Design of Expert System for Digestive Diseases Identification Using Naïve Bayes Methodology for IOS-Based Application

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Abstract— Symptoms in some digestive diseases show similarity, resulting suspected diseases before and after diagnosis attempt might turn out to be different. The aim for this research is to build an expert system for digestive disease identification using Naïve Bayes for iOS-based application, as a helping tool for medical interns during early-stage examination. Naïve Bayes is chosen because it has higher accuracy level than other classification methods. This research includes collecting data through the study of literature on digestive disorders and their symptoms, then processed and turned into a knowledge base for the expert system, to be calculated using Naïve Bayes by the designed expert system application. The result of this research is the suspected diseases shown by the expert system application has higher accuracy, which is 84%.

Keywords— Digestive Disease, Expert System, Naïve Bayes, IOS, Knowledge-based

Abstrak— Latar belakang masalah dari penelitian ini adalah gejala yang ditunjukkan oleh beberapa penyakit gangguan pencernaan memiliki kemiripan, sehingga terdapat kemungkinan dugaan penyakit sebelum upaya diagnosa dan hasil diagnosa tidak sama. Tujuan dari penelitian ini adalah untuk menghasilkan sebuah sistem pakar untuk identifikasi penyakit gangguan pencernaan dengan metode Naïve Bayes berbasis aplikasi iOS, sebagai alat bantu bagi dokter muda dalam pemeriksaan tahap awal. Metode Naïve Bayes dipilih karena dinilai lebih akurat dibandingkan metode klasifikasi lainnya. Metodologi dari penelitian ini meliputi pengumpulan data melalui studi literatur mengenai penyakit gangguan pencernaan beserta gejalanya, yang kemudian diolah menjadi basis pengetahuan sistem pakar untuk dikalkulasikan menggunakan metode Naïve Bayes pada aplikasi sistem pakar yang dibuat pada penelitian ini. Hasil penelitian menunjukkan hasil identifikasi dugaan penyakit yang dihasilkan oleh aplikasi sistem pakar memiliki tingkat akurasi yang lebih tinggi, yakni sebesar 84%.

Kata kunci— Penyakit Gangguan Pencernaan, Sistem Pakar, Naïve Bayes, IOS, Basis Pengetahuan

I. Introduction

Shown symptoms in digestive diseases might be similar, such as nausea and vomiting which likely to appear in Crohn's disease, gallstone, irritable bowel syndrome (IBS), gastritis, and gastroesophageal reflux disease (GERD). Another example for symptoms to appear in three or more digestive diseases are diarrhoea and flatulence. Hence, an expert system is required to help medical interns in determining the suspected disease the patient might suffer to make an effective diagnosis. With the help of an expert system, the less precise medical diagnosis could be minimalized, which also helps in saving time and reducing costs.

Expert systems are a branch of Artificial Intelligence (AI) [1], in the form of a system that adopts an expert ability to solve problems [2]. An expert is someone who has proficient skills and knowledge in a certain field, which common people don't have [1]. The function of an expert system is to solve a problem or being a support tool in the decision-making process [3].

The designed expert system application in this research is to identify suspected digestive disease patients might have. Digestive diseases included in this research scope are Irritable Bowel Syndrome (IBS), ulcerative colitis, Crohn's disease, peptic ulceration, gallstone, gastroesophageal reflux disease (GERD), and gastritis.

II. Research Methodology

The calculation of probability used in the designed expert system application is based on the methodology of Multinomial Naïve Bayes. Multinomial Naïve Bayes calculates probability based on words' frequency to appear in a document [4]. The general Multinomial Naïve Bayes equation is shown by Equation (1)

$$P(c|d) = P(c) \prod_{i=1}^{n} P(w_i|c) \quad (1)$$

$P(c|d)$: Probability document d is class c
$P(c)$: Prior probability of class c
$P(w_i|c)$: Probability of term i in class c

