IMPLEMENTATION OF DEMPSTER SHAFER IN EXPERT SYSTEM IN EARLY DIAGNOSIS OF DENTAL AND MOUTH DISEASES IN CHILDREN

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Abstract

Diseases of the teeth and oral cavity are one of the health problems that many people experience. This is very inversely proportional to the needs of everyone who wants to have a healthy mouth and teeth. Lack of awareness to maintain oral and dental health is still low. Many people think that brushing your teeth is enough, even though this activity is not enough to maintain healthy teeth and oral cavity. When diagnosing doctors often do X-rays. Therefore, doctors need a system to diagnose diseases of the teeth and oral cavity, where the system used uses a Dempster Shafer method where the accuracy of this method has been proven to be 93%.

Keywords - teeth and mouth, Dempster Shafer, Expert System

INTRODUCTION

Maintaining the health of the teeth and oral cavity is the most important factor that must be considered, teeth are the most important factor in the growth of a child. In children, tooth decay is very prone to occur because children's tooth enamel is not as strong as adult tooth enamel.

Based on the results of the Global Burden of Disease Study in 2016, it was stated that teeth and mouth in the form of dental caries have affected half of the world's population (3.58 billion people) experiencing it. Gum disease (periodontal) which can lead to tooth loss is the 11th disease in the world or globally.

A lot of plaque or tartar can cause an unpleasant odor in the mouth, thus reducing self-confidence in communicating so that it greatly interferes with daily activities.

The factors that cause oral and dental disease include unhealthy diet, use of cigarettes and alcohol and lack of oral hygiene. Teeth and mouth disease greatly affects aspects of life, because teeth and mouth are self-confidence.

Therefore, we need a system that can provide information about dentistry and oral diseases and can carry out early diagnosis so that the disease can be resolved immediately, one of which is an expert system.

Based on the study described above, it can be concluded that there are a number of things that must be studied in this final project, including how to design the relationship between the symptoms that will be caused by the type of disease predicted and how to find solutions based on predetermined results.

In order for this discussion to be in accordance with the title, then the authors limit the problems to be discussed, namely the use of the Dempster shafer method which is applied to expert systems to determine the diagnosis of dental and oral diseases in children, such as thrush, tooth decay, gingivitis and dental caries.

The purpose of this thesis is to design an expert system application so that users can find out the problems caused by teeth and mouth by understanding the Dempster Shafer method and providing solutions to treat children diagnosed with diseases and symptoms of dental and oral diseases. The results of the research are expected, with the existence of this expert system, the public's understanding of oral health can improve. From several journal references taken, it is concluded that the application of the dempster shafer method to get the type of disease in children has an accuracy rate of 80% [1], the Dempster-Shafer method is a system that diagnoses various diseases of the teeth and oral cavity based on symptoms and provides dental health information, and oral cavity to the public by applying the Dempster Shafer method [2]. Periodonal disease can cause tooth loss due to inflammation from bacteria and a serious infection that can damage the gums and can destroy the

jawbone [3]. Gingivitis is a periodontal disease with milder symptoms characterized by red swelling of the gingiva, and bleeding easily without finding alveolar bone damage [4]. Meanwhile, dental caries is an infection that can damage teeth, causing cavities, pain, and sleeplessness caused by bad bacteria due to lack of proper dental hygiene [5]. The Dempster Shafer method, an expert system, has provided convenience to the public in diagnosing infectious diseases in children regarding complaints of illness with an accuracy rate of 80% [6]. Through the lymph nodes, oral cancer can spread to all body tissues [7] Dental hygiene can greatly affect health because teeth destroy food in the mouth and lubricate with saliva before the food enters the stomach [8].

II. RESEARCH METHODS

A. Expert System

The expert system is a computer media-based system that can diagnose dental and oral diseases. Expert systems can work automatically because they contain data from human knowledge, so it is certain that this system is very helpful for doctors' work. In addition, expert systems have also been widely used by medical experts when diagnosing diseases and analyzing and assisting health experts in making decision.

B. Expert system method

Arthur P. Dempster and Glenn Shafer who are experts for the first time introduced the Dempster-Shafer method in 1976. This theory is a mathematical theory that can provide evidence by combining evidence from various sources or obtaining a certain level of confidence from the available evidence. The interval in the Dempster-Shafer method is belief and plausibility.

A way of measuring the strength of evidence is called belief. If the value is 0 proves the absence of evidence, conversely if 1 says there is evidence. Plausibility is a measure of distrust of evidence / symptoms. If value 1 represents uncertainty, if value 0 represents uncertainty. This plausibility is denoted by:
plau (s) = 1- (reliability value) .... (1).

