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Expert System Diagnosis Dental Disease Using Certainty Factor Method

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Abstract

Technological development is growing rapidly among with the increasing of human needs especially in mobile technology where the technology that often be used is android. The existence of this android facilitates the user in access of information. This android can be used for healthy needs, for example is detecting dental disease. One of the branches of computer science that can help society in detecting dental disease is expert system. In this research, making expert system to diagnosis dental disease by using certainty factor method. Dental disease diagnosis application can diagnose the patient based on griping of the patient about dental disease so it can be obtained diseases possibility of the patient itself. This application is an expert system application that operates on android platform. Furthermore, in the measurement accuracy of the system test performed by 20 patients, there were 19 cases of corresponding and 1 cases that do not fit. So, from system testing performed by 20 patients resulted in a 95% accuracy rate.

Keywords: Expert System, Dental Disease, Certainty Factor, Android

1. INTRODUCTION

The development of time that getting advanced like nowadays makes human needs become many and it is increasingly moreover it supported with increasingly of information technology especially in mobile technology where the technology that often be used is android. Almost all types of android smartphone have an affordable price that allows the public to have this smartphone. This operating system can be utilized in the implementation process expert system applications for android is an open platform for developers to create their own applications that can be used by a variety of mobile devices.

As important part of digestion system, teeth is used for chewing foods before it goes down to digestion system so if the teeth get trouble in chewing foods, the digestion process will get trouble too. Teeth are very susceptible to germs, although small teeth sometimes get less attention has influence on human health because of teeth problems can lead to other diseases that have a higher level of danger.

Expert systems are computer-based systems that use knowledge, facts and reasoning techniques in solving the problem can usually be solved by an expert in a particular field [1]. It is part of the high-level specialized software or high-level programming language, which is trying to duplicate the functionality of an expert in a particular field of expertise [2]. The purpose of expert system is not to replace the human roles, but to presented human knowledge in forms of a system, so it can be used by many

people. Expert systems are made in the area of knowledge for a particular expertise approaching human capabilities in one specific field [3].

The problems were dealt an expert not only the problems that rely on algorithm only but sometimes also the problem that is difficult to comprehend. Therefore the expert system based algorithm built not just yet built on the basis of knowledge and rule.

Statistical methods are based on the assumption that the uncertainty is the probability of an incident/fact is true or false. In theory certainty, as well as fuzzy logic, uncertainty is represented with a degree of confidence. There are two steps in the use of any non-probability method. First, the necessity be able to express degrees of confidence. Second, the necessity to manipulate (combine) the degree of confidence when using knowledge-based systems. Certainty theory underlying the use of Certainty Factors (CFs). CFs express confidence in the incidence (or facts or hypotheses) based on the occurrence (or on the assessment of an expert) [4].

2. METHODS

The concept of certainty factor is proposed to a accommodate the uncertainty of an expert who is often thought of analyzing information with phrases such as "May", "Likely", "almost certainly" and so on [5]. Selection certainty factor method is suitable for expert systems in this research, because basically CF method is assumed as an expert level of confidence for the used data. Certainty Factor introduced the concept belief and unbelief [6]. This method is suitable for diagnosing something uncertain. Certainty factor method can only process two weights in one calculation. For weights more than 2 many, to perform a calculation to avoid problems when the weights are calculated random means that there are no rules to combine weight due to a combination of any such outcome will remain the same. Previous research describes expert system search results indicate that any symptoms are selected by the user will be searching for all kinds of diseases that meet the symptoms. If found congruence, between the symptoms of the disease, then the system will calculate the value of CF combination in accordance with existing rules to the knowledge base and CF values entered by the user [5].

Certainty Factor (CF) shows the measure of certainty to a fact or rule. General formula certainty factor method as follows:

$$CF[h,e] = MB[h,e] - MD[h,e] \quad (1)$$

CF[h,e] = certainty factor
MB[h,e] = the size of belief / certainty level of the hypothesis h, if given / are influenced evidence e (between 0 and 1)
MD[h,e] = the size of unbelief / uncertainty level of the hypothesis h, if given / are influenced evidence e (between 0 and 1)

There are three things that might happen:

1) Some evidence combined to determine the CF of a hypothesis
   If e1 and e2 are observation, then:

$$MB[h,e1 \wedge e2] = \begin{cases} 0 \\ MB[h,e1]+MB[h,e2]*(1-MB[h,e1]) \end{cases}$$

$$MD[h,e1 \wedge e2] = \begin{cases} 0 \\ MD[h,e1]+MD[h,e2]*(1-MD[h,e1]) \end{cases}$$

2) CF calculated from a combination of several hypotheses
If h1 and h2 is a hypothesis, then:

MB[h1 ∧ h2,e] = min (MB[h1,e], MB[h2,e])
MB[h1 ∨ h2,e] = max (MB[h1,e], MB[h2,e])

MD[h1 ∧ h2,e] = min (MD[h1,e], MD[h2,e])
MD[h1 ∨ h2,e] = max (MD[h1,e], MD[h2,e])

3) Some rules are interrelated, the uncertainty of a rule becomes the input to other rules, then;

MB[h,s] = MB'[h,s] * max (0,CF[s,e])

MB'[h,s] = the size of the confidence h based on full confidence in the validity of s

In designing and developing expert system diagnosis dental disease used different approaches Waterfall Model. Using a Waterfall This model is a sequential software development. Waterfall model is divided into 4 stages are interrelated and influence. Four stages of the Waterfall Model, namely analysis, design, code, test.