Prior probability of class c ($P(c)$) is obtained through the calculation shown by Equation (2)

$$P(c) = \frac{N_c}{N} \quad (2)$$

Nc : Number of class c documents
N : Total documents

Probability of term i in class c ($P(w_i|c)$) is obtained through the calculation shown by Equation (3)

$$P(w_i|c) = \frac{count(w_i,c)+1}{count(c)+|V|} \quad (3)$$

$count(w_i,c)$: Number of term i in class c
$count(c)$: Number of words in class c
$|V|$: Number of unique word

Dataset to be used as the knowledge base in the designed expert system application consists of relations between symptoms and seven digestive diseases that are included in the scope, which are: Irritable Bowel Syndrome (IBS), ulcerative colitis, Crohn's disease, peptic ulcer, gallstone, gastroesophageal reflux disease (GERD), and gastritis.

Dataset used in this research are retrieved from Supplementary Data 3 from an article by the title of Human Symptoms-Disease published by Nature Communications in 2014. Supplementary Data 3 consists of 147,978 records of relations between 4,219 diseases and 322 symptoms in the form of *.txt file [5].

Each record contains disease term, symptom term, and frequency of both terms to appear in PubMed citation. PubMed provides more than 30 million citations for biomedical literature and life science journals.

The retrieved file from Supplementary Data 3 is then filtered, resulting in 573 records consisting of 188 symptom terms associated with seven digestive diseases that are included in the research scope.

The designed expert system application has workflow as follows:

1. Application shows options of symptoms related to the digestive diseases based on the dataset
2. Medical intern (user) selects the patient's symptoms based on the shown symptom options
3. The application calculates the probability based on the selected symptoms using Multinomial Naïve Bayes method and shows the suspected disease the patient might suffer
4. The calculation result could be saved as a patient data in the application

The designed expert system application was developed using Swift programming language in Xcode Integrated Development Environment

III. Result and Discussion

The filtered 573 records consisting of 188 symptoms dataset are used as the knowledge base of the designed expert system application to calculate the probability of suspected digestive diseases using Multinomial Naïve Bayes.

A. Dataset

The obtained dataset was fitted to the use of Multinomial Naïve Bayes.

1) Prior Probability (P(c)): Calculation of prior probability is by the equation of $P(c) = \frac{N_c}{N}$, with the number of documents for class c (N_c) is obtained by the sum of PubMed occurrences in class c, and total documents (N) is obtained by the sum of PubMed occurrences in every class. The prior probability for each class is shown by Table I.

TABLE I
PRIOR PROBABILITY OF EACH CLASS

Class	N_c	P(c)
Crohn's Disease	1168	0.13796
Gallstone	1170	0.13820
Gastritis	698	0.08245
GERD	2630	0.31065
IBS	1122	0.13253
Peptic Ulcer	825	0.09745
Ulcerative Colitis	853	0.10076
Total Documents (N)	8466	1

2) Number of Words in Class (count(c)): In the used dataset, every document consists of two words, which are a symptom term and a disease term. The number of words for each class is as shown by Table II.

TABLE II
NUMBER OF WORDS IN EACH CLASS

Class	N_c	count(c)
Crohn's Disease	1168	2336
Gallstone	1170	2340
Gastritis	698	1396
GERD	2630	5260
IBS	1122	2244
Peptic Ulcer	825	1650
Ulcerative Colitis	853	1706

3) Number of Unique Words (|V|): A word that is not a conjunction is regarded as a unique word. The dataset that is used in the research does not contain any conjunction. Hence, the number of unique words is obtained by the sum of disease terms and symptom terms. The number of disease terms based on the research scope is 7, and the number of symptom terms based on the filtering process done previously is 188. Hence, the number of unique words in the used dataset is 195 words.

B. Implementation

The following is an example of the implementation on a patient with symptoms of nausea, vomiting, and chest pain. Data of each symptom can be seen in Table III.

