle Disease	No
53	0,00084	0,00084	0,00084	0,59347	Newcastle Disease	Newcastle Disease	No
54	0,09265	0,01798	0,09265	0,47751	Newcastle Disease	Newcastle Disease	No
55	0,01798	0,09265	0,01798	0,01798	Newcastle Disease	Pullorum	Yes
56	0,00129	0,00025	0,00025	0,91207	Newcastle Disease	Newcastle Disease	No
57	0,00084	0,00087	0,00084	0,59247	Newcastle Disease	Newcastle Disease	No
58	0,00537	0,02767	0,00537	0,73510	Newcastle Disease	Newcastle Disease	No
59	0,00666	0,00666	0,00129	0,91207	Newcastle Disease	Newcastle Disease	No
60	0,01798	0,00349	0,01798	0,47751	Newcastle Disease	Newcastle Disease	No

Based on the comparison, its performance can be described as follow: the number of error data is 4, the amount of correct data is 56. Therefore, the accuracy of the method is 93.3 %. The Confusion matrix is given in table 3:

Table 3. Conversion Naive Bayes to *Confusion Matrix*

Class	Positive	Negative
Positive	TP : 28	FN : 28
Negative	FP : 2	TN : 2

Based on the confusion matrix, each class of diseases shows identical result as follow:

Table 4. Result for each class of disease

Diseases	Recall	Precision	Accuracy
Infectious Bursal Disease (IBD)	93.3 %	100 %	93.3 %
Pullorum	93.3 %	100 %	93.3 %
Avian Influenza	93.3 %	100 %	93.3 %
Newcastle Disease	93.3 %	100 %	93.3 %

The confusion matrix shows that the accuracy of using the Naive Bayes method is quite high at 93.3%, which represents correctly identified value of the proportion towards correctly identified cases, and the proportion of cases towards true positive results.

CONCLUSIONS

Based on the results and discussion it can be concluded that Naive Bayes has the potential to be used for Broiler Digestive

Tract Disease Detection. The experiment result using sample data show that the accuracy reached 93,3%, which is good. There are chickens with gastrointestinal disease that cannot be determined using Naive Bayes, this is due to the value of classification which as high as some types of gastrointestinal diseases. This study can be enhanced by applied the method for larger data samples as well as applied modification of the method or other method to obtain with higher accuracy.

REFERENCES

[1]. Wikipedia. 2015. "Ayam broiler". https://id.wikipedia.org/wiki/Ayam_broiler. (Diakses pada tanggal 13 Desember 2017)

[2]. Informatikalogi. 2017. "Algoritma Naive Bayes" https://informatikalogi.com/algoritma-naive-bayes/. (Diakses pada tanggal 02 Mei 2015)

[3]. Saleh Alfa. 2015. "Implementasi Metode Klasifikasi Naive Bayes Dalam Memprediksi Besarnya Penggunaan Listrik Rumah Tangga". Citec Jurnal. Vol. 2, No. 3.

[4]. Hermawati Laily. 2012. "Penerapan Algoritma Naive Bayes Untuk Deteksi Bakteri E-Coli". Jurnal Teknik Unisfat. Vol. 8, No. 1, Hal. 17-23.

[5]. Syarifudin Achmad, Hidayat Nurul & Fanani Lutfi. 2017. "Sistem Pakar Diagnosis Pada Tanaman Jagung Menggunakan metode Naive Bayes Berbasis Android". Jurnal Pengembangan Teknologi Informasi Dan Ilmu Komputer. Vol. 2, No. 7, Hal. 2738-2744.

[6]. Sulaksono Juli & Darsono. 2015. "Sistem Pakar Penentuan Penyakit Gagal Jantung Menggunakan Metode Naive Bayes Classifier". Seminar Nasional Teknologi Informasi Dan Multimedia 2015. ISSN : 2302-3805.

[7]. Ginting Garuda, Tarigan S. H. Siska, & Fadlina. 2017. "Sistem Pakar Mendiagnosa Penyakit Gumboro Pada Ayam Broiler Dengan Metode Certainty Factor". Media Informatika Budidarma. Vol. 1, No. 2, Hal. 54-57.

[8]. Sandjaja Andry, Emanuel W. H. Andi, & Wijianto C. Maresha. "Sistem Pakar Deteksi Penyakit Ayam Dengan Media Interaktif". Seminar Nasional Teknologi Informasi Dan Komunikasi. ISSN : 2089-9815.

[9]. Setiawan Wahyudi & Ratnasari Sofie. 2014. "Sistem Pakar Diagnosis Penyakit Mata Menggunakan Naive Bayes Classifier". Seminar Nasional Sains Dan Teknologi, ISSN : 2407-1846.

[10]. Omkicau. 2017. "Budidaya Ayam Ras Pedaging". https://omkicau.com/berbagai-peluang-usaha-bidang-peternakan-perkebunan/budidaya-ayam-ras-pedaging/. (Diakses pada tanggal 13 Desember 2017)

[11]. Ilmu Ternak. 2016. "Cara Beternak Ayam Pedaging (Broiler) Yang Baik Bagi Pemula". http://www.ilmuternak.com/2016/05/cara-beternak-ayam-pedaging-broiler-yang-baik-bagi-pemula.html#. (Diakses pada tanggal 13 Desember 2017).

