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Design and Build an ENT Disease Diagnosis Expert System with Bayesian Probability Method

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Abstract

Sinusitis is one of the most common causes of health problems in the world and the cases are most often found in daily practice. The incidence of sinusitis is a fairly severe disease, namely 1.3 and 3.5 per 100 cases of adults per year to see a doctor. Patients with a disease need accurate information that is easily accessible to find out the disease they are experiencing based on the symptoms they feel. One of the reliable information sourced from experts or people who are experts in their fields and can be easily accessed is the existence of an expert system. In this case, the expert system needed is an ENT (Ear, Nose and Throat) disease diagnosis expert system. The expert system for diagnosing ENT diseases, designed in this study uses the Bayesian Probability method. The research on the design of an expert system for diagnosing ENT diseases that have been carried out can be used as a decision making for ENT patients using the Bayesian Probability method.

Keywords: *Bayes Probability, ENT (Ear, Nose and Throat), Expert System*

1. Introduction

Sinusitis is one of the most common causes of health problems in the world and is often found in daily practice [1]. Rhinitis and Sinusitis are diseases that can significantly reduce quality of life, worsen comorbidities and decrease productivity at work and school learning [2]. The incidence of sinusitis is a disease severe enough that people see a doctor, which is between 1.3 and 3.5 per 100 adult cases per year [3]. A patient with a disease sometimes needs information about the symptoms experienced before deciding to consult a doctor, so that an easy access to information is needed for sufferers to know the disease [4]. One of the access to reliable information is the existence of an expert system sourced from experts or people who are experts in their fields in this case can help provide information on ENT diseases based on the symptoms felt.

An expert system (expert system) is a system that seeks to adopt human knowledge of computers that work to solve certain problems like experts [5]. The existence of an expert system for diagnosing ENT disease is expected to facilitate access to information for people with ENT disease. Research with the theme of disease diagnosis, expert systems has been widely studied by previous researchers, such as the research of an expert system for diagnosing sinusitis, which applies 125 sample data of patients who have been diagnosed with the criteria of the existing symptoms using the Bayes method [6]. Other research is an expert system for diagnosing nasal polyps with rhinosinusitis which can classify each symptom using the Naïve Bayes method [7]. In addition to Bayes, the Certainty Factor (CF) method in web-based expert system research for diagnosing Ear, Nose and Throat (ENT) diseases can provide solutions that are in accordance with the symptoms of the disease suffered by patients based on system tests with advanced tracing using 12 types of diseases and 44 symptoms [8]. Comparative analysis, research on the CF Method and Bayesian Probability Method on an ENT disease expert system

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concluded that the CF method is more accurate in diagnosing ENT diseases compared to the Bayesian probability method which has been carried out on 10 patient samples [9].

In addition to diagnosing diseases in humans, expert systems can also be used to diagnose diseases in plants and animals, such as in expert system research using the Bayes method which has succeeded in diagnosing diseases in corn plants based on the symptoms inputted by the user [10]. In the study of expert systems for diagnosing chicken diseases using the Bayes Theorem method to solve the problem while in the inference process using the Forward Chaining method [11]. Research on an expert system for diagnosing rabies in dogs using the Forward Chaining method, the final result in this study not only diagnoses rabies in dogs but can provide information on handling humans who are bitten by dogs carrying rabies [12]. Research on an expert system for diagnosing chili pests and diseases using the Bayes theorem, in addition to producing a diagnosis of chili pests and diseases, the system can also provide information on early handling in control and treatment without having to consult the Center for Food Crops and Horticulture Protection (BPTPH) [13]. Expert system research to diagnose Feline Virus cat disease using the CF method, the results in this study can diagnose 5 cat diseases and are proven by validation testing, the percentage level of conformity is 100% [14].

From the description above, the expert system can be used as a tool to diagnose a disease. This study aims to design and build an expert system for diagnosing ENT diseases using the Bayesian Probability method.

2. Research Methodology

2.1. Research Stages

The stages of the research carried out can be seen in Figure 1. The steps are:

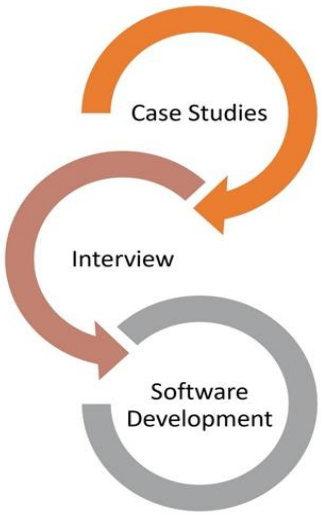


Figure 1. Research Stages

Case Studies, in this step contain collecting and studying various existing reference sources, both in the form of journals, books, and articles from the internet that support the design of the expert system that will be made.

Interviews, in the interview step, the research explores needs in the form of data to the experts, namely ENT specialist doctors and ENT disease patients in the form of data on perceived symptoms.