TABLE III
DATA OF NAUSEA, VOMITING, AND CHEST PAIN IN DATASET

Symptom	PubMed Occurrences						
	Crohn's disease	Gallstone	Gastritis	GERD	IBS	Peptic ulcer	Ulcerative colitis
Nausea	24	15	17	19	7	9	17
Vomiting	22	37	37	180	5	15	13
Chest pain	3	5	6	226	0	5	4

1) Probability of Crohn's Disease as the Suspected Disease: The calculation below shows the probability of Crohn's disease as the suspected disease of patient with symptoms of nausea, vomiting, and chest pain using Multinomial Naïve Bayes.

$$P(crohn's\ disease|nausea, vomiting, chest\ pain)$$
$$= P(crohn's\ disease)P(nausea|crohn's\ disease)P(vomiting|crohn's\ disease)P(chest\ pain|crohn's\ disease)$$
$$= P(crohn's\ disease)\left(\frac{count(nausea, crohn's\ disease)+1}{count(crohn's\ disease)+|V|}\right)\left(\frac{count(vomiting, crohn's\ disease)+1}{count(crohn's\ disease)+|V|}\right)\left(\frac{count(chest\ pain, crohn's\ disease)+1}{count(crohn's\ disease)+|V|}\right)$$
$$= (0{,}13796)\left(\frac{24+1}{2336+195}\right)\left(\frac{22+1}{2336+195}\right)\left(\frac{3+1}{2336+195}\right)$$
$$= (0{,}13796)(0{,}00988)(0{,}00909)(0{,}00158)$$
$$= 0{,}00000002$$

2) Probability of Gallstone as the Suspected Disease: The calculation below shows the probability of gallstone as the suspected disease of patient with symptoms of nausea, vomiting, and chest pain using Multinomial Naïve Bayes.

$$P(gallstone|nausea, vomiting, chest\ pain)$$
$$= P(gallstone)P(nausea|gallstone)P(vomiting|gallstone)P(chest\ pain|gallstone)$$
$$= P(gallstone)\left(\frac{count(nausea, gallstone)+1}{count(gallstone)+|V|}\right)\left(\frac{count(vomiting, gallstone)+1}{count(gallstone)+|V|}\right)\left(\frac{count(chest\ pain, gallstone)+1}{count(gallstone)+|V|}\right)$$
$$= (0{,}13820)\left(\frac{15+1}{2340+195}\right)\left(\frac{37+1}{2340+195}\right)\left(\frac{5+1}{2340+195}\right)$$
$$= (0{,}1382)(0{,}00631)(0{,}01499)(0{,}00237)$$
$$= 0{,}000000031$$

3) Probability of Gastritis as the Suspected Disease: The calculation below shows the probability of gastritis as the suspected disease of patient with symptoms of nausea, vomiting, and chest pain using Multinomial Naïve Bayes.

$$P(gastritis|nausea, vomiting, chest\ pain)$$
$$= P(gastritis)P(nausea|gastritis)P(vomiting|gastritis)P(chest\ pain|gastritis)$$
$$= P(gastritis)\left(\frac{count(nausea, gastritis)+1}{count(gastritis)+|V|}\right)\left(\frac{count(vomiting, gastritis)+1}{count(gastritis)+|V|}\right)\left(\frac{count(chest\ pain, gastritis)+1}{count(gastritis)+|V|}\right)$$
$$= (0{,}08245)\left(\frac{17+1}{1396+195}\right)\left(\frac{37+1}{1396+195}\right)\left(\frac{6+1}{1396+195}\right)$$
$$= (0{,}08245)(0{,}01131)(0{,}02388)(0{,}0044)$$
$$= 0{,}000000098$$

4) Probability of GERD as the Suspected Disease: The calculation below shows the probability of GERD as the suspected disease of patient with symptoms of nausea, vomiting, and chest pain using Multinomial Naïve Bayes.

$$P(GERD|nausea, vomiting, chest\ pain) = P(GERD)P(nausea|GERD)P(vomiting|GERD)P(chest\ pain|GERD)$$
$$= P(GERD)\left(\frac{count(nausea, GERD)+1}{count(GERD)+|V|}\right)\left(\frac{count(vomiting, GERD)+1}{count(GERD)+|V|}\right)\left(\frac{count(chest\ pain, GERD)+1}{count(GERD)+|V|}\right)$$
$$= (0{,}31065)\left(\frac{19+1}{5260+195}\right)\left(\frac{180+1}{5260+195}\right)\left(\frac{226+1}{5260+195}\right)$$
$$= (0{,}31065)(0{,}00367)(0{,}03318)(0{,}04161)$$
$$= 0{,}000001574$$

