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Case-Based Expert System for Diagnosing Scalp Disease

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Abstract. Scalp disease is usually general in nature which tends to be ignored by sufferers because it is often considered harmless. This is a major factor slow to detect scalp disease so that if left untreated, the sufferer can be affected by acute scalp disease, which is very dangerous. This research builds an expert system to diagnose scalp disease earlier based on the symptoms that appear so that it is expected to assist medical personnel in identifying types of diseases, prevention solutions, and optimal treatment. This research used the Case-Based Reasoning (CBR) method, which combines similarity methods Similarity Measure introduced by Tversky with 10 types of diseases, 29 symptoms consisting of 110 cases of scalp disease. The results obtained in this study are a diagnosis of scalp disease, prevention solutions, and treatment. From the research, the conclusions are a diagnosis of scalp disease, prevention solutions, and treatment.

Keywords: Scalp Disease, Case Based Expert System, Prevention Solution, Treatment

1. Introduction

There are many areas outside the computer field that utilize computer technology to facilitate their work, for example, health, physical infrastructure, psychology, communications, Virtual Reality, Modelling, and many other areas [1]. The field of health has been widely used computer applications to help work efficiently. One of the forms is an expert system [2,3]. The expert system application is one of the branches of AI (Artificial Intelligence), which can be described as a computer device that has a knowledge base for a particular field that uses inference reasoning resembles an expert in solving a problem [4,5].

Scalp disease is usually a general disease that sufferers tend to ignore because it is often considered harmless, so sufferers usually ignore to check for symptoms of the disease to the doctor. This causes slow detection of the type of scalp disease, and not knowing how to handle, prevent correct treatment solutions, and lack of information about the symptoms of the disease, which are the main factors causing sufferers to suffer from a very dangerous level of acute scalp disease. Scalp disease has almost the same indications and symptoms as the type of scalp disease that is suffered. This is what causes many ordinary people, even

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medical personnel, to find it difficult to recognize the type of scalp disease they suffer. Also, the drugs that are given are sometimes almost the same for various types of scalp diseases. One of the solutions given to overcome this problem can be assisted by an expert system that can help both the medical and the sufferer determine the types of illnesses suffered early so that it can prevent someone from suffering from an acute level of scalp disease.

Expert systems are not a substitute for experts in a particular field but a method used to adopt specialist knowledge into systems that can be accessed through computers, smartphones, or other devices [3,6,7]. Case-Based Reasoning (CBR) [8,9] Method is one method of solving problems by using a solution that has been used previously against similar issues [9], the use of CBR methods on the diagnosis with its similarity method "Similarity Measure."

2. Method

An expert system is a branch of Artificial Intelligence (AI) developed in the mid-1960. The expert system the first time it appeared was General Purpose Problem Solver (BPS). An expert system is a system that uses human knowledge in which knowledge is incorporated into a computer and then used to solve problems that usually require human skills [2,10].

Expert systems are designed on a specific knowledge area for expertise to approach human ability in one field [6]. The expert system was trying to find a satisfactory solution as one expert does. Also, expert systems can explain each step that was taken and provide reasons for suggestions or conclusions that have been found [7,11,12].

An expert is a person who has expertise in a particular field. They have the knowledge or unique ability that others do not know or are capable of in the area it has [12]. Knowledge [13,14] in expert systems may be an expert or knowledge commonly found in books, magazines, and people who know a field. In the expert system, the user delivers the facts or information to the system and then accepts the advice of the expert or the expert answer. The inside of the expert system consists of two main components, the knowledge base, which contains the knowledge, and the inference engine that illustrates the conclusion. The conclusion is the response of the expert system at the request of the user [10,12].

The case-Based Reasoning [8] method is one of the ways to build expert systems with decision-making from new cases based on solutions from previous cases. There are four process steps in the Case-Based Reasoning method. Retrieve the most similar case, Reuse (using) information and knowledge of the case to solve the problem, Revise (repair) the proposed solution, and Retain (s) part of the experience that might be useful for solving problems in the future [6,8,15]. See Figure 1 for diagram process Case-Based Reasoning.

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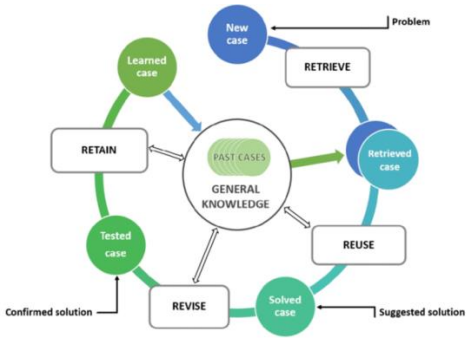

Figure 1. Case-Based Reasoning Method [15]

In looking for the old case, which has similarities with the new case, the method is used similarity measure introduced by Tversky 1977 with the following formula.

$$SM_{pq} = \frac{\alpha(\text{common})}{\alpha(\text{common}) + \beta(\text{different})} \quad (1)$$

Where "SM" is the similarity measure where "p" is the new case, and "q" is the case stored in the old case/case base. "Common" is the number of the same attributes. Meanwhile, "different" is the number of different attributes.