Software Development, in this step the researcher analyzes the related information, data so that the existing data can be used in system design. In system design, software architecture description, interface description, and data description are carried out.

2.2. Workflow

The workflow of the ENT Disease Expert System on the diagnostic display menu is shown in Figure 2.

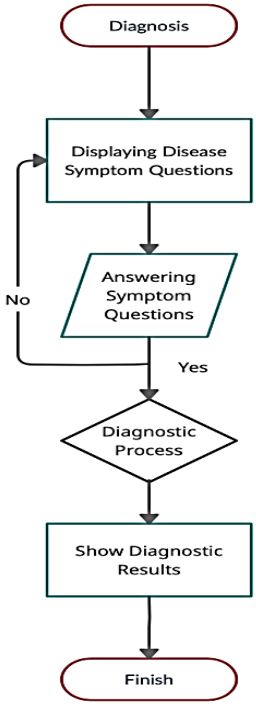


Figure 2. Flowchart Diagram

3. Result and Discussion

The research data obtained from interviews with experts used for diseases and 17 symptoms, which can be seen in Table 1.

Table 1. Symptoms and Disease Data

Symptom ID	Symptom	Disease			
		D1	D2	D3	D4
S01	Cough	•	•		•
S02	Have a cold	•	•	•	•
S03	Fever	•			•
S04	Sneeze			•	
S05	Headache	•	•	•	•
S06	Blocked nose			•	•
S07	Reduce Smell			•	•
S08	Congested nose on the side alternately			•	
S09	Stuffy nose on the side				•
S10	Stuffy nose on both noses				•
S11	Stufy runny nose on both noses			•	
S12	Headache at the bridge of the nose, cheeks or forehead				•
S13	Watery ears ≥ 2 months		•		

Symptom ID	Symptom	Disease			
		D1	D2	D3	D4
S14	Ear pain	•			
S15	Dicreased hearing	•	•		
S16	Ringing in the ears (low tone)	•	•		
S17	Watery ears ≤ 2 months	•	•		

Description:
D1: Acute Otitis Media
D2: Chronic Suppurative Otitis Media
D3: Chronic Rhinitis
D4: Sinusitis

3.1. Bayesian Probability Method

Bayesian probability is one method that can resolve the uncertainty by using the Bayes formula as follows [15]:

$$P(H_k|E) = \frac{P(E|H_k)P(H_k)}{\sum_{k=1}^{n} P(E|H_k)P(H_k)} \quad (1)$$

Description:
P = probability,
H_k = type of disease,
E = symptom,
$(H_k|E)$ = types of disease on symptoms,
$(E|H_k)$ = symptoms of every disease,
$\sum_{k=1}^{n} P(E|H_k)P(H_k)$ = the sum of the product of the probability of symptoms of the disease with the probability of disease.

Bayesian probability theory is a branch of mathematics, statistical theory that allows making a model of the uncertainty of an event by combining general knowledge with observed facts [16].

3.2. Diagnostic Result

In the diagnostic results, there are examples of cases, if an ENT disease patient chooses symptoms, then the patient can click the diagnosis button to find out the diagnosis results, the display can be seen in Figure 3.

