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Accuracy Level of Diagnosis of ENT Diseases in Expert System

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Abstract

Purpose of this study is to test the accuracy of ear, nose and throat (ENT) diseases with an expert system. The expert system is designed to help people make early detection of illnesses so that the possibility of delay in treatment can be minimized. The method used is Naive Bayes with Forward Chaining Inference for 14 types of diseases with 42 symptoms originating from ENT specialists. The method was tested on 25 patients who used an expert system and adjusted the results of expert diagnoses. The test results are influenced by the number of symptoms, so that the accuracy obtained is only 88%. So this research is needed to be further developed to find a more reliable expert system in diagnosing ENT diseases.

Keywords: Expert System, naïve bayes, Forward Chaining, Disease, Ear, Nose and Throat (ENT)

1. Introduction

The ear, nose and throat (ENT) are parts of the body that have an important role in the human body. ENT conditions must be maintained as well as possible so that it does not have bad consequences. However, at this time the condition that often occurs is that many people still think that ENT is only a mild disease and many do not want to go to the doctor who is influenced by several factors such as high consultation fees. In addition, the lack of awareness of the public to receive information is also low [8].

This problem can be solved with one of them, namely making an expert system. Expert system, namely the transfer of knowledge possessed by humans (experts) to the computer so that it can solve problems like experts [2]. Expert systems have many methods that can be used. In this study, the method used is naïve bayes because this method produces calculations that make it easier to determine the ENT disease suffered [1]. Transfer of knowledge from experts by using naïve Bayes based on the diagnosis of previous experts to be used as training data, and continued as test data and conclusions are obtained [4].

2. Literatur Review

2.1. Expert System

Expert systems can make people who do not understand a particular problem understand it through the application of the expert system created. Problems are solved to draw conclusions from these problems [5]. The systems created can be regarded as advisors of specific fields of expertise as a group of experts [6]. Expert systems maintain expert expertise and are easy to use by non-experts [7].

2.2. Naïve Bayes

Naïve Bayes is an expert system method that classifies probabilities that computes a set of probabilities by summing the frequency combinations of dataset values [3]. The calculation of the Naïve Bayes process starts from the determination of the Naïve Bayes Classifier (NC). Furthermore, calculating the probability is done by the formula

$$Z(X|Y) = \frac{Z(Y|X) * Z(X)}{Z(Y)} \quad \text{.....(1)}$$

a. a. X is a specific hypothesis, true or false.
b. b. Y is evidence that has been observed.

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c. c. Z (X) probability of X being inferred before new evidence.
d. d. Z (Y | X) is called the probability of proof Y if hypothesis X does occur.
e. e. P (E | H) is called the likelihood function.
f. f. Z (Y) is called the marginal probability of Y in all possible hypotheses. [11-12].

2.3. ENT Symptoms and Diseases

The THT patients used in this study were 14 with details as in table 1 [13].

Table 1 : Types of ENT disease

Id_ disease	Disease	Id_ disease	Disease
P1	Rhinitis Allergica	P8	Nasopharyngeal cancer
P2	Nasal polyps	P9	Tonsil Cancer
P3	Sinusitis	P10	Laryngitis
P4	Selesma cold and flu	P11	Neorhitis vestibular
P5	Deviated septum	P12	Acute otitis media
P6	Pharyngitis	P13	Meniere
P7	Laryngeal cancer	P14	Otosclerosis

The symptoms used are based on the number of diseases detailed in table 1 in this study totaling 42 with details as in table 2 [13].

Table 2 : Symptoms of ENT disease

Id_symptoms	Symptoms	Id_symptoms	Symptoms
G1	Nasal congestion	G22	Mucus in the throat
G2	Sneezing	G23	Muscle ache
G3	Watery snot	G24	Limp
G4	Headache	G25	Diarrhea
G5	Ear pain	G26	Fever
G6	Buzzing ears	G27	Enlargement of lymph glands in the neck
G7	Itchy eyes	G28	Increased white blood cell count
G8	Smell less	G29	Throat pain
G9	Wet nose	G30	Weight loss
G10	Smelly nose	G31	Abnormal breathing sounds
G11	Nasal pain	G32	Blood and pus come out in the nose
G12	Difficulty breathing	G33	Lump on the neck
G13	Nasal voice	G34	The sound is gone
G14	Neck pain	G35	Nausea and vomiting
G15	Itchy nose	G36	The eyeball is moving outside of consciousness
G16	Bleeding nose accompanied by snot	G37	Deaf
G17	Difficult to blow your snot	G38	Ears ringing