3. RESULTS AND DISCUSSION

Based on the interview with an expert on the symptoms that lead to the emergence of dental disease and acquired 28 dental disease symptoms and 10 dental disease. Knowledge base inserted into the computer program so the computer acts as an expert were able to identify the symptoms of dental disease. Here are the data tables symptoms that can be seen in Table 1 and table disease data shown in Table 2.

Table 1. Data Symptoms

id_symptoms	nm_symptoms
G0001	Hard to chew
G0002	Swelling of the gums or redness
G0003	Swelling of the jaw
G0004	Fever
G0005	Pain or tenderness around the gums (when or without touch)
G0006	Gums or tooth fester
G0007	Swelling lymph nodes
G0008	Pain when opening the mouth
G0009	Tooth ache or throb
G0010	More sensitive teeth
G0011	Gums bleed easily
G0012	Sores or pockets between the teeth and gums
G0013	Sensitive to sweetness
G0014	The circular form of gum
G0015	Do not grow all or some teeth, both milk teeth and permanent teeth

G0016	Tooth shape looked eroded
G0017	Earache
G0018	Insomnia or feel uneasy
G0019	Consistency gums soft
G0020	swollen cheeks
G0021	White or brownish stain on tooth surfaces
G0022	Rough tooth surfaces
G0023	Teeth look longer than normal
G0024	tooth wobbly
G0025	There are cracks in the teeth
G0026	Existence teeth broken
G0027	Cold, sweet, or wry typically causes pain
G0028	There are hole on the surface of the tooth

Table 2. Data Disease

id_disease	nm_disease
K0001	Abscess Periodontal
K0002	Abscess Periapical
K0003	Anodontia
K0004	Tooth Abrasion
K0005	Bruxism
K0006	Gingivitis
K0007	Gums Purulent
K0008	Tooth Perforated
K0009	Fractures Tooth
K0010	Periodontitis

Furthermore, will do the rule base. The rule base is a rule made to link symptoms with disease. Base rules can be written to the structure of the **IF (id_symptoms) THEN (id_disease) CF(x)**. Here's a rule base table obtained from interview with the dentist with the certainty factor value in Table 3.

Table 3. Rule Base Table

No	IF	THEN	CF
1	G0001	K0001	0,8
2	G0002	K0001	0,4
3	G0006	K0001	0,2
4	G0008	K0001	0,8
5	G0001	K0002	0,8
6	G0003	K0002	0,6
7	G0004	K0002	0,4
8	G0007	K0002	0,3
9	G0009	K0002	0,4
10	G0015	K0003	0,9
11	G0010	K0004	0,9
12	G0016	K0004	0,8

13	G0001	K0005	0,5
14	G0013	K0005	0,7
15	G0017	K0005	0,4
16	G0018	K0005	0,5
17	G0002	K0006	0,7
18	G0010	K0006	0,8
19	G0014	K0006	0,5
20	G0019	K0006	0,4
21	G0004	K0007	0,2
22	G0006	K0007	0,8
23	G0009	K0007	0,4
24	G0020	K0007	0,8
25	G0008	K0008	0,8
26	G0021	K0008	0,9
27	G0022	K0008	0,6
28	G0025	K0009	0,8
29	G0026	K0009	0,7
30	G0027	K0009	0,4
31	G0028	K0009	0,7
32	G0002	K0010	0,5
33	G0005	K0010	0,5
34	G0006	K0010	0.3
35	G0012	K0010	0,6
36	G0023	K0010	0,3
37	G0024	K0010	0,4

Application testing phase was conducted to test the diagnose application with results that have been calculated manually using certainty factor. If a patient chooses hard to chew symptoms, fever, swelling of the jaw, Swelling Lymph Seed and tooth ache or throb in Table 4.

