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Application of Certainty Factor Method in Intelligent System for Diagnosis of Periodontal Disease Based on Android

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Abstract: This study discusses the design of an Android-based innovative application that is useful in the early diagnosis of periodontal disease in cigarette addicts. The problem which is the main topic of discussion in this study is the health issue of organs that are often ignored by humans, namely the teeth and mouth. Then one of the types of dental and oral diseases that many people often complain about is the periodontal disease which also gets less attention in Indonesian society. And one of the causes of this periodontal disease is caused by smoking habits. So to facilitate the identification in knowing the periodontal symptoms caused by the cigarette, a system that can identify the early symptoms of periodontal disease is needed. The technology proposed to build the system applies expert system technology with Certainty Factor. In building an android-based innovative application to diagnose periodontal disease, there are cigarette addicts in this study with the Research & Development research method to produce an output that can be right on target by the expected target. In addition, interviews and direct observation techniques were also carried out with experts or experts in the field of dental and oral diseases to collect the required data on the needs of the system to be built.

Keywords: Expert System; Periodontal Disease; Certainty Factor; Artifial Intelligence; Android

INTRODUCTION

Dental and oral health is sometimes not a top priority for some people. Dental and oral diseases often have severe consequences for health because teeth and mouth are the entry point for bacteria and other bacteria, so they tend to interfere with oral health and other body organs (Wijaya et al., 2017).

Periodontal disease is one of the most common dental and oral diseases or bacterial inflammatory diseases that causes progressive destruction of the supporting tissues of the teeth and causes tooth loss (Tedjasulaksana, 2016). Traditionally, periodontal disease has been divided into two main categories: gingivitis and periodontitis (Nisa & Primartha, 2013). The cause of the most periodontal disease is smoking (Sumerti, 2016). Cigarettes contain nicotine, tar, arsenic, carbon monoxide, benzene, and other chemicals, of which nitrogen compounds account for 24%, and hydrocarbons account for 15% (Asiking, 2016). The indications and causes of periodontal disease are not understood. Dentists have not treated so chronic periodontal disease. Therefore, a method and system are needed to diagnose periodontal disease early, quickly, and accurately.

From these problems, it is necessary to have a system that can diagnose early periodontitis. One can apply one of the technological features of artificial intelligence to overcome this problem, the Expert System.

The expert system is an issue of human-made intelligence that learns how an expert thinks in solving a problem (Saputri et al., 2017), making decisions or drawing conclusions from some facts. The introductory study in the expert system is how to enter the knowledge possessed by an expert into the system (Nasyuha et al., 2020) and how to make decisions or draw conclusions based on that knowledge by storing information and combining it with an adequate set of reasoning rules (Dahria et al., 2013).

This study's application in identifying periodontal disease in cigarette addicts by applying Certainty Factor method. Certainty Factor method is a method that is used to express confidence in an event based on the results of research or assessments from experts (Rahmah & Saputra, 2017). The certainty factor method is used when facing a problem for which the answer is uncertain. This uncertainty can be in the form of probability

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(Supiandi & Chandradimuka, 2018). Certainty factor method is divided into several stages related to the training data, namely the -record data that was previously calculated (Annisa, 2018). This method is very suitable for expert systems to diagnose things that are not certain and to show great confidence (Septiana, 2016).

Developing this intelligent application is expected to help the community identify the symptoms of periodontal disease, especially in cigarette addicts. And it also aims to provide scientific libraries, insights, and the latest knowledge about the Expert System concepts so that they can be utilized in a broader scope in the future.

LITERATURE REVIEW

Periodontal

Periodontal disease is a pathological process manifested by several inflammatory conditions involving the supporting tissues of the teeth caused by bacteria due to the failure of many people to maintain good oral and dental hygiene. The effects of periodontal disease are damage to the jaw structure, pain can impair mobility to a more severe degree, and death can occur due to systemic disease due to ongoing bacterial infection. There are two main types of periodontal disease namely (Ibrahim & Rahmah, 2020):

a. Gingivitis
   Gingivitis is an inflammatory process in the soft tissues supporting the teeth, where the junctional epithelium has not undergone any changes in an attachment (Quamilla, 2016).

b. Periodontitis
   Periodontitis is an inflammatory disease of the supporting tissues of the teeth, where there is progressive destruction of the periodontal tissues characterized by pocket formation, recession, or both, caused by specific groups of microorganisms. Periodontitis is initiated by untreated gingivitis so that the supporting bones of the teeth will be damaged (Arifiana & Prandita, 2019).