G18	Itchy throat	G39	Severe permanent earache
G19	Pain in the face	G40	Hearing disorders
G20	Cough	G41	Sudden nausea and vomiting
G21	Snore	G42	There is pressure inside the ear

3. Methodology

The research method used is the expert system that is built has symptoms that are filled by the user. From the symptom data that has been filled in, the nc value and probability attribute attribute will be calculated. Next will be calculated the posterior probability value for each disease. The output of the diagnosis is the highest Naive Bayes value. In this study, the diagnostic results of the system will be tested for compatibility with the expert diagnostic results. The level of accuracy is the aim of this study. The research method as shown in Figure 1 [9-10].

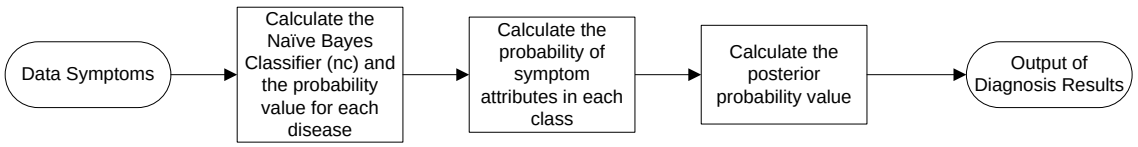

Figure 1: Research Methods

4. Result and Discussion

4.1 Naïve Bayes Calculation

a. Specifies the nc value for each class

Calculations are carried out from disease 1 to disease 14 with examples of data on symptoms 26, 27 and 28 namely fever, enlargement of lymph nodes in the neck and an increase in the number of white blood cells.

First ENT disease
: Rhinitis Allergica
n = 1
p = 1/14 = 0.071428571
m = 42
26.nc = 0
27.nc = 0
28.nc = 0

to

Last ENT disease: Meniere
n = 1
p = 1/14 = 0.071428571
m = 42
26.nc = 0
27.nc = 0
28.nc = 0

b. Calculate the Probability value

Probability values are calculated using formula (1) and performed for all listed diseases. In this example calculation using data on symptoms 26, 27 and 28 namely fever, enlargement of lymph nodes in the neck and an increase in the number of white blood cells.

First ENT disease : Rhinitis Allergica

P(26|X) = 0 + 42 x 0.071428571 / 1+42=0.069767

P(27|X) = 0 + 42 x 0.071428571 / 1+42=0.069767

P(28|X) = 0 + 42 x 0.071428571 / 1+42=0.069767

P(X)=1/14=0.071428571

to

Last ENT disease: Meniere

P(26|X) = 0 + 42 x 0.071428571 / 1+42=0.069767

P(27|X) = 0 + 42 x 0.071428571 / 1+42=0.069767
P(28|X) = 0 + 42 x 0.071428571 / 1+42=0.069767
P(X)=1/14=0.071428571

c. Calculates the total probability value for each disease

Calculation of probability is obtained by using nc multiplied by each probability value for each disease.

P1=0.071428571*0.069767*0.069767*0.069767=0.0000242566
P2=0.071428571*0.069767*0.069767*0.069767=0.0000242566
P3=0.071428571*0.071429*0.069767*0.069767=0.0000248342
P4=0.071428571*0.071429*0.069767*0.069767=0.0000248342
P5=0.071428571*0.069767*0.069767*0.069767=0.0000242566
P6=0.071428571*0.071429*0.071429*0.071429=0.0000260308
P7=0.071428571*0.069767*0.069767*0.069767=0.0000242566
P8=0.071428571*0.069767*0.071429*0.069767=0.0000248342
P9=0.071428571*0.069767*0.071429*0.069767=0.0000248342
P10=0.071428571*0.069767*0.069767*0.069767=0.0000242566
P11=0.071428571*0.069767*0.069767*0.069767=0.0000242566
P12=0.071428571*0.069767*0.069767*0.069767=0.0000242566
P13=0.071428571*0.071429*0.069767*0.069767=0.0000248342
P14=0.071428571*0.069767*0.069767*0.069767=0.0000242566

The highest value is a disease diagnosis obtained from 3 symptoms that are used like bold in the data above.

