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.

Keyword: 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].

1. METHOD

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]

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:

$$MB\left[h,e1 ∧e2\right]=\{\_{MB\left[h,e1\right]+MB\left[h,e2\right]\*(1-MB\left[h,e1\right])}^{0} $$

$$MD\left[h,e1 ∧e2\right]=\{\_{MD\left[h,e1\right]+MD\left[h,e2\right]\*(1-MD\left[h,e1\right])}^{0}$$

1. 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])

1. 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.

1. 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:

1. CF value for Abscess Periodontal

CFAbscess Periodontal = $\frac{0,8}{0,8+0,4+0,2+0,8}=\frac{0,8}{2,2}=0,363$

1. CF value for Abscess Periapical

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

1. CF vslue of Bruxism

CFBruxism = $\frac{0,5}{0,5+0,7+0,4+0,5}=\frac{0,5}{2,1}=0,239$

1. CF value of Gums Purulent

CFGums 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:

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

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

Result = 95%

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

1. CONCLUSION

Based on the results of research and discussion on the application of expert system diagnosis dental disease using certainty factor it can be concluded that 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 CodeIgniter 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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