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Web-Based Expert System for Diagnosing Human Eye Disease Using the Naïve Bayes Method

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ABSTRACT

The eye is one of the organs of the body that is very important for humans, so it must be kept in good health, but as humans age and the unhealthy lifestyle of many people in Indonesia experience problems with their eyes. Based on the existing problems this study discusses the application of expert systems to diagnose eye diseases. The data used for the study consisted of 22 symptoms and 5 eye diseases. Expert system that was built using the Naïve Bayes method. There are two stages of work from this application. First, the system asks the patient to choose the symptoms they are experiencing. Secondly, the system will automatically display the diagnosis results of the eye disease suffered by the patient through the calculation of Naïve Bayes. This system has advantages compared to the existing system in the reference journal, namely in the design of the symptom page display, making it easier for users to answer according to the symptoms felt. The results of subsequent system diagnoses are compared with the results of diagnoses from actual experts. The system trial used data of 15 eye disease patients. From the experimental results, the percentage of diagnostic suitability of 86%.

1. Introduction

Advances in technology had been unable to deny it again. Technology has now become a part of life for human beings, both in everyday life and in terms of work or anything related to humans. One existing technology is artificial intelligence (artificial intelligence) technology which is helping people work normally only someone expert or experts who can, namely expert systems (expert systems), is a derivative of Artificial Intelligence (artificial intelligence), the system can be incorporated in a computer, the Website-based, Android, and Desktop Applications.

In accordance title taken, diagnosis of eye diseases using expert systems require algorithms in the process, and in this journal using Naïve Bayes method. Naïve Bayes method serves as a classifier of some attributes of a condition suffered symptomatic cases to obtain a category that has the highest probability [1].

And in the journal this time trying to develop a website or program in reference journals. Website created using PHP programming language, namely ftamework Bootstrap CSS and MySQL as the database. The purpose of this Final Project research carried out to establish a web-based application to diagnosis of eye diseases in humans which are equipped with the causes and solutions to the disease diagnosed for the user and determine the statistical probability of eye diseases in humans with the adoption of Naïve Bayes.

2. Research Methods

2.1 Method of Naïve Bayes

Naive Bayes is a simple method for classifying probability based on the Bayes theorem. In Bayes's Theorem combined with "Naive" which means the attribute with abandonment / stand alone (independent).

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Steps Naïve Bayes calculation method as follows [1]:
1. Determine the category (disease) which appear based on training data.
2. Calculating the value of the probability of disease and symptoms.
3. Calculating the value of Bayes based on the probability of disease and symptoms.
4. Determining the percentage of the predicted value category.

In the process of naïve Bayes probability formula as follows:

$$(1)\ P(H|X) = \frac{P(X|H)\,P(H)}{P(X)}$$

Where:
X = an unknown class data
H = hypothesis that the data are a specific class
P (H | X) = the probability of the hypothesis H is based on the condition X (posterior probability)
P (H) = probability of the hypothesis H (prior probability)
P (X | H) = probability X is based on the condition H
P (X) = probability of X

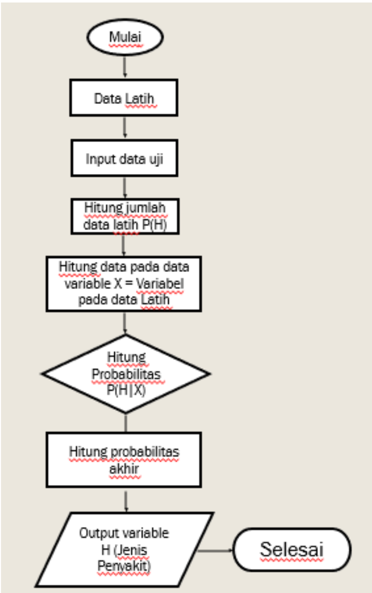

Fig 1, method flowchart

In Figure 1, describes the calculation steps of Naïve Bayes methods that are implemented in a system that is created. The first is to input the training data, both count the number of training data and calculate the amount of the variable data in the training data. Then recalculate the probability end for output on any kind of human eye diseases.

2.2 Application Flowchart

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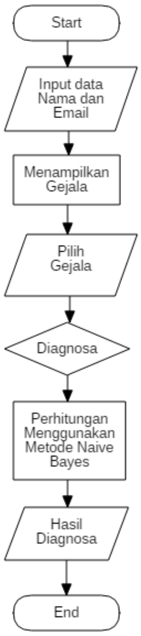

Fig 2. Application flowchart

In Figure 2, described how the flow is in the system that has been created. Starting from entering the name and e-mail, after which the system will display symptoms that correspond with the specialist / expert, then the user will select any symptoms experienced, then the system will calculate and display the results of the diagnosis of eye disease user based on that user input and can print the diagnostic results.