4.2 Main Page Interface

The main page becomes the page that first appears every time a user accesses a system that looks like Figure 2.

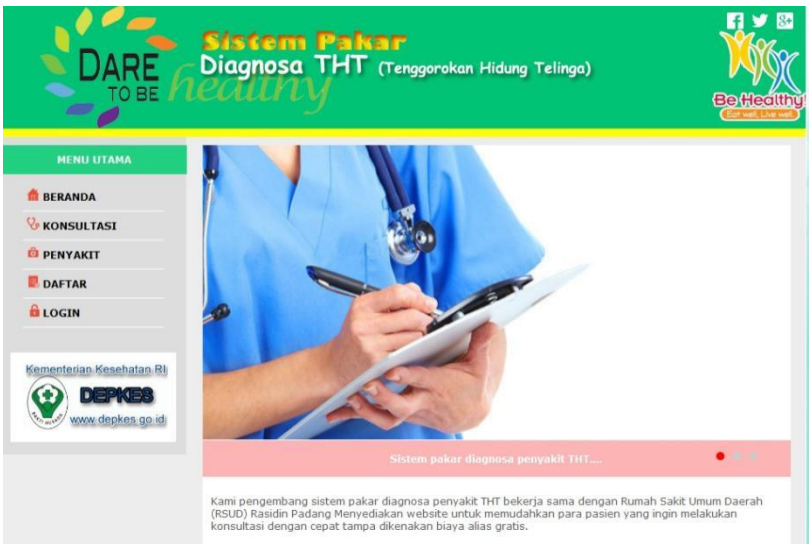

Figure 2 : Main Page

4.3 Consultation Page Interface

The consultation page contains the symptoms that are selected for ENT, on this page there are four categories namely general, nose, ear and throat with the condition that the symptoms chosen are at least two and a maximum of 10. Symptoms are filled based on what the user feels. The consultation page looks like in Figure 3.

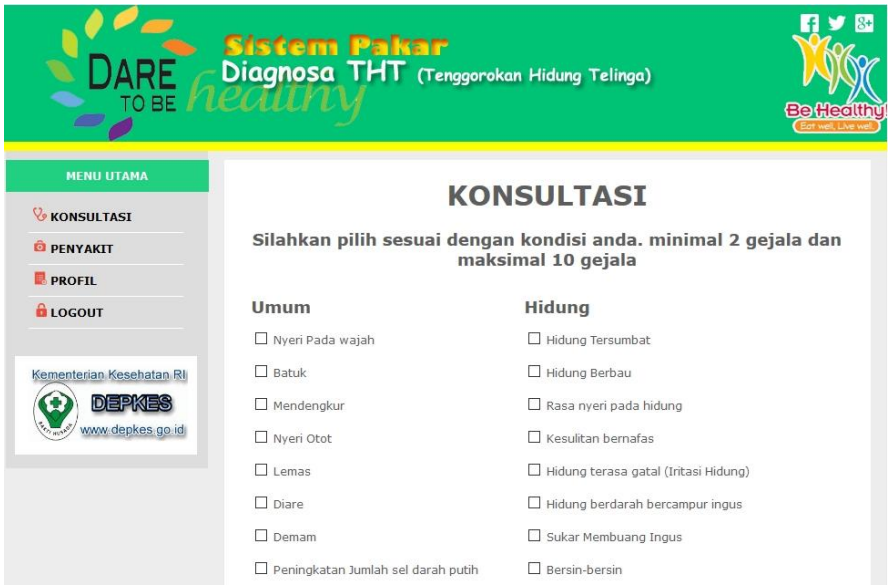

Figure 3 : Consultation Page

4.4 Results Page Interface

Consultation results page contains the results of diagnoses of diseases suffered by users as in Figure 4

Figure 4 : Consultation Results Page

4.5 System Testing

Testing is done by trying to choose the symptoms of weakness, diarrhea, sneezing, runny mucus, mucus in the throat and hearing loss, the results obtained as in Figure 5. Diagnosis of the disease obtained from the highest Naive Bayes values.