5) Probability of IBS as the Suspected Disease: The calculation below shows the probability of IBS as the suspected disease of patient with symptoms of nausea, vomiting, and chest pain using Multinomial Naïve Bayes.

$$P(IBS|nausea, vomiting, chest\ pain) = P(IBS)P(nausea|IBS)P(vomiting|IBS)P(chest\ pain|IBS)$$
$$= P(IBS)\left(\frac{count(nausea, IBS)+1}{count(IBS)+|V|}\right)\left(\frac{count(vomiting, IBS)+1}{count(IBS)+|V|}\right)\left(\frac{count(chest\ pain, IBS)+1}{count(IBS)+|V|}\right)$$
$$= (0{,}13253)\left(\frac{7+1}{2244+195}\right)\left(\frac{5+1}{2244+195}\right)\left(\frac{0+1}{2244+195}\right)$$
$$= (0{,}13253)(0{,}00328)(0{,}00246)(0{,}00041)$$
$$= 0{,}000000000$$

6) Probability of Peptic Ulcer as the Suspected Disease: The calculation below shows the probability of peptic ulcer as the suspected disease of patient with symptoms of nausea, vomiting, and chest pain using Multinomial Naïve Bayes.

$$P(peptic\ ulcer|nausea, vomiting, chest\ pain)$$
$$= P(peptic\ ulcer)P(nausea|peptic\ ulcer)P(vomiting|peptic\ ulcer)P(chest\ pain|peptic\ ulcer)$$
$$= P(peptic\ ulcer)\left(\frac{count(nausea, peptic\ ulcer)+1}{count(peptic\ ulcer)+|V|}\right)\left(\frac{count(vomiting, peptic\ ulcer)+1}{count(peptic\ ulcer)+|V|}\right)\left(\frac{count(chest\ pain, peptic\ ulcer)+1}{count(peptic\ ulcer)+|V|}\right)$$
$$= (0{,}09745)\left(\frac{9+1}{1650+195}\right)\left(\frac{15+1}{1650+195}\right)\left(\frac{5+1}{1650+195}\right)$$
$$= (0{,}09745)(0{,}00542)(0{,}00867)(0{,}00325)$$
$$= 0{,}000000015$$

7) Probability of Ulcerative Colitis as the Suspected Disease: The calculation below shows the probability of ulcerative colitis as the suspected disease of patient with symptoms of nausea, vomiting, and chest pain using Multinomial Naïve Bayes.

$$P(ulcerative\ colitis|nausea, vomiting, chest\ pain)$$
$$= P(ulcerative\ colitis)P(nausea|ulcerative\ colitis)P(vomiting|ulcerative\ colitis)P(chest\ pain|ulcerative\ colitis)$$
$$= P(ulcerative\ colitis)\left(\frac{count(nausea, ulcerative\ colitis)+1}{count(ulcerative\ colitis)+|V|}\right)\left(\frac{count(vomiting, ulcerative\ colitis)+1}{count(ulcerative\ colitis)+|V|}\right)\left(\frac{count(chest\ pain, ulcerative\ colitis)+1}{count(ulcerative\ colitis)+|V|}\right)$$
$$= (0{,}10076)\left(\frac{17+1}{1706+195}\right)\left(\frac{13+1}{1706+195}\right)\left(\frac{4+1}{1706+195}\right)$$
$$= (0{,}10076)(0{,}00947)(0{,}00736)(0{,}00263)$$
$$= 0{,}000000018$$

Based on the seven calculations above, gastroesophageal reflux disease (GERD) has the highest probability. Hence, the patient with symptoms of nausea, vomiting, and chest pain might suffer from GERD.