3. Results and Discussion

3.1 Data Collection Process

After collecting data from specialists / experts in the can after the interview, they invented a table of disease, disease symptoms table and the sample table system rules.

Table 1, Types of diseases

Diseases code	Disease name
P01	Cataract
P02	Glaucoma
P03	conjunctivitis
P04	Macular degeneration
P05	Retina ablation

In Table 1, described some eye disease is most common, according to experts / specialists.

table 2. Disease symptoms

Symptoms code	Symptoms name
G01	Experiencing severe eye pain
G02	Currency decreased vision at night
G03	Eyes have difficulty seeing at night
G04	Dazzled eyes will light
G05	Eye glasses frequently change
G06	Eye perceives double vision in one eye side
G07	Experienced eye swollen eye lens
G08	Eyes feel pain / tenderness
G09	Suppress excessive eye blink
G10	Eye perceives a rainbow-colored light source if you see neon lights

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G11	Eye experiencing blurred vision gradually becomes normal
G12	Eye swelling
G13	Eye experiencing blurred vision
G14	Eyes sensitive to light
G15	Watery eyes
G16	Experienced eye itching
G17	Currency impaired vision in one eye
G18	Eyes wavy line
G19	The eye is not painful
G20	Experienced eye strain
G21	Eyes experiencing vision hovering
G22	Eyes like seeing flashes of light

In Table 2, describes the symptoms of the disease existing in Table 1.

Table 3. Example Rule System

IF	THEN
G01, G02, G03, G04, G05, G06, G07	Cataract
G08, G09, G10, G11, G12	Glaucoma
G01, G05, G06, G07, G13, G14, G15, G16	conjunctivitis
G17, G18, G19	Macular degeneration
G13, G20, G21, G22	Retina ablation

In Table 3, explain the rules of each respective class of eye disease by experts.

3.2 Calculation Process Naïve Bayes Method

Example calculations using Naive Bayes method can be applied to one of the eye diseases in Table 1 are cataracts, as follows:

Table 4. Cataract Cases experience along Symptoms

Symptoms code	Symptoms name	symptoms Experienced
G01	Experiencing severe eye pain	Yes
G02	Currency decreased vision at night	Yes
G03	Eyes have difficulty seeing at night	Yes
G04	Dazzled eyes will light	Yes
G05	Eye glasses frequently change	Yes
G06	Eye perceives double vision in one eye side	Yes
G07	Experienced eye swollen eye lens	Yes
G08	Eyes feel pain / tenderness	No
G09	Suppress excessive eye blink	No
G10	Eye perceives a rainbow-colored light source if you see neon lights	No

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G11	Eye experiencing blurred vision gradually becomes normal	No
G12	Eye swelling	No
G13	Eye experiencing blurred vision	No
G14	Eyes sensitive to light	No
G15	Watery eyes	No
G16	Experienced eye itching	No
G17	Currency impaired vision in one eye	No
G18	Eyes wavy line	No
G19	The eye is not painful	No
G20	Experienced eye strain	No
G21	Eyes experiencing vision hovering	No
G22	Eyes like seeing flashes of light	No

Based on the cases in Table 4, the application of Naïve Bayes calculation as follows:

1. Calculating the amount of training data class / Label / P (X). The amount of data from cataracts, glaucoma, conjunctivitis, Degenaeasi Macula and Retina Ablation on training data compared with the entire amount of data.

table 5, Amount of Each Class

Number of Class Diseases / Entire Data Practice	
1	P (X = Cataracts) = 14/54 = 0.2592
2	P (X = Glaucoma) = 10/54 = 0.1851
3	P (X = conjunctivitis) = 16/54 = 0.2962
4	P (X = Macular Degeneration) = 6/54 = 0.1111
5	P (X = Ablation Retina) = 8/54 = 0.1481

In Table 5, shows of each Class disease divided by the total number of training data.

2. Calculating the amount of the same case with the same Class suffered cataracts / P (H | X)

Table 6. The calculation of P (H | X)

Probability calculations Cataracts: Number of cases with the same Class / P (H | X)	
Calculate G1	P (G01 = Yes | X = Cataracts) = 7/14 = 0.5
	P (G01 = Yes | X = Glaucoma) = 1/10 = 0.1
	P (G01 = Yes | X = conjunctivitis) = 8/16 = 0.5
	P (G01 = Yes | X = Macular Degeneration) = 1/6 = 0.16
	P (G01 = Yes | X = Ablation Retina) = 1/8 = 0.125
Calculate G2	P (G02 = Yes | X = Cataracts) = 7/14 = 0.5
	P (G02 = Yes | X = Glaucoma) = 1/10 = 0.1
	P (G02 = Yes | X = conjunctivitis) = 1/16 = 0.0625
	P (G02 = Yes | X = Macular Degeneration) = 1/6 = 0.16
	P (G02 = Yes | X = Ablation Retina) = 1/8 = 0.125
Calculate G3	P (G03 = Yes | X = Cataracts) = 7/14 = 0.5
	P (G03 = Yes | X = Glaucoma) =