The Effect of Cigarettes on Dental and Oral Health

Smoking habits increase the risk of periodontal disease. The more you smoke, the more cigarettes you smoke, the higher the risk of periodontal disease and the more severe the process of tissue destruction. In addition, if you do not stop smoking, it will be more difficult for the periodontal tissues to heal after treatment. [(Liana & Arbi, 2019).

Expert system

An expert system is a system that provides a solution to a particular problem in a particular domain. The solution is run in the capacity of an expert who is an expert in his field. Expert systems impart knowledge based on expert competence. Knowledge embedded in expert systems can be obtained from various sources, such as books, magazines, and even experts in specific fields (Dharmawan & Meidia, 2015).

Certainty Factor

Certainty Factor is a method to prove whether a fact is certain or uncertain in the form of metrics commonly used in expert systems (Permata & Hadi, 2020). The amount of Certainty Factor ranges from -1 to 1; -1 indicates absolute distrust, while the value of 1 indicates absolute confidence (Latumakulita, 2019). The certainty Factor method is used when facing a problem whose answer is uncertain. This uncertainty can be a probability. The expert system uses Certainty Factor method to calculate the certainty value of the symptoms given by the patient and the value given by the expert (Simorangkir, 2020). One of the advantages of Certainty Factor method is that this method is suitable for use in expert systems to measure something, whether it is certain or uncertain in diagnosing disease, as one example because calculations using this method in one count can only process two data so that the accuracy of the data can be determined. Awake. The formula used to calculate the certainty factor value in a case is in equation (1), equation (2), and equation (3) below:

$$CF[H,E] = MB[H,E] - MD[H,E] \quad (1)$$

$$MB[H,E] = \frac{\max[P(H|E),P(H)] - P(H)}{\max[1,0] - P(H)} \quad (2)$$

$$MD[H,E] = \frac{\min[P(H|E),P(H)] - P(H)}{\min[1,0] - P(H)} \quad (3)$$

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METHOD

This Section describes the application design process chart for diagnosing periodontal disease by the rules determined by the application of Research and Development, which aims to create an android-based application that can diagnose periodontal disease with Certainty Factors. Besides that, a framework must be done to complete this research. The stages of the process of Certainty Factor in calculating the probability of diagnosing periodontal disease are as follows:

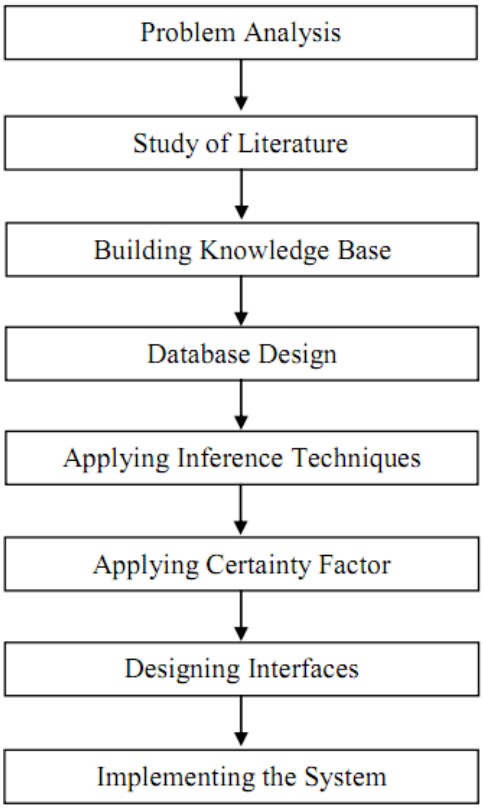

Fig 1. Framework of Research

Problem Analysis

The problem raised is the application of an expert system to present the expertise of an expert to assist users in solving a problem. The public, especially active smokers often neglect public dental and oral health. The addiction to smoking cigarettes experienced by smokers is often the cause of severe dental and oral diseases, especially periodontal disease.

Study of literature

The literature study will be collected in the form of data related to periodontal disease. In addition, in this research, it is necessary to collect various references used for theoretical discussions, such as books or journals that discuss expert systems and the Certainty Factor method.

Building Knowledge Base

At this stage, the aim is to build a knowledge base. This stage is used to classify the data obtained so that the system design can later accommodate these data.

Database Design

This stage is used to classify the data obtained so that the system design can later accommodate these data.

Applying Inference Techniques

The process of tracing the diagnosis of periodontal disease in selected cigarette addicts by applying the Forward Chaining tracing technique so that later the classification of the identified periodontal disease can be known.