C. User Interface

The designed expert system application is available in Bahasa Indonesia, and the following are some of the screenshots of the user interface.

1) Calculation Result: The application shows the suspected disease based on the calculation which can be seen in Figure 1 and the probability of each disease which is shown by Figure 2.

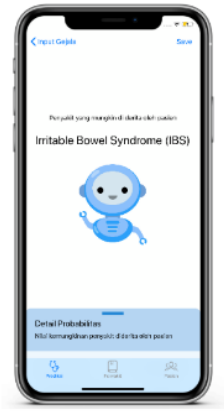

Figure 1 Suspected Disease Page View

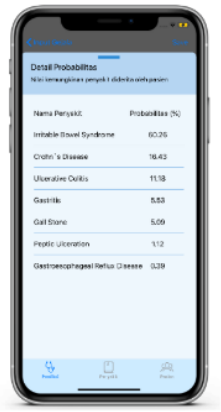

Figure 2 Detail Probabilities Page View

2) Stored Data: The application saves patient data and suspected disease calculation results, which can be seen in Figure 3. Including patient's symptoms and details such as diagnosis result and additional note, which is shown by Figure 4

Figure 3 Patient's Calculation Result Records

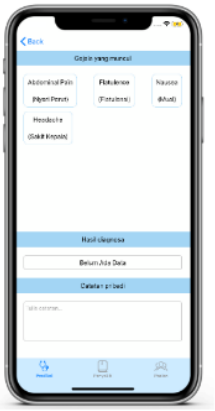

Figure 4 Patient's Record Detail

D. Testing

There were two tests conducted during this research, one for internist as an expert and one for medical interns as users.

1) Accuracy Test: The accuracy test uses patient symptoms data, suspected disease data estimated by an internist, and diagnosis results. The test compares suspected diseases—both from internist estimation and calculation output from the designed application—to diagnosis result. The test was conducted by the help of Dr. Didiet Pratignyo, SpPD, FINASIM, an internist in RSUD Kota Cilegon, Banten, Indonesia. The comparison results are shown in Table IV.

TABLE IV
COMPARISON RESULT IN ACCURACY TEST

No.	Patient Symptoms	Internist Estimation	Application Output	Diagnosis Result
1	Nausea, abdominal pain, vomiting, hematemesis	Gastritis	Gastritis	Gastritis
2	Abdominal pain, dizziness, hematemesis	Gastritis	Gastritis	Gastritis
3	Abdominal pain, jaundice, fever	Gallstone	Gallstone	Gallstone
4	Acute abdomen, diarrhea, weight loss	Crohn's disease	Crohn's disease	Crohn's disease
5	Abdominal pain, nausea, vomiting, dizziness	GERD*	Gastritis	Gastritis
6	Chest pain, heartburn, nausea, asthenia, abdominal pain	GERD	GERD	GERD
7	Chest pain, heartburn, nausea	GERD	GERD	GERD
8	Diarrhea, flatulence, abdominal pain, headache	Crohn's disease*	IBS	IBS
9	Chest pain, dysgeusia	GERD	GERD	GERD
10	Abdominal pain, nausea, vomiting	Gastritis	Gastritis	Gastritis
11	Nausea, vomiting, abdominal pain, hematemesis	Gastritis	Gastritis	Gastritis
12	Nausea, vomiting, flatulence, heartburn, asthenia	GERD*	GERD*	Peptic ulcer
13	Chest pain, heartburn, dysgeusia	GERD	GERD	GERD
14	Fatigue, back pain, constipation	IBS	IBS	IBS
15	Dizziness, nausea, flatulence, diarrhea	IBS	IBS	IBS
16	Acute abdomen, diarrhea, fatigue, weight loss	Crohn's disease*	Crohn's disease*	Ulcerative colitis
17	Chest pain, heartburn, sleep disorders	GERD	GERD	GERD
18	Abdominal pain, nausea, vomiting	Gastritis	Gastritis	Gastritis
19	Nausea, fever, fatigue	Gastritis*	Crohn's disease	Crohn's disease
20	Abdominal pain, jaundice, nausea, vomiting	Gallstone	Gallstone	Gallstone

*suspected disease is different from diagnosis result

Based on the Table IV, 72% suspected diseases estimated by the internist were correct, which is 18 out of 25. On the other hand, 84% suspected diseased from the calculation result of the designed expert system application were correct, which is 21 out of 25. Hence, by the use of the designed expert system application, the suspected disease has higher accuracy.