1. If the attribute is in the new case and there is in the old case, then it is assigned a value of 1 (One).
2. If the attribute does not exist in the new case and does not exist in the old case, then it is assigned a value of 1 (One).
3. If the attribute exists in the new case and does not exist in the old case, then it is assigned a value of 0 (Zero).

If the attribute does not exist in the new case and exists in the old case, then it is assigned a value of 0 (Zero).

3. Results and Discussion

This test used data from RSUD Selasih at Pelalawan Regency, which consists of 10 types of scalp diseases, 29 symptoms consisting of 110 cases of scalp disease. With this data, the application of Case-Based Reasoning for the diagnosis of scalp disease requires new cases that have four symptom data: an oily scalp, red bumps on the scalp, small edged lumps (pustules), and abscesses of the scalp (see Table 1).

Table 1. Data for Symptoms and New Cases.

No	Symptoms	New Case
1	Normal scalp	0
2	Dry scalp	0
3	*Oily scalp*	*1*
4	Scaly scalp	0
5	Crusty scalp	0

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No	Symptoms	New Case
6	Yellow crusty scalp Inflamed Scalp	0
7	Inflamed Scalp	0
8	Rash on the scalp	0
9	Red rash on the scalp	0
10	A round, red rash with raised margins	0
11	Thickened scalp (plaque)	0
12	The scalp peels off	0
13	White powder on the hair	0
14	Ulcers on the scalp	0
15	*Red bumps on the scalp*	*1*
16	*Small edged lumps (pustules)*	*1*
17	A large lump with more than one eye	0
18	fleas	0
19	smelly scalp	0
20	*Abscess of the scalp*	*1*
21	Bleeding scalp	0
22	Watery scalp	0
23	The scalp hurts	0
24	The scalp feels itchy	0
25	Scalp burns hot	0
26	Hair loss	0
27	Baldness	0
28	Occurs in the navel of the scalp	0
29	It occurs on the back of the scalp	0

The process of calculating the value of similarity (similarity) between new cases in Table 1 and the old case on case bases, resulting in new case bases in Table 2 and Table 3. Number 1, which means the value of similar cases, number 0, which means the value of cases is not similar. For example, the calculation of the similarity value (similarity) has been discussed in the previous chapter. If the symptom in the new case is 0 and the symptom on the old case is 0, then the similarity value is 1. If the symptom in the new case is 1 and the symptom in the old case is 1, the similarity value is 1, and if the symptom in the new case is 0 and the symptom in the old case is 1, then the similarity value is 0 and vice versa.

Table 2. Case Bases 1-10

New Case	Case 001	Case 002	Case 003	Case 004	Case 005	Case 006	Case 007	Case 008	Case 009	Case 010
0	0	0	0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	1	1	1	1
1	0	0	0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	0

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New Case	Case 001	Case 002	Case 003	Case 004	Case 005	Case 006	Case 007	Case 008	Case 009	Case 010
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
1	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
1	0	0	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	0	0	0	1	1	0	1	1	1	0
0	1	1	0	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1

Table 3. Case Bases 101-110

New Case	Case 101	Case 102	Case 103	Case 104	Case 105	Case 106	Case 107	Case 108	Case 109	Case 110
0	0	0	0	0	0	0	0	0	0	1
0	1	1	1	1	1	1	1	1	1	0
1	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	1	0	0	0	1	1
0	1	1	1	1	1	1	1	1	1	0
0	1	1	1	0	1	0	1	1	1	1
0	0	0	0	0	0	0	0	0	0	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	0	1	1	1	0	0	1	0
1	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1
1	0	0	0	0	0	0	0	0	0	0
0	1	1	0	1	1	1	0	0	1	1
0	1	1	1	1	1	1	1	1	1	1

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New Case	Case 101	Case 102	Case 103	Case 104	Case 105	Case 106	Case 107	Case 108	Case 109	Case 110
0	0	0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	1	1	1	1
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	1	1	1	1

Table 4 and Table 5 show the results of the calculation of case 1 to case 110. In Table 2 and Table 3, the number of similar cases is taken from the total value 1 in the case bases table, and the number of dissimilar cases is taken from the total value 0 in the case of bases table, for each case 1 to case 110. The results of the similarity value are obtained after being calculated using formula (1).