In this theory, it is also called a discrete frame, denoted by (θ). FOD is a set of hypotheses, this theory is also called a mass function, denoted by (m). In this system, the user can select several symptoms that are included in the system. The rules for dealing with this problem in Dempster-Shafer theory are:

$$M_3(Z) = \frac{\sum_{X \cap Y = z} m_1(X).m_2(Y)}{1 - K} \quad ....(2)$$

Where:

M3 (z) = z value of z symptom / evidence quality function

M1 (x = symptom / evidence quality function value x M2 (y) = symptom / evidence quality function value y ∑a∩b m1 (a) .m2 (b) = is the sum of m1 and m2 and their parts

K = If the pieces are blank, the amount of evidence to the contrary.

The steps in using the Dempster-Shafer method are:

a. Administrators get hypothetical data.

b. Administrators prepare evidence data.

c. Administrators create rules that contain evidence for each hypothesis

d. The user selects the evidence displayed by the system

e. The system adopts rules based on input.

f. do the initial combination count. First, determine the initial mass functions, namely m1 and m2.

g. Determine the combination of the initial mass function, namely m3. The result of this combination becomes the mass function for further calculations.

h. After the symptoms disappear, the count will stop Counting everything

i. Take the maximum value and use the hypothesis contained in the quality function. The data obtained is the result of the final calculation
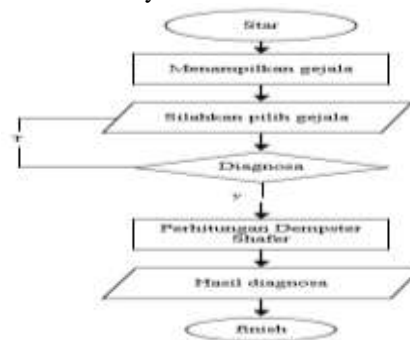
C.flowchart system

Figure 1. Flowchart of system applications

The flowchart in Figure 1 explains that the system will display all the symptoms for each disease. As a first step, the patient is asked to choose the symptoms of the type of oral disease experienced in the diagnostic system. After that the patient chooses the symptoms they feel, the results of the answers will be processed according to the rules designed by the system, after the results come out the user can consult a doctor.
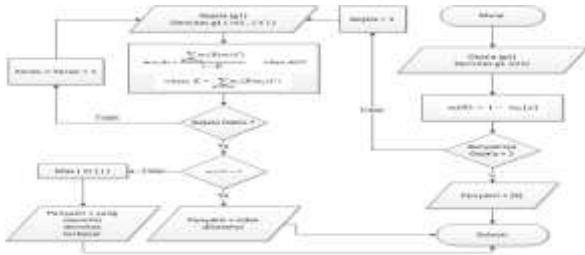
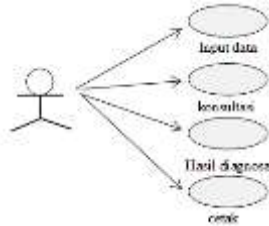Figure 2. Flowchart of Dempster shafer calculation

Figure 3. User use case

Based on the Use Case User flow in Figure 3, it explains the user account registration flow requested by the system to fill in all biodata forms, so that users can access the diagnostic expert system with an account that has been registered and approved by the admin. The user is asked to choose the symptoms that are available in the system. After the user selects the symptoms they feel, the diagnostic results will be processed based on the rules designed by the system
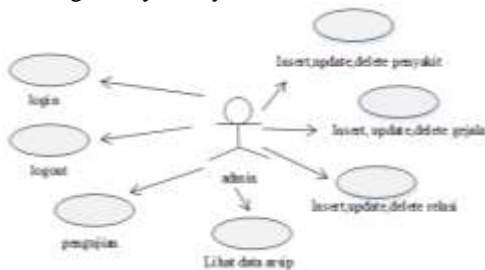

Figure 4. Use case admin

Based on the Use Case Admin in Figure 4, it explains that the admin has all access to manage all existing systems such as changing, adding or deleting existing disease symptom data.

III. RESULTS AND DISCUSSION

When building a system to be implemented, the first step that must be taken is to build a knowledge base. The belief value was obtained from a doctor, namely drg. Dira Pratiwi, S.kg and drg. Rahma Safra Wilda by conducting an online interview.