Perhitungan Navie Bayes		
Kode	Penyakit	Hasil Klasifikasi
P1	Rhinitis Allergica	9.05035e-009
P2	Polip hidung	8.4335e-009
P3	Sinusitis	8.23737e-009
P4	Salesma atau Cold dan flu	9.05035e-009
P5	Deviated Septum	8.23737e-009
P6	Faringitis (Radang Tenggorokan)	8.23737e-009
P7	Kanker Laring	8.23737e-009
P8	Kanker Nasofaring	8.23737e-009
P9	Kanker Tonsil (Amandel)	8.23737e-009
P10	Laringitis (Radang Pita Suara)	8.23737e-009
P11	Neuronitis Vestibularis	8.23737e-009
P12	Otosklerosis	8.23737e-009
P13	Otitis Media Akut	8.6343e-009
P14	Penyakit Meniere	8.23737e-009

Figure 5 : System Diagnostic Results

Based on 25 tests conducted, the results are as shown in table 3 as follows

Table 3 : Test Result

No	System Diagnosis	Expert Diagnosis	Accuracy value
1	Nasal polyps	Nasal polyps	1
2	Deviated septum	Deviated septum	1
3	Sinusitis	Nasal polyps	0
4	Sinusitis	Sinusitis	1
5	Nasal polyps	Nasal polyps	1
6	Rhinitis Alergica	Rhinitis alergica	1
7	Selesma cold and flu	Selesma cold and flu	1
8	Tonsil Cancer	Tonsil Cancer	1
9	Nasopharyngeal cancer	Nasopharyngeal cancer	1
10	Rhinitis alergica	Rhinitis alergica	1
11	Otosclerosis	Otosclerosis	1
12	Rhinitis alergica	Deviated septum	0
13	Rhinitis alergica	Rhinitis alergica	1
14	Sinusitis	Sinusitis	1
15	Nasal polyps	Nasal polyps	1
16	Nasal polyps	Selesma cold and flu	0

17	Rhinitis alergica	Rhinitis alergica	1
18	Nasal polyps	Nasal polyps	1
19	Rhinitis alergica	Rhinitis alergica	1
20	Rhinitis alergica	Rhinitis alergica	1
21	Laryngitis	Laryngitis	1
22	Nasal polyps	Nasal polyps	1
23	Deviated septum	Deviated septum	1
24	Acute otitis media	Acute otitis media	1
25	Rhinitis alregica	Rhinitis alergica	1

By means of the accuracy value of 1, the results are in accordance and the value of 0 results is not appropriate so that the accuracy of the system is obtained by 88% from 25 times the testing on the system and the results of expert diagnosis.

In addition to testing the results of the diagnosis, the system is also tested by respondents from users conducted to assess the quality of the system in terms of use and achievement of the system objectives with detailed questions as follows:

1. This application is easy to learn and use. (X1)
2. The menus in the application can be used easily and do not make users confused. (X2)
3. This application provides feedback that is easy to understand. (X3)
4. This application helps users in analyzing diseases. (X4)
5. This application is in accordance with the doctor's diagnosis in analyzing. (X5)
6. This application has provided solutions related to the disease experienced. (X6)
7. Application makes it easy for you in consultation. (X7)
8. Display applications provide comfort for you. (X8)
9. The application can replace the doctor if the doctor is not in place. (X9)
10. I need this application in analyzing diseases. (X10)

The test results are obtained in detail as in table 4 below

Table 4 : Procurement of Respondents

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
X1	5	19	1	0
X2	5	19	1	0
X3	4	21	0	0
X4	11	8	6	0
X5	8	16	1	0
X6	9	15	1	0
X7	9	14	2	0
X8	7	15	3	0
X9	6	16	3	0
X10	8	17	0	0
Total	72	160	18	0

Percentage score of observations: (804/1000) x 100% = 80.4%. These results prove that the expert system built has benefits for users and has an attractive appearance.

5. Conclusion

Based on research that has been done, it can be concluded:

1. Expert system of ENT (Ear Nose Throat) with the naïve Bayes method can provide an initial diagnosis of the disease suffered by the community based on the symptoms suffered.

2. The accuracy of the suitability of the diagnosis system with experts reaches 88% with symptoms of at least 2 and a maximum of 10 symptoms.
3. Subsequent tests can be carried out using other methods and the symptoms processed can be added.
4. Community testing stated that 80.4% of respondents rated positively on the expert system designed.

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