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EXPERT SYSTEM WITH FUZZY MANDANI FOR PREDICTION OF DIGESTIVE DISEASES

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Abstract
Digestive diseases of the stomach often occur in everyday life. So that almost everyone experiences the disease. every day the health center is full of patients who experience digestive disorders in the stomach. Not only medical treatment but also consultation regarding solutions for digestive ailments, especially in the stomach. Every day the health center records and reports the number of visiting patients, but consulting in this service is considered ineffective, so it takes quite a long time. To facilitate and speed up services at the PUSKESMAS, an expert system was created to assist the PUSKESMAS and patients in conducting consultation services at the PUSKESMAS. An expert system is a system that seeks to produce a decision that is equal to that of an expert or experts using a computer system so that the decision results are accurate. The expert system is implemented using the fuzzy Mamdani method so that it can assist in determining a diagnosis with the maximum. The results of this study are 6 types of digestive diseases in the stomach, using the Mamdani fuzzy expert system. So that it produces an accurate diagnosis. In making the web program, it has been tested using Black Box testing.

1.0 INTRODUCTION

Digestive system disorders are health disorders that attack one or several organs of the digestive system simultaneously [1]. The digestive system is tasked with digesting food to become nutrients that can be absorbed and then distributed throughout the body through the blood. Indigestion is a problem that often occurs in the digestive tract organs [2]. Disgetive diseases that often occur such as ulcers, gastritis, dyspsia, stomach cancer, gastric tumors, and GERD (Gastroesophageal Reflux Disease) which is a health condition of swelling, inflammation or irritation of the stomach [3]. The lack of awareness about health and also the costs for consulting with medical personnel is not small so that people are reluctant to consult or come to the clinic/PUSKESMAS, so that the disease gets worse. Therefore an expert system is needed to diagnose diseases of the digestive system. An expert system is a system that tries to adopt human knowledge into a computer to be able to solve problems that are usually done by experts [4]. The lack of awareness about health and also the costs for consulting with medical personnel is not small so that people are reluctant to consult or come to the clinic/PUSKESMAS, so that the disease gets worse [5]. Therefore an expert system is needed to diagnose diseases of the digestive system [6]. An expert system is a system that tries to adopt human knowledge into a computer to be able to solve problems that are usually done by experts [7].

The purpose of developing an expert system is not to replace the role of humans, but rather to provide human knowledge in the form of a system so that it can be used by many people

and is not limited by time [8]. The ability of the system to diagnose a symptom is indeed not as good as that of an expert doctor, there are still many things that are uncertain or inconsistent which can lead to the possibility of a misdiagnosis [9]. This inconsistency can lead to obfuscation of system diagnostic results and become a new question about the percentage certainty of these results [10]. Calculation of uncertainty is needed in an expert system, so that the results of a system diagnosis can be as convincing as the diagnosis of an expert [11].

In this study using the Fuzzy Mandani method with the maximum value concentration which will draw conclusions into a conclusion or results with Fuzzy Mandani maximum [12]. The identification of problems reviewed from the background above are difficulty in diagnosing a disease of the digestive system. The reason for using the Fuzzy Mamdani method is because it predicts a simple structure using maximum fuzzy Mamdani. By using an expert system, the Fuzzy Mandani method is expected to obtain accurate results. The purpose of this research is designing and building an expert system to be able to diagnose a disease in the digestive tract. Designing an expert system with the Fuzzy Mandani method which is implemented into a web-based system using PHP and MYSQL.

2.0 THEORETICAL

The research entitled Expert System with Fuzzy Mandani for Prediction of Digestive Diseases discusses how to diagnose digestive diseases in the stomach using an expert system with the Fuzzy Mamdani method to produce an accurate diagnosis, by making rules, symptom and disease data and weighting symptoms. to produce a maximum final decision.

2.1. Theories system used

2.1.1 Expert system

An expert system is a computer-based system that uses knowledge, facts, and reasoning techniques to solve problems that usually can only be solved by an expert in that field. Expert systems provide added value to technology to assist in dealing with an increasingly sophisticated information age [12].

2.1.2 Fuzzy Mandani

Fuzzy Mandani is often known as the max–min method. This method was introduced by Ebrahim Mandani in 1975 [13]. The form of distribution that allows the output of a fast and simple defuzzification procedure is to take one of the largest values that has the maximum degree of truth (maxima method) [8]. The possible choices are first (smallest), last (largest) or, in the case of a unimodal likelihood distribution, the median value. So far the most common maxima method is to choose the average value of the elements with the maximum degree of truth (MOM method). To get the output required 4 stages, including [14]:

1. Formation of sets In the Mamdani method both input and output variables are divided into one or more fuzzy sets.
2. Application of the implication function In the Mamdani Method, the implication function used is min.
3. The composition of the rules The method used to infer fuzzy systems is the Max (Maximum) method. In general it can be written: μsf[Xi] = max (μsf [Xi], μkf [Xi]) Where: μsf[Xi] = membership value of fuzzy solution up to the ith rule μkf[Xi] = membership value of fuzzy consequent
4. Affirmation (Defuzzy) Defuzzification of the Mamdani rule composition using the centroid method. Where in this method, a crisp solution is obtained by taking the regional center point fuzzy