Table 1 Dental and Oral Disease in Children

Code	Name of disease	Definition
SA	Sprue	The occurrence of sores or inflammation of the lips and mouth, causing pain and discomfort
GB	Cavity	If a tooth is damaged, erosion will erode the inside and outside of the tooth, causing tooth decay
BU	Gingivitis	Gingivitis characterized by redness of the gums around the roots
KG	Dental caries	Dental tissue can damage the surface of the tooth and then spread to the pulp

Table 2. Symptoms of the disease.

Code	Symptom Name
A01	Burning sensation on the tongue
A02	Red gums
A03	A white wound appeared on his tongue
A04	Discomfort when swallowing
A05	The inside of the mouth and throat are red bewarma
A06	There are clearly visible holes in the teeth
A07	Tooth sensitivity
A08	Light bleeding that occurs when scratched
A09	Bad breath
A10	Mild to severe pain when consuming sweet things
A11	Swollen gums
A12	There are brown or black spots on the surface of the teeth
A13	Saki on the teeth

Table 3. Knowledge base of disease symptoms

code	Disease name	Rule
SA	Sprue	A01,A03,A04,A05,A08

GB	Cavity	A06,A07,A10,A12,A13
RG	Gingivitis	A02,A08,A09,A11
KG	Dental caries	A06,A07,A09,A10,A13

table 4. symptom values

Kode	SA	GB	RG	KG	Bel
A01	✓				0,8
A02			✓		0,7
A03	✓				0,8
A04	✓				0,8
A05	✓				0,8
A06		✓		✓	0,4
A07		✓		✓	0,3
A08	✓		✓		0,6
A09			✓	✓	0,7
A10		✓		✓	0,6
A11			✓		0,7
A12		✓			0,9
A13		✓		✓	0,5

A. The analysis of the Dempster Shafer method is by testing the 3 symptoms that have been proposed by the patient / user, namely:
1. Has sensitivity to teeth (A07)
2. Burning sensation on the tongue (A01)
3. Bad breath (A09)

The first symptoms:
Having tooth sensitivity (A07)
A07 : {GB , KG }
m1 {GB, KG } = 0.3
Mm {0} = 1-0.3 =0.7
Second Symptom:
Burning sensation on the tongue
B01 : SA
m2 {SA}=0.8
m2{0}=1-0.8=0.2

	m2{GB} 0.6	m2{0}0.4
m1{GB,KG}03	{SA}0.18	(GB,KG}0.12
m1{0}0.7	{SA}0.42	{0}0.28

m3 {SA} = $\frac{0.18+0.42}{1-0}$ = 0.6

m3 {GB,KG} = $\frac{0.28}{1-0}$ = 0.12

m3 {0} = $\frac{0.28}{1-0}$ = 0.28

The third symptom:
Bad breath (A09)
B11 : {RG, KG}
m4 { RG,KG} =0.3
m4 {0} = 1-0.3=0.7

	m4(RG,KG} 0.3	m4 {0} 0.7
m3 {SA} 0.6	{RG,KG} 0.18	{RG,KG} 0.42
m3 {GB, KG} 0.12	{RG,KG}0,36	{GB,KG} 0.084
m3 {0} 0.28	{ RG,KG} 0.084	{0} 0.196

m5 {GB,KG} = $\frac{0.48+0.12+0,36+0.084}{1-0}$ = 0.72

m5 { SA } = 0.084

The greatest confidence value is in the disease {GB, KG}, namely bleeding gums and dental caries with a value 0.72 x 100 % = 72 %

A. Initial view

Figure 5. Login page

The user uses the login form to select data about the symptoms of the disease and its diagnosis, while the administrator login form is used to access all data in the system
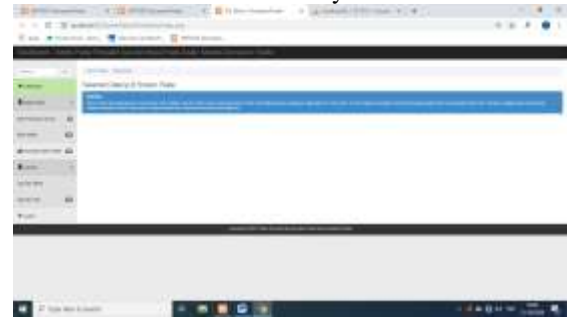

Figure 6. Home Menu

The image above is the main page when the admin has logged in, where the admin has all access related to all the menus that are displayed.
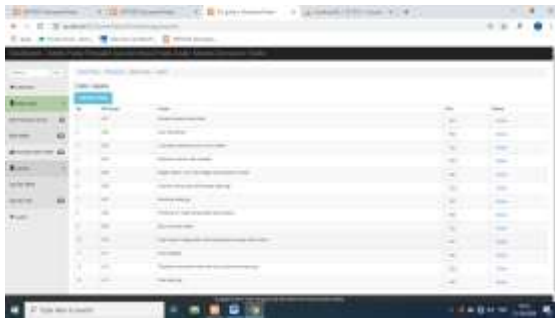
Figure 7. Symptom Form

In this picture displays all the symptoms in the system.

