EXPERT SYSTEM FOR HYPOTHYROIDISM DIAGNOSIS USING CASE BASED REASONING METHOD (CASE STUDY OF MELATI II Public Health Center)

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Abstract
In this study, we will discuss the development of an expert system application for diagnosing Hypothyroidism. In diagnosing Hypothyroidism, this expert system will use the Case Based Reasoning (CBR) method. CBR uses artificial intelligence in solving problems based on knowledge from previously stored cases. Case data obtained from medical records from the results of handling Hypothyroidism patients diagnosed by internal medicine specialists. There are 5 types of hypothyroidism disease with one symptom of the disease in the old case. And there are new cases that will be used to calculate the similarity value to the old cases that exist in the knowledge base owned by the system.

Keywords: Expert System, Case Based Reasoning Method, Hypothyroidism

1. Introduction
Information technology has developed very rapidly. This progress has changed the manual information processing system into a computerized information processing system. The computerized system as an application of information technology has been used in various fields of activity, one of which is in the field of health or medicine which requires precision and accuracy