2.1.3 Digestive Disease

In the digestive system there are several diseases that often attack the stomach such as ulcers, gastritis, dyspepsia, stomach cancer, gastric tumors, and GERD (gastroesophageal reflux disease). In this case, we first identify the types of complaints that occur in the disease. Information regarding the diagnosis of this disease was obtained from an expert equipped with books on disease and health. The book used as a source of disease data was ISO PHARMACOTHERAPY compiled by Sukandar, Elin Yulinah et al [15].

2.1.4 PHP

PHP or Hypertext Preprocessor is a programming language that is usually used to create websites, or is used to create other programs. The PHP programming language is much different from HTML. The PHP code / script that is created cannot be displayed on the home page only, but must be processed first by the web server and then displayed in the form of a web page in a web browser, PHP scripts can also be inserted in HTML and PHP scripts always start with . The database used is usually for PHP programming, for example, MySQL, some use Oracle, Microsoft Access, and others. PHP is known as a server-side scripting programming language, because PHP is processed on a server computer [14]

2.1.5 MySQL

Implementation of a relational database management system/RDBMS or what we usually call MySQL. Every user is free to use MySQL, but there are software limitations so that it cannot be used as a commercial derivative product. MySQL is actually a derivative of one of the main concepts in pre-existing databases; SQL (Structured Query Language). SQL is the concept of operating a database, especially for selecting or sorting and entering data, which allows data operations to be carried out easily, automatically and effectively [14].

3.0 METHODOLOGY

The Expert System for Diagnosing Stomach Diseases, namely ulcers, gastritis, dyspepsia, gastric cancer, GERD, and gastric polyps uses an expert system method with a prototype development approach model [16].

Figure 1. Frame of Mint

4.0

4.1 RESULANTS

4.1 Knowledge Base

Knowledge is the essence of an expert system, which is in the form of a representation of knowledge from experts. The Knowledge Base contains facts and rules. Facts are information about objects, circumstances and events, where the information obtained by this research is in the form of disease indications, symptoms and others arranged in tables so that they are easy to understand.

Table 1. Disease Name

Kode	**Disease Name**
P001	Indigestion
P002	Gastritis
P003	Dyspepsia
P004	Stomach Cancer
P005	Gastrosophageal Reflux Disease (GERD)
P006	Stomach Polyb

Table 2. symptom code

Code	Symptom
G001	Upper heartburn
G002	Nauseous
G003	Vomit
G004	No appetite
G005	Bloated
G006	Sour taste in the mouth
G007	Feel hot / sore in the solar plexus
G008	Stomach feels full

G009	Get full quickly when you eat
G010	Burp frequently
G011	Rising stomach acid
G012	Yellowish skin or whites of the eyes
G013	Difficulty swallowing food
G014	Bad breath
G015	Hoarse throat
G016	Difficulty sleeping after eating
G017	Pain in the chest
G018	Dry cough at night
G019	Stomach feels hard when pressed
G020	Bloody bowel movements
G021	Anemia

Table 3. disease definition and solution

Disease definition	Disease solution
Indigestion Ulcer disease is a feeling of discomfort in the stomach, such as a full stomach, heartburn at the top, nausea, vomiting, and flatulence.	eat slowly with small portions, limit spicy and fatty foods, and reduce caffeinated drinks.
Gastritis Gastritis is an inflammation of the stomach wall.	arrange a regular eating pattern and schedule, eat small portions but more often, avoid fatty, sour and spicy foods, don't smoke.
Dyspepsia Dyspepsia is a condition caused by discomfort in the upper abdomen due to stomach acid	reduce stress/depression, stop smoking, don't consume alcoholic beverages, reduce fatty, spicy and sour foods, eat small and regular meals, don't rush, avoid lying down after eating, don't take medicine on an empty stomach and minimal medication without a doctor's prescription .
Stomach Cancer Stomach cancer is cancer that occurs due to abnormal and uncontrolled growth of stomach cells. This abnormal cell growth occurs because the cells in the stomach experience genetics.	stop smoking, avoid salty and ready-to-eat food, exercise diligently, adopt a healthy diet by consuming fresh foods rich in fiber and vitamins, take medication for stomach infections properly by using antibiotics.
Gastrosophageal Reflux Disease (GERD) Gastrosophageal Reflux Disease (GERD) is a condition when stomach acid rises into the esophagus or esophagus.	stop smoking, eat small and frequent meals, avoid fatty and spicy foods, sleep using a higher pillow, and reduce carbonated drinks.
Stomach Polyb Gastric polyb disease is a collection of cells that grow into abnormal tissue in the stomach wall.	maintaining food hygiene, washing hands when touching food, exercising diligently, not smoking, consuming foods rich in fruit and vegetable fiber.