Applying Certainty Factor Method Calculations

Then apply the Certainty Factor method to identify periodontal disease, and the test results will be implemented into an Android-based application. In the process of testing the Certainty Factor calculation in the case in this

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study to diagnose periodontal disease based on equations (1), (2), and (3) from the previous chapter. The steps taken are to prepare the periodontal disease classification data first, then the periodontal disease symptom data along with the trust value from the expert, then determine the identification of the periodontal disease classification based on the combination of the periodontal disease symptoms determined in this study with the determined periodontal disease classification results. For the calculation of the diagnosis, it is calculated by a combination process of multiplying the trust value of the expert with the trust value of the system user. and the results obtained later are to see which is the highest confidence value among all symptom calculations against disease classification, then that is the result of the diagnosis that was chosen to be the result of the final identification of system users to diagnose periodontal disease.

Designing Interfaces

Interface design is done to determine the needs and description of the android application.

Implementing the System

This system will be built based on Android and used to get the results from the application of the methods that have been carried out so that later users who will use the system can find out the results of the diagnosis of periodontal disease in cigarette addicts based on the symptoms selected through the application interface and can be used as conclusions to identify the disease. Periodontitis in cigarette addicts.

RESULT

In the early diagnosis of periodontal disease in cigarette addicts, data on symptoms and types of disease are needed based on the symptoms selected by the user. Table 1 below shows the types of periodontal disease data used in this study.

Table 1. Periodontal Disease Data

No.	Code	Classification
1.	P01	Gingivitis
2.	P02	Periodontitis
3.	P03	Candidiasis
4.	P04	Periodontal Abscess
5.	P05	Periapical Abscess
6.	P06	Gingivostomatitis

Then in Table 2 below, the symptomatic data used to diagnose periodontal disease in cigarette addicts:

Table 2. Indications Data

No.	Code	Indications	CF Expert
1.	G01	Bad breath	0.7
2.	G02	Swollen gums	0.8
3.	G03	Gums bleed easily when teeth	0.8
4.	G04	Gums are blackish red	0.6
5.	G05	The gums are inflamed, and when touched	0.8
6.	G06	Missing gums	0.7
7.	G07	Gums look longer	0.7
8.	G08	The front teeth are starting to shift	0.6
9.	G09	An abscess on the gum begins to form	0.7
10.	G10	loose teeth	0.7
11.	G11	A poke is formed between the teeth and gums	0.5
12.	G12	White sores on the tongue, inner cheeks, palate, gums, and tonsils	0.6
13.	G13	Slight wound	0.5
14.	G14	eat or swallow	0.4
15.	G15	Bleeding when the wound is rubbed	0.4
16.	G16	Cracked or angry at the corner of the mouth	0.5
17.	G17	Pain in the mouth	0.7
18.	G18	Pus appears in the mouth	0.8
19.	G19	It hurts when you open your mouth	0.6
20.	G20	Swollen lymph nodes in the neck	0.6

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21.	G21	Pain when chewing food	0.8
22.	G22	Feeling pain in the gums	0.7
23.	G23	The tip of the gum is eroding	0.7
24.	G24	Lips feel dry	0.5
25.	G25	Wide open sores in the mouth	0.6
26.	G26	Red gums	0.7

Then in Table 3 below, for the identification of symptom diagnoses with periodontal disease data:

Table 3. Identification of Periodontal Disease

Indication Code	P01	P02	P03	P04	P05	P06
G01	×	×				
G02	×			×		
G03	×					
G04	×					
G05	×	×				
G06		×				
G07		×				
G08		×				
G09		×				
G10		×				
G11		×				
G12			×			×
G13			×			
G14			×	×	×	
G15			×			
G16			×			
G17				×		
G18				×		
G19					×	
G20					×	
G21					×	
G22					×	
G23						×
G24						×
G25						×
G26						×

Based on the identification table in Table 3 previously, six rules were found, namely:

Rule 1:
IF *Bad breath*
AND *Swollen Gums*
AND *Gums bleed easily when brushing teeth*
AND *Gums are blackish red*
AND *The gums are inflamed and sensitive*
THEN Gingivitis (P01)

Rule 2:
IF *Bad breath*
And *the gums are inflamed and sensitive*
AND *Gums lose*
AND *Gums look longer*
AND *The front teeth start to shift*
AND *An abscess on the gum begins to form*
AND *Loose teeth*

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AND *A poke is formed between the teeth and gums*
THEN Periodontitis (P02)

Rule 3:
IF *White sore on tongue….*
AND *Slightly inflamed wound*
AND *Difficulty eating or swallowing*
AND *Bleeding when the wound is rubbed*
AND *Cracks or redness at the ends*
THEN Candidiasis (P03)