2) User Acceptance Test: User acceptance test (UAT) is conducted to measure the level of user acceptance towards the designed expert system application. A simple experiment with 10-20 samples could be successful through a strict control *[6]*. The test was done with the help of 13 medical interns. Medical interns were asked to do certain user scenarios and finished by filling the provided questionnaire. Likert scale is used as the rating system in the provided questionnaire with a range of 1 to 5, with 5 represents the highest score. The calculation of user acceptance level result is shown by Equation (4).

$$index(\%) = \frac{Total\ Score}{Maximum\ Score} * 100 \quad (4)$$

The maximum score is obtained by the multiplication of the highest score—which is 5, and the number of respondents—which is 13. Hence, the maximum score is 65. The results of the test are shown in Table V.

TABLE V
USER ACCEPTAMCE TEST RESULT

No	Statement	Score	Result
1	The application is easy to understand	86%	Strongly Agree
2	The application is easy to use	88%	Strongly Agree
3	The how-to-use information of the application is precise and easy to understand	85%	Strongly Agree
4	The user interface is attractive	86%	Strongly Agree
5	The application is useful	89%	Strongly Agree

Based on Table V, all of the statements listed on the questionnaire used for the user acceptance test were strongly agreed on. Hence, the designed expert system application is easy to use and indeed useful for its users.

IV. CONCLUSION

In this research, an IOS-based expert system application was made to help medical interns to identify patient's digestive disease in the early-stage examination. The provided features were made to fulfill the needs of medical interns as its users. Through accuracy test, the designed application shows higher accuracy which is 84% compared to the internist estimation which is 72%. And by conducting User Acceptance Test and the use of Likert scale, the designed expert system application scores 86% on the ease to understand, 88% on ease of use, 85% on how-to-use information, 86% on user interface attractiveness, and 89% on the usefulness. The designed expert system application made through this research is available on the App Store by the name of "Gastrome" in Bahasa Indonesia.

REFERENCE

[1] N. A. Hasibuan, H. Sunandar, S. Alas och S. , "Sistem Pakar Mendiganosa Penyakit Kaki Gajah Menggunakan Metode Certainty Factor," *Jurnal Riset Sistem Informasi Dan Teknik Informatika (JURASIK)*, pp. vol. 2, no. 1, 29-39, 2017.

[2] R. R. Fanny, N. A. Hasibuan och E. Buulolo, "Perancangan Sistem Pakar Diagnosa Penyakit Asidosis Tubulus Renalis Menggunakan Metode Certainty Factor dengan Penulusuran Forward Chaining," *Media Informatika Budidarma, vol. 1, no. 1*, pp. 13-16, 2017.

[3] M. K. Rosananda och R. Tanamal, "Android-Based Dental and Oral Health Diagnostic Expert System," *Jurnal Informatika Universitas Pamulang, Vol. 3, No. 4*, pp. 5-13, 2018.

[4] F. Rosi, M. A. Fauzi och R. S. Perdana, "Prediksi Rating Pada Review Produk Kecantikan Menggunakan Metode Naive Bayes dan Categorical Proportional DIfference (CPD)," *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer*, pp. 1991-1997, 2018.

[5] X. Zhou, J. Menche, A.-L. Barabási och A. Sharma, "Human symptoms-disease network," *Nature Communications, vol. 5, article number: 4212*, 2014.

[6] I. Alwi, "Kriteria Empirik dalam Menentukan ukuran Sampel pada Pengujian Hipotesis Statistika dan Analisis Butir," *Jurnal Formatif 2, vol. 2*, pp. 140-148, 2015.

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