[12]. Info Midion Online. 2011. "Gangguan Pencernaan Akibat Infeksi Bakteri". http://info.medion.co.id/artikel-broiler/artikel-penyakit/2131-gangguan-pencernaan-akibat-infeksi-bakteri-2.html. (Diakses pada tanggal 13 Desember 2017)

AUTHOR(S) BIOGRAPHY

Christian Cahyaningtyas
Christian Cahyaningtyas received her B.Cs. from the Department of Information Technology, Satya Wacana Christian University, Indonesia. Her research interest is in the field of applied computing for farming.

Hindriyanto Dwi Purnomo
Hindriyanto Dwi Purnomo is a senior lecturer at the Department of Information Technology, Satya Wacana Christian University, Indonesia. He has published many articles in well-known journal as well as conference. His research interests are in the field of applied soft-computing and intelligence system.

Budhi Kristianto
Budhi Kristianto is a senior lecturer at the Department of Information Technology, Satya Wacana Christian University, Indonesia. His research interests are in the field of data science and biomedical informatics.

APPENDICES

Table 1. Type of Digestive Tract Disease

No	The type of disease
1	Infectious Bursal Disease (IBD)
2	Pullorum
3	Avian influenza
4	Newcastle disease

Table 2. Diseases of the Gastrointestinal Tract Symptoms

No.	Symptoms
1	Dilute white feces
2	Lethargic
3	No appetite
4	Curl up
5	Matted fur
6	Clustered
7	Feathers dirty around the anus
8	Sleeping with a beak laid over the floor
9	Tremble
10	The breath breathless
11	Condensed white shit
12	Had descended beneath the wings
13	Shit white dilute and a deep green
14	Cockscomb blue
15	Sudden dead
16	The neck twisted
17	Paralyzed
18	Coughing and sneezing
19	Snoring
20	Feathers suddenly standing
21	Cockscomb purplish
22	Wings circulation
23	Appear spots on the body
24	Shit white dilute and a pale green
25	Sleepy
26	Blindfolded

Table 3. Disease and Symptom

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No.	Disease Name	Disease Symptom
1.	Infectious bursal disease (IBD)	1, 2, 4, 3
2.	Infectious bursal disease (IBD)	2, 5, 6, 1, 7
3.	Infectious bursal disease (IBD)	1, 2, 25, 5, 26, 6
4.	Infectious bursal disease (IBD)	5, 1, 2, 8
5.	Infectious bursal disease (IBD)	9, 2, 3, 10, 1
6.	Infectious bursal disease (IBD)	1, 5, 2, 9
7.	Infectious bursal disease (IBD)	1, 3
8.	Infectious bursal disease (IBD)	2, 9, 1
9.	Infectious bursal disease (IBD)	1, 7, 3, 2, 9
10.	Infectious bursal disease (IBD)	1, 7
11.	Infectious bursal disease (IBD)	1, 4, 2, 5, 3, 8
12.	Infectious bursal disease (IBD)	1, 25, 7
13.	Infectious bursal disease (IBD)	1, 3, 9
14.	Infectious bursal disease (IBD)	3, 9, 10, 19
15.	Infectious bursal disease (IBD)	9, 7, 1
16.	Pullorum	11, 2, 25, 3
17.	Pullorum	11, 3, 6, 26, 12
18.	Pullorum	25, 6, 11
19.	Pullorum	2, 11, 25
20.	Pullorum	25, 3, 11
21.	Pullorum	11, 21, 25, 3, 2, 12,17
22.	Pullorum	20, 21, 26, 17, 11
23.	Pullorum	11, 25, 2, 3, 12
24.	Pullorum	17, 3, 11, 26, 12, 21
25.	Pullorum	25, 26, 6, 3, 11, 2
26.	Pullorum	17, 11
27.	Pullorum	12, 17, 26, 11
28.	Pullorum	26, 11, 20
29.	Pullorum	20, 25, 21, 17, 11
30.	Pullorum	6, 4, 2, 5, 3, 11, 14
31.	Avian influenza	13, 2, 3, 14, 15
32.	Avian influenza	13, 2, 3, 14, 10, 15
33.	Avian influenza	15, 10, 14, 13
34.	Avian influenza	2, 13, 14
35.	Avian influenza	14, 13
36.	Avian influenza	13, 14, 15, 2
37.	Avian influenza	2, 10, 14, 13
38.	Avian influenza	10, 18, 19, 13, 3
39.	Avian influenza	3, 14, 10, 23, 13
40.	Avian influenza	3, 2, 13
41.	Avian influenza	23, 15, 10, 13, 2, 3
42.	Avian influenza	23, 13
43.	Avian influenza	10, 3, 13
44.	Avian influenza	2, 13, 3, 10, 26
45.	Avian influenza	15, 13
46.	Newcastle disease	24, 3, 2
47.	Newcastle disease	9, 24, 2, 17, 16
48.	Newcastle disease	24, 3, 2, 10, 18, 19
49.	Newcastle disease	24, 2, 10, 18, 19
50.	Newcastle disease	3, 24, 10, 9
51.	Newcastle disease	18, 19, 10, 3, 24
52.	Newcastle disease	16, 24
53.	Newcastle disease	18, 19, 16, 24
54.	Newcastle disease	24, 3, 10
55.	Newcastle disease	12, 24, 21
56.	Newcastle disease	16, 22, 17, 19, 10, 24, 3
57.	Newcastle disease	18, 19, 22, 24
58.	Newcastle disease	17, 2, 3, 16, 22, 24
59.	Newcastle disease	18, 19, 3, 2, 9, 16, 24
60.	Newcastle disease	10, 18, 19, 24