Rule 4:
IF *Swollen gums*
AND *Difficulty eating or swallowing*
AND *Pain in the mouth*
AND *Pus appears in the mouth*
THEN Periodontal Abscess (P04)

Rule 5:
IF *Swollen gums*
And *It hurts when you open your mouth*
AND *Swelling of the lymph nodes*
And *I feel pain when I chew food*
AND *Feels painful on the gums*
THEN Periapical Abscess (P05)

Rule 6:
IF *White sore on tongue….*
AND *the tip of the gum is eroding*
AND *Lips feel dry*
AND *Wide open sores on the mouth*
AND *Gums are red*
THEN Gingivostomatitis (P06)

In the first-line testing, scenario trials were carried out to identify the disease from the symptoms of periodontal disease, as well as the scenario in Table 4 as follows:

Table 4. Testing Scenarios with CFExpert

No.	Rule	Indications	CF Expert
CF1	*IF*	Bad breath	0.7
CF2	*AND*	Swollen gums	0.8
CF3	*AND*	Gums bleed easily when brushing teeth	0.8
CF4	*AND*	Gums are blackish red	0.6
CF5	*AND*	Gums are inflamed and sensitive to the touch	0.8

Table 5. Value of Trust from Users

Indications Code	Value of CF Expert	Value of CF User
CF1	0.7	0.2
CF2	0.8	0.4
CF3	0.8	0.6
CF4	0.6	0.8
CF5	0.8	0.8

Then calculate the Certainty Factor value between CF Expert and CF User. The calculation is as follows:

CF1 = CF User * CF Expert
= 0.7 * 0.2

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= 0.14

CF2 = CF User * CF Expert
= 0.8 * 0.4
= 0.48

CF3 = CF User * CF Expert
= 0.8 * 0.6
= 0.48

CF4 = CF User * CF Expert
= 0.6 * 0.8
= 0.48

CF5 = CF User * CF Expert
= 0.8 * 0.8
= 0.64

Next, look for the certainty value of the combination of the CF Expert confidence value and CF User. And here is the calculation of the combination obtained:

$CF_{combine}$ CF[H,E]1,2 = $CF[H,E]_1 + CF[H,E]_2 * (1-CF[H,E]_1)$
= 0.14 + 0.48 * (1-0.14)
= 0.14 + 0.48 * 0.76
= 0.5048 old1

$CF_{combine}$ CF[H,]Gold,3 = $CF[H,E]_1 + CF[H,E]_3 * (1-CF[H,E]_1)$
= 0.5048 + 0.48 * (1-0.5048)
= 0.5048 + 0.48 * 0.4952
= 0.7424 old2

$CF_{combine}$ CF[H,E]old2,4 = $CF[H,E]_{old2} + CF[H,E]_4 * (1-CF[H,E]_1)$
= 0.7424 + 0.48 * (1-0.7424)
= 0.7424 + 0.48 * 0.2576
= 0.8660 old3

$CF_{combine}$ CF[H,E]old3,5 = $CF[H,E]_1 + CF[H,E]_2 * (1-CF[H,E]_1)$
= 0.8660 + 0.64 * (1-0.8660)
= 0.8660 + 0.64 * 0.134
= 0.95176 old4

$CF_{combine}$ CF[H,E]ol4,6 = $CF[H,E]_{old3} + CF[H,E]_5 * (1-CF[H,E]_{old3})$

CF[H,E]old6 * 100% = 0.95176 * 100%
= 95.176 %

From the results of the above calculations, it can be seen that the level of confidence from the results of the diagnosis in the certainty factor test scenario is 95.176%

CONCLUSION

Based on the test results on the application of Certainty Factor in the process of diagnosing periodontal disease in cigarette addicts in this study, it is known that the calculation of Certainty Factor is capable of producing predictions of diagnostic results by the level of confidence made by the user by displaying the predictive results of the diagnosis of periodontal disease. So that with this system, it can be used as an auxiliary fly in diagnosing periodontal disease in a short time and does not take a long time to diagnose the symptoms of periodontal disease in cigarette addicts.

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REFERENCES

Annisa, R. (2018). Sistem Pakar Metode Certainty Factor Untuk Mendiagnosa Tipe Skizofrenia. *IJCIT (Indonesian Journal on Computer and Information Technology)*, *3*(1).

Arifiana, V. D., & Prandita, N. (2019). Penatalaksanaan Periodontitis Kronik Pada Penderita Diabetes Mellitus. *STOMATOGNATIC-Jurnal Kedokteran Gigi*, *16*(2), 59-63.