Figure 9. Consultation page

Figure 10. Expert system diagnosis results

Testing of the level of system accuracy obtained from the same results as tests carried out manually or based on the results of interviews with doctors. Data calculation in calculating the level of accuracy is: Accuracy = (5/5) * 100 = 100% The results obtained in measuring the level of trust in the system. Based on data that has been obtained from doctors.

IV. CONCLUSION

Healthy teeth are the teeth that are clean and free of radiation and supported by healthy, hard, pink gums. To get the best oral health, routine maintenance is needed to determine the health of teeth and tissues in the oral cavity. This can be achieved by conducting dental and oral health checks with the dentist every six months, not only if there are complaints.

V. REFERENCES

[1] N, Norfai dan E, Rahman2. 2017. The relationship between knowledge and tooth brushing habits with the incidence of dental caries at SDI Darul Mu'minin, Banjarmasin City, Faculty of Public Health, Islamic University of Kalimantan (UNISKA) Muhammad Arsyad Al Banjari Banjarmasin.

[2] Effendy, Z, Rakhmatillah, L. (2015). The expert system for diagnosing diseases in children uses the Dempster Shafer method

[3] Valentine, H. M, Nasution, H & Sasty pratiwi, H. 2015. Designing Expert System for Early Diagnosis of Dental and Oral Diseases Using the Dempster Shafer Method.

[4] Wijaksana I. 2019. periodontal chart and periodontal risk assessment as material for evaluation and education of patients with periodontal disease, p-ISSN: 2407-0866.

[5] Titik Sugiarti, Yunita Dyah Puspita Santik of Epidemiology and Biostatistics, Department of Public Health, Faculty of Sport Sciences, Semarang State University.

[6] Merlina, N, Fitriyati, NH. 2016. Expert System in Diagnosing Infectious Diseases in Children Using the Dempster-Shafer Method. Bina Insani ICT Journal, 3 (2), 307-316.

[7] Fajrin, M, Fatimah, DDS. Design of an Expert System for Diagnosis of Oral Cancer, ISSN: 2302-7339 Vol. 12 No. 1 2015.

[8] Nasution, YL, Mesran M. 2017. Expert System for Diagnosing Brain Tumors Using the Definitty Factor (CF).

[9] Schubert, J. 2010. Conflict management in Dempster – Shafer theory using the degree of falsity, International Journal of Approximate Reasoning, Stockholm, Sweden.

[10] Adhi Kusnadi. 2013. Expert System Application Design for Diagnosis of Diseases in Humans.

[11] Panggabean, EK, 2018. Comparative Analysis of Dempster Shafer Method With Certainty Factor Method for Diagnose Stroke Diseases, International Journal of Artificial Intelligence Research, Medan.

[12] Arfajsyah Sidiq H and Permana Inggih. February 2018, Salisah Febi Nur febi, Android-Based Dental and Oral Diagnosis Expert System. Journal of Information Systems Engineering and Management

Science, Volume One. No. 4 2 August 2018, No. 110-117 e-ISSN 2502-8995, p-ISSN 2

[13] Minardi Joko, Suyatno Suyatno. Expert system for diagnosing pregnancy disease using the Dempster-Shafer method and decision tree, vol 7, no 1 (2016)

[14] Ritong Rosmita Eli, Irawan Dedi Muhammad, Expert System for the Diagnosis of Lung Disease in Children with

[15] Panggabean, EK. (2018). Comparative Analysis Of Dempster Shafer Method With Certainty Factor Method For Diagnose Stroke Diseases. International Journal Of Artificial Intelligence Research, 2 (1), 32-38. Using the Dempster-Shafer Method, vol 2, no 1 (2017)

[16] Kirman, Saputra Andi, Sukmana Jacky, Expert System for Diagnosing Stomach Disease and Its Treatment Using the Dempster Shafer Method, Pseudocode Journal.

[17] Maseleno, A, Hassan, MM. 2012. Skin diseases expert system using Dempster Shafer theory. International Journal of Intelligent Systems and Applications, 4 (5), 38- 44.