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	1/10 = 0.1
	P (G03 = Yes | X = conjunctivitis) = 1/16 = 0.0625
	P (G03 = Yes | X = Macular Degeneration) = 1/6 = 0.16
	P (G03 = Yes | X = Ablation Retina) = 1/8 = 0.125
Calculate G4	P (G04 = Yes | X = Cataracts) = 7/14 = 0.5
	P (G04 = Yes | X = Glaucoma) = 1/10 = 0.1
	P (G04 = Yes | X = conjunctivitis) = 1/16 = 0.0625
	P (G04 = Yes | X = Macular Degeneration) = 1/6 = 0.16
	P (G04 = Yes | X = Ablation Retina) = 1/8 = 0.125
Calculate G5	P (G05 = Yes | X = Cataracts) = 7/14 = 0.5
	P (G05 = Yes | X = Glaucoma) = 1/10 = 0.1
	P (G05 = Yes | X = conjunctivitis) = 8/16 = 0.5
	P (G05 = Yes | X = Macular Degeneration) = 1/6 = 0.16
	P (G05 = Yes | X = Ablation Retina) = 1/8 = 0.125
Calculate G6	P (G06 = Yes | X = Cataracts) = 7/14 = 0.5
	P (G06 = Yes | X = Glaucoma) = 1/10 = 0.1
	P (G06 = Yes | X = conjunctivitis) = 8/16 = 0.5
	P (G06 = Yes | X = Macular Degeneration) = 1/6 = 0.16
	P (G06 = Yes | X = Ablation Retina) = 1/8 = 0.125
Calculate G7	P (G07 = Yes | X = Cataracts) = 7/14 = 0.5
	P (G07 = Yes | X = Glaucoma) = 1/10 = 0.1
	P (G07 = Yes | X = conjunctivitis) = 8/16 = 0.5
	P (G07 = Yes | X = Macular Degeneration) = 1/6 = 0.16
	P (G07 = Yes | X = Ablation Retina) = 1/8 = 0.125
Calculate G8	P (G08 = No | X = Cataracts) = 13/14 = 0.9285
	P (G08 = No | X = Glaucoma) = 5/10 = 0.5
	P (G08 = No | X = conjunctivitis)

	= 15/16 = 0.9375
	P (G08 = No | X = Macular Degeneration) = 5/6 = 0.8333
	P (G08 = No | X = Ablation Retina) = 7/8 = 0.875
Calculate G9	P (G09 = No | X = Cataracts) = 13/14 = 0.9285
	P (G09 = No | X = Glaucoma) = 5/10 = 0.5
	P (G09 = No | X = conjunctivitis) = 15/16 = 0.9375
	P (G09 = No | X = Macular Degeneration) = 5/6 = 0.8333
	P (G09 = No | X = Ablation Retina) = 7/8 = 0.875
Calculate G10	P (G10 = No | X = Cataracts) = 13/14 = 0.9285
	P (G10 = No | X = Glaucoma) = 5/10 = 0.5
	P (G10 = No | X = conjunctivitis) = 15/16 = 0.9375
	P (G10 = No | X = Macular Degeneration) = 5/6 = 0.8333
	P (G10 = No | X = Ablation Retina) = 7/8 = 0.875
....	**....**
Calculate G20	P (G20 = No | X = Cataracts) = 13/14 = 0.9285
	P (G20 = No | X = Glaucoma) = 9/10 = 0.9
	P (G20 = No | X = conjunctivitis) = 15/16 = 0.9375
	P (G20 = No | X = Macular Degeneration) = 5/6 = 0.8333
	P (G20 = No | X = Ablation Retina) = 4/8 = 0.5
Calculate G21	P (G21 = No | X = Cataracts) = 13/14 = 0.9285
	P (G21 = No | X = Glaucoma) = 9/10 = 0.9
	P (G21 = No | X = conjunctivitis) = 15/16 = 0.9375
	P (G21 = No | X = Macular Degeneration) = 5/6 = 0.8333
	P (G21 = No | X = Ablation Retina) = 4/8 = 0.5
Calculate G22	P (G22 = No | X = Cataracts) = 13/14 = 0.9285
	P (G22 = No | X = Glaucoma) =

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	9/10 = 0.9
	P (G22 = No | X = conjunctivitis) = 15/16 = 0.9375
	P (G22 = No | X = Macular Degeneration) = 5/6 = 0.8333

	P (G22 = No | X = Ablation Retina) = 4/8 = 0.5

In Table 6 describes the calculation of any symptoms of cataracts with hypotheses and generating a probability value of each Class cataract disease based on symptoms experienced.