Table 4. rule of disease and symptoms

Code	Disease					
	P001	P002	P003	P004	P005	P006
G001	X			X		X
G002	X	X	X	X	X	X
G003	X	X	X	X	X	X
G004	X	X				
G005	X	X	X	X		

Code	Disease					
	P001	P002	P003	P004	P005	P006
G006	X					
G007		X	X			
G008		X	X			
G009			X	X		
G010				X		
G011				X		
G012				X		
G013				X		
G014					X	
G015					X	
G016					X	
G017					X	
G018					X	
G019						X
G020						X
G021						X

4.2 Interpretation of Weight Values

In this study using an expert system with Fuzzy Mamdani Max (maximum) by interpreting the weight values.

Table 5. Weight

Term	Weight
Less Influence	0,1 s/d 0,4
Influential	0,5 s/d 0,7
Very influential	0,8 s/d 1

Table 6. Symptom Weight

Disease Name	Symptom	Interpretation	Weight
Indigestion	Upper heartburn (G001)	Influential	0,5
	Nauseous(G002)	Less Influence	0,4
	Vomit(G003)	Less Influence	0,3
	No appetite(G004)	Influential	0,5
	Bloated(G005)	Influential	0,5
	Sour taste in the mouth(G006)	Very influential	0,8
Gastritis	Feel hot / sore in the solar plexus(G007)	Influential	0,6
	Stomach feels full(G008)	Influential	0,7
	No appetite(G004)	Very influential	0,9
	Bloated(G005)	Influential	0,5
	Vomit(G002)	Less Influence	0,4
	No appetite(G003)	Less Influence	0,3
Dyspepsia	Vomit(G002)	Less Influence	0,4
	No appetite(G003)	Less Influence	0,3
	Bloated(G005)	Influential	0,5
	Stomach feels full(G008)	Influential	0,6
	Get full quickly when you eat(G009)	Very influential	0,8
	Feel hot / sore in the solar plexus(G007)	Influential	0,7
Stomach Cancer	Bloated(G005)	Influential	0,5
	Burp frequently(G010)	Influential	0,5
	Upper heartburn (G001)	Less Influence	0,4

Disease Name	Symptom	Interpretation	Weight
	Rising stomach acid (G011)	Influential	0,6
	Get full quickly when you eat(G009)	Influential	0,6
	Vomit(G002)	Less Influence	0,4
	No appetite(G003)	Less Influence	0,3
	Yellowish skin or whites of the eyes(G012)	Very influential	0,9
	Sour taste in the mouth(G006)	Influential	0,5
Gastrosophageal Reflux Disease (GERD)	Bad breath(G014)	Influential	0,7
	Hoarse throat(G015)	Influential	0,5
	Difficulty sleeping after eating(G016)	Very influential	0,8
	Pain in the chest(G017)	Very influential	0,9
	Dry cough at night(G018)	Very influential	0,8
Stomach Polyb	Vomit(G002)	Less Influence	0,4
	No appetite(G003)	Less Influence	0,3
	Stomach feels hard when pressed(G019)	Influential	0,7
	Bloody bowel movements(G020)	Very influential	0,9
	Anemia(G021)	Very influential	0,8
	Feel hot / sore in the solar plexus(G007)	Influential	0,6

a. Gastric Pains
   If Upper heartburn (0,5)
   And Nauseous(0,4)
   And Vomit(0,3)
   And No appetite(0,5)
   And Bloated(0,5)
   And Sour taste in the mouth(0,8)
   Then Gastric Pains

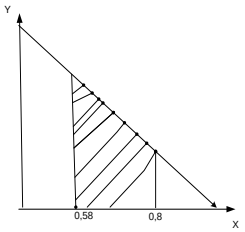

figure 1. graph of gastric disease

μdf (xi) = max (μdf(xi,) μkf(xi))
= max (0,58 ; 0,8)
= 0,8

4.3 System Implementation

The following is the display result of the Expert System application with Fuzzy Mamdani. Initial display when opening the application.

a. Where there is a Home menu, Diagnosis, disease info, About, and admin.

Figure 2. Initial display of the application

b. Patient registration display where fill in identity such as fill in name, gender, age, address, and email then click register.

Figure 3. Patient Registration

c. Display of a selection of symptoms, where the patient selects the symptoms according to what is experienced by ticking and then clicking on the diagnosis process.

Figure 4. Display of selecting symptoms according to what is experienced

d. The final display of the results of the diagnostic process, where the patient knows the disease he is experiencing and the solution to the disease.

Figure 5. Display of symptom results

5.0 CONCLUSION

From the research results found, it can be concluded that trials in expert system applications with Fuzzy Mamdani can be used with maximum results with an accuracy rate of 90%. And the Fuzzy Mamdani method has an accurate calculation value, so when analyzing problems it can produce maximum values.

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