Table 4. Results of Calculation Case Bases 1-10

Case Bases	Number of Similar Cases	Number of Unequal Cases	Similarity
Case 1	24	5	0.827586
Case 2	25	4	0.862069
Case 3	23	6	0.793103
Case 4	26	3	0.896552
Case 5	*26*	*3*	*0.896552*
Case 6	25	4	0.862069
Case 7	26	3	0.896552
Case 8	26	3	0.896552
Case 9	26	3	0.896552
Case 10	24	5	0.827586

Table 5. Results of Calculation Case Bases 101-110

Case Bases	Number of Similar Cases	Number of Unequal Cases	Similarity
Case 101	17	12	0.586207
Case 102	18	11	0.62069
Case 103	15	14	0.517241
Case 104	16	13	0.551724
Case 105	18	11	0.62069
Case 106	16	13	0.551724
Case 107	14	15	0.517241
Case 108	15	14	0.517241
Case 109	19	10	0.655172
Case 110	18	11	0.62069

Based on Table 1, there are new cases with symptoms of an oily scalp, red bumps on the scalp, small edged lumps (pustules), and abscesses of the scalp. Then, this new case goes into the retrieve process to look for the similarity of the new case to the old case in Table 2 and Table 3. The number of similar cases and the number of different cases using the similarity measure formula (1) are shown in Table 4 and Table 5. Therefore, it can be concluded that the

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similarity of the new and old cases is in the 5th, with a similarity value of 0.89 (89%). The use of case-based reasoning methods in Table 1 is completed in an expert system. Figure 2 displays information on the amount of disease data, symptom data, solution data, and diagnosis history data; Figure 3 shows diagnosis forms that have 4 symptom data: an oily scalp, red bumps on the scalp, small edged lumps (pustules), and abscesses of the scalp.

Figure 2. Main Display

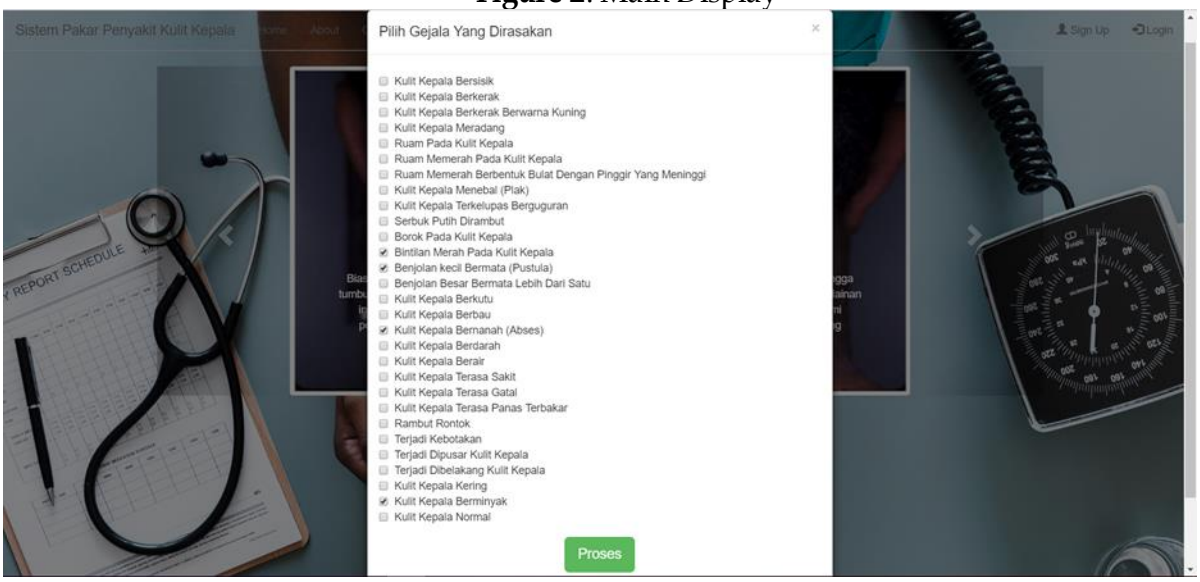

Figure 3. Diagnosis Form

From Figure 4, the results of the calculation process through the system are the same as the results of manual calculations in Table 4 so that testing and implementation using the case-based reasoning method in an expert system can help both the medical and the sufferer determine the types of illnesses suffered early so as to prevent someone from suffering from an acute level of scalp disease.

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Figure 4. Display Diagnosis Results

4. Conclusion

Expert systems with the Case-Based Reasoning method can be applied well to Scalp Disease. This system can help medical personnel and patients to identify early types of diseases, solutions, prevention, and optimal treatment.

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