3. Multiply all the result of cataracts, glaucoma, Konjuntivitas, degeneration of the macula and retina detachment.

Table 7. Multiplication of Class Diseases

Types of diseases	Results Multiplication
Cataract	0.000666429
Glaucoma	.0000000002017815
conjunctivitis	.000000138935
Macular degeneration	.0000000055646
Retina ablation	.00000000101633

In Table 7 is the result of the multiplication of each class of cataracts, glaucoma, conjunctivitis, macular degeneration and retinal detachment that has been multiplied by the sum of the class. Then compared the results of a class of diseases, based on the results that have been able it will show the highest probability value is in P (X = Cataracts). So it can be concluded that calcification diseases suffered by the human eye are cataracts.

3.3 display Interface

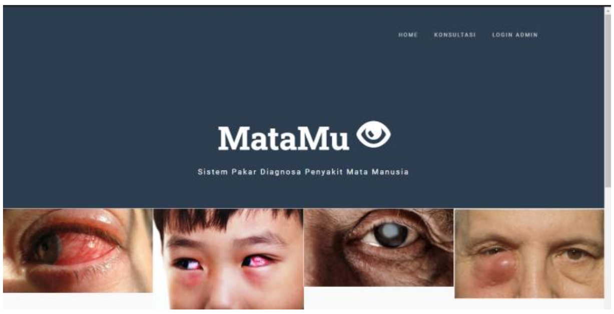

Figure 3. Home Applications

In Figure 3 is an initial display of eye disease diagnosis expert system based on web. Inside there is a picture of eye disease and displays an information and information about the application. There navbar consisting of Home and Consulting.

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Figure 4. Weather Consulting

In figure 4 shows the view pages in Consulting, in it was told that there were 22 questions which should be in charge and before going into the question, the user must write the name and email:.

Figure 5. Symptoms options page User

In Figure 5 show the questions / choices symptoms experienced user and all there are 22 questions / symptoms to be selected by users.

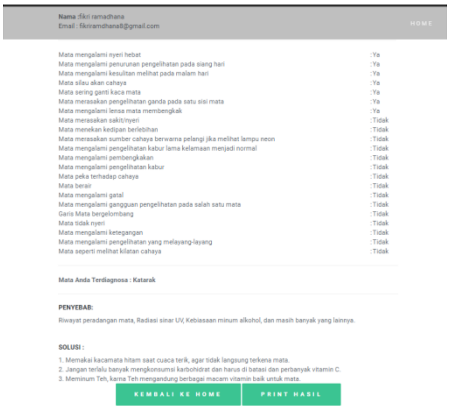

Figure 6. Diagnosis Result Display

Figure 6 shows the results of the diagnosis after the user selects the symptom in Figure 6. And the result will appear in accordance with the highest probability. And on this page features the Print diagnosis and Return to Home.

3.4 Testing and Accuracy

Comparison of the results of the testing on the system with testing conducted by a specialist to determine the level of accuracy in the system are made.

table 8, Comparison with Expert System

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No.	symptom	System	Specialists (Refrensi)	result
1	G1, G2, G5, G7	KT	KT	√
2	G2, G3, G4	KT	KT	√
3	G8, G9, G11, G12	NO	NO	√
4	G1, G5, G13	KJ	KT	×
5	G13, G14, G15, G16	KJ	KJ	√
6	G15, G17, G18, G19	DM	DM	√
7	G1, G2, G3, G4, G5 , G6	KT	KT	√
8	G20, G21, G22	AR	AR	√
9	G5, G7, G21, G22	AR	KT	×
10	G1, G13, G20, G21, G22	AR	AR	√
11	G18, G19	DM	DM	√
12	G9, G10, G11, G12	NO	NO	√
13	G1, G18, G19	DM	DM	√
14	G21, G22	AR	AR	√
15	G1, G2, G3, G4, G5, G6, G7	KT	KT	√

**Information*

KT = Cataracts DM = Macular Degeneration √= Match

GK = Glaucoma AR = Ablation Retina × = Not Available

KJ = conjunctivitis

From the test data taken on the system and the expert, calculated by the formula:

(2) $\text{Accuracy} = \frac{Banyak\ \ Data\ yang\ Sesuai}{Jumla\ h\ Data\ Uji} \times 100\%$

$$= \frac{13}{15} \times 100\% = 86\%$$

Based on 15 test data, obtained 13 testing compatibility between the system and the expert. The degree of accuracy to 86%.

4. Conclusion

Based on the results of discussions, calculations and comparisons on the web-based expert system diagnosis of diseases of the human eye using Naïve Bayes method, can take the conclusion that:

a. With a simple application that can facilitate the user in diagnosing the corresponding disease symptoms being experienced and know the causes and solutions of the disease in the suffering.
b. On systems using Naïve Bayes method, this time has an accuracy of 86% with 15 test data based on get 13 testing in accordance with the experts

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