Table 4. User input based on the symptoms experienced and the value of CF

Symptoms	CF Abscess Periodontal	CF Abscess Periapical	CF Bruxism	CF Gums Purulent
Hard to Chew	0,8	0,8	0,5	-
Fever	-	0,4	-	0,2
Swelling of the Jaw	-	0,6	-	-
Tooth Ache or Throb	-	0,4	-	0,4
Swelling Lymph Seed	-	0,3	-	-

So that the manual calculation as follows:

a. CF value for Abscess Periodontal

$$CF_{\text{Abscess Periodontal}} = \frac{0,8}{0,8+0,4+0,2+0,8} = \frac{0,8}{2,2} = 0,363$$

b. CF value for Abscess Periapical

$$CF_{\text{Abscess Periapical}} = \frac{0,8+0,4+0,6+0,3+0,4}{0,8+0,4+0,6+0,3+0,4} = \frac{2,5}{2,5} = 1$$

c. CF vslue of Bruxism

$$CF_{\text{Bruxism}} = \frac{0,5}{0,5+0,7+0,4+0,5} = \frac{0,5}{2,1} = 0,239$$

d. CF value of Gums Purulent

$$CF_{\text{Gums Purulent}} = \frac{0,2+0,4}{0,2+0,4+0,8+0,8} = \frac{0,6}{2,2} = 0,272$$

From manual calculations above the results obtained Certainty Factor values for each disease: Abscess Periodontal (0,363), Abscess Periapical (1), Bruxism (0,239), Gums Purulent (0,272). It can be concluded that the patients suffering from the disease abscess periapical with the percentage of 1 x 100% = 100%. When calculated using the application it will generate as shown in Figure 1.

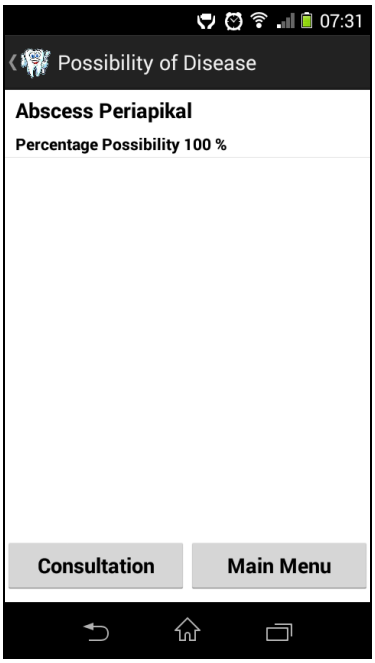

Figure 1. Calculation Results Application

Expert system diagnosis dental disease trials are done by comparing the accuracy of the final result of possible types of dental diseases generated by the system to those produced by experts.

The experimental of expert system diagnose dental disease is done by comparing result accurate the types of dental disease that produced by system and expert. Following is a table result of testing the accuracy of the system shown in Table 5.

Table 5. Result of Testing the Accuracy System

No	Symptom	Expert	System	Accuracy
1	G0001, G0013, G0017, G0018	K0005	K0005	Corresponding
2	G0008, G0021, G0022	K0008	K0008	Corresponding
3	G0001, G0002, G0006, G0008	K0002	K0001	Not Corresponding
4	G0002, G0010, G0014, G0019	K0006	K0006	Corresponding
5	G0008, G0021, G0022	K0008	K0008	Corresponding
6	G0002, G0005, G0012, G0024	K0010	K0010	Corresponding
7	G0001, G0003, G0007, G0009	K0002	K0002	Corresponding
8	G0004, G0006, G0020	K0007	K0007	Corresponding
9	G0008, G0021, G0022	K0008	K0008	Corresponding
10	G0006, G0009, G0020	K0007	K0007	Corresponding
11	G0025, G0026, G0028	K0009	K0009	Corresponding
12	G0002, G0010, G0014	K0006	K0006	Corresponding
13	G0001, G0002, G0006, G0008	K0001	K0001	Corresponding
14	G0015	K0003	K0003	Corresponding
15	G0001, G0013, G0017, G0018	K0005	K0005	Corresponding
16	G0010, G0016	K0004	K0004	Corresponding
17	G0025, G0026, G0027, G0028	K0009	K0009	Corresponding
18	G0001, G0003, G0004, G0007, G0009	K0002	K0002	Corresponding
19	G0002, G0005, G0006, G0012, G0023, G0024	K0010	K0010	Corresponding
20	G0008, G0021, G0022	K0008	K0008	Corresponding

Testing conducted on 20 respondents. In all cases there were 19 cases of corresponding and 1 cases that do not fit. To determine the level of accuracy of the system, then the calculation is as follows:

$$\text{Result} = \frac{\Sigma \text{ case which corresponding}}{\Sigma \text{ case}} x100\%$$

$$\text{Result} = \frac{19}{20} x100\%$$

Result = 95%

So, it can be concluded that the level of accuracy system with an expert by 95%.

4. CONCLUSION

The development of dental disease diagnosis expert system is made through several stages of system design with the aim to provide a general description of dental disease. Each symptom rated weight to calculate the value of CF from a disease. Application of expert system diagnosis dental disease was built using the JAVA programming language with the help of software Eclipse Mars. To adopt the expertise a doctor, the weight of each symptom input data used web-based system using the programming language PHP with Code Igniter framework and MySQL as database. Furthermore, in the measurement accuracy of the system test performed by 20 patients, there were 19 cases of corresponding and 1 cases that do not fit. So, from system testing performed by 20 patients resulted in a 95% accuracy rate. As for suggestions on further research to adopt expertise a doctor entered through the android that enables doctors to monitor this application.

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