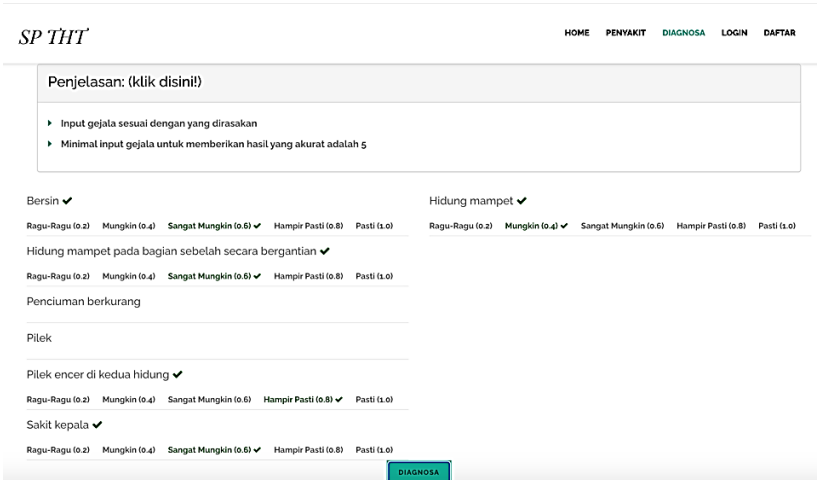
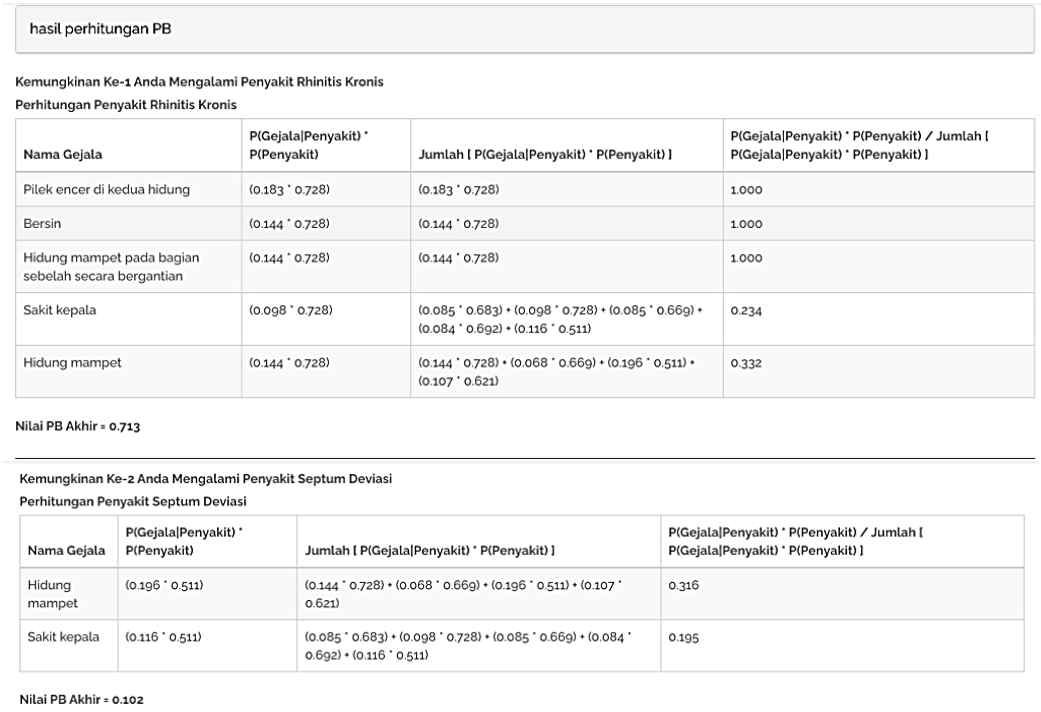


Figure 3. Select Symptoms Display

Then after selecting the symptoms felt and clicking the diagnosis button, the next display is the diagnosis result in the form of several possible diseases experienced by the patient along with manual calculations with the Bayes Probability Method displayed by the system to the patient, which can be seen in Figure 4.



hasil perhitungan PB

Kemungkinan Ke-1 Anda Mengalami Penyakit Rhinitis Kronis

Perhitungan Penyakit Rhinitis Kronis

Nama Gejala	P(Gejala|Penyakit) * P(Penyakit)	Jumlah [P(Gejala|Penyakit) * P(Penyakit)]	P(Gejala|Penyakit) * P(Penyakit) / Jumlah [P(Gejala|Penyakit) * P(Penyakit)]
Pilek encer di kedua hidung	(0.183 * 0.728)	(0.183 * 0.728)	1.000
Bersin	(0.144 * 0.728)	(0.144 * 0.728)	1.000
Hidung mampet pada bagian sebelah secara bergantian	(0.144 * 0.728)	(0.144 * 0.728)	1.000
Sakit kepala	(0.098 * 0.728)	(0.085 * 0.683) + (0.098 * 0.728) + (0.085 * 0.669) + (0.084 * 0.692) + (0.116 * 0.511)	0.234
Hidung mampet	(0.144 * 0.728)	(0.144 * 0.728) + (0.068 * 0.669) + (0.196 * 0.511) + (0.107 * 0.621)	0.332

Nilai PB Akhir = 0.713

Kemungkinan Ke-2 Anda Mengalami Penyakit Septum Deviasi

Perhitungan Penyakit Septum Deviasi

Nama Gejala	P(Gejala|Penyakit) * P(Penyakit)	Jumlah [P(Gejala|Penyakit) * P(Penyakit)]	P(Gejala|Penyakit) * P(Penyakit) / Jumlah [P(Gejala|Penyakit) * P(Penyakit)]
Hidung mampet	(0.196 * 0.511)	(0.144 * 0.728) + (0.068 * 0.669) + (0.196 * 0.511) + (0.107 * 0.621)	0.316
Sakit kepala	(0.116 * 0.511)	(0.085 * 0.683) + (0.098 * 0.728) + (0.085 * 0.669) + (0.084 * 0.692) + (0.116 * 0.511)	0.195

Nilai PB Akhir = 0.102

Figure 4. Diagnostic Results Display

4. Conclusion

The conclusion on the research on the design of an expert system for diagnosing ENT diseases using the Bayesian Probability method is that the system can be used as a tool to diagnose ENT diseases for patients before deciding to consult an expert or in this case the expert is an ENT specialist. There is a need for scientific developments in the form of symptom and disease data from experts to be included as a knowledge base in an ENT disease diagnosis expert system for more optimal diagnostic results. And the results of the diagnosis in the system cannot be used as a 100% reference for patients in determining the disease they are suffering from. It is still necessary to consult with an ENT Specialist.

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