*Ahmadi Irmansyah Lubis

Asiking, W., Rottie, J., & Malara, R. (2016). Hubungan Merokok dengan Kesehatan Gigi dan Mulut pada Pria Dewasa di Desa Poyowa Kecil Kecamatan Kotamobagu Selatan Kota Kotamobagu. *Jurnal Keperawatan*, *4*(1).

Dahria, M., Silalahi, R., & Ramadhan, M. (2013). SISTEM PAKARMETODEDAMSTER SHAFER UNTUK MENENTUKANJENIS GANGGUAN PERKEMBANGAN PADA ANAK. *Universitas Trihuna Darma, Medan*.

Dharmawan, F., & Meidia, H. (2015). Analisis Perbandingan Performa Sistem Pakar Zakat menggunakan Algoritma Rule-Based dan Algoritma Rete Berbasis Web. *Ultima Computing: Jurnal Sistem Komputer*, *7*(1), 5-11.

Ibrahim, R. Z., & Rahmah, M. (2020). PERIODONTITIS DAN PENYAKIT KARDIOVASKULAR (Tinjauan Pustaka). *Cakradonya Dental Journal*, *12*(1), 24-29.

Latumakulita, L. A. (2019). Sistem Pakar Pendiagnosa Penyakit Anak Menggunakan Certainty Factor (CF). *Jurnal Ilmiah Sains*, *12*(2), 120-126.

Liana, I., & Arbi, A. (2019). HUBUNGAN KEBIASAAN MEROKOK DENGAN PENYAKIT PERIODONTAL PADA MASYARAKAT USIA 15 TAHUNKEATAS DI DESA SIREN KECAMATAN BANDAR BARU PIDIE JAYA TAHUN 2018. *Jurnal Mutiara Kesehatan Masyarakat*, *4*(1), 25-32.

Nasyuha, A. H., Angin, M. I. P., & Marsono, M. (2020). Implementasi Dempster Shafer Dalam Diagnosa Penyakit Impetigo Pada Balita. *JURNAL MEDIA INFORMATIKA BUDIDARMA*, *4*(3), 700-706.

Nisa, T. D., & Primartha, R. (2013). Diagnosis penyakit gigi periodontal menggunakan sistem pakar fuzzy. *Jurnal Generic*, *8*(1).

Permata, W. W., & Hadi, A. (2020). Diagnosis Penyakit Ikan Lele Berbasis Android Menggunakan Metode Certainty Factor. *Voteteknika (Vocational Teknik Elektronika dan Informatika)*, *8*(2), 1-8.

Quamilla, N. (2016). Stres dan kejadian periodontitis (kajian literatur). *Journal of Syiah Kuala Dentistry Society*, *1*(2), 161-168.

Rahmah, J., & Saputra, R. A. (2017). Penerapan Certainty Factor Pada Sistem Pakar Diagnosa Penyakit Saluran Pencernaan Ayam Broiler. *Jurnal Informatika*, *4*(1).

Saputri, M. P. N., Isnanto, R. R., & Windasari, I. P. (2017). Android Application of Expert System for Gastroenteritis Detection. *J. Teknol. dan Sist. Komput*, *5*(3), 110-114.

Septiana, L. (2016). Perancangan sistem pakar diagnosa penyakit ISPA dengan metode certainty factor berbasis Android. *Techno Nusa Mandiri: Journal of Computing and Information Technology*, *13*(2), 89-96.

Simorangkir, L. (2018). SISTEM PAKAR DIAGNOSA PENYAKIT THT (TELINGA, HIDUNG, TENGGOROKAN) MENGGUNAKAN METODE CERTAINTY FACTOR (STUDI KASUS: RSUD H. ABDUL MANAP JAMBI). *FORTECH (Journal of Information Technology)*, *2*(1), 13-20.

Sumerti, N. N. (2016). Merokok dan efeknya terhadap kesehatan gigi dan rongga mulut. *Jurnal Kesehatan Gigi (Dental Health Journal)*, *4*(2), 49-58.

Supiandi, A., & Chandradimuka, D. B. (2018). Sistem Pakar Diagnosa Depresi Mahasiswa Akhir Dengan Metode Certainty Factor Berbasis Mobile. *Jurnal Informatika*, *5*(1), 102-111.

Tedjasulaksana, R. (2016). Metronidasol sebagai salah satu obat pilihan untuk periodontitis marginalis. *Denpasar: Jurnal Kesehatan Gigi*, *4*(1).

Wijaya, Ni Putu Ardhani Putri, Noer Ulfah, and Agung Krismariono. "Keparahan Gingivitis pada Pasien Poli Gigi Puskesmas Mulyorejo Tahun 2016 Menggunakan Gingival Index." *Periodontic Journal* 9.1 (2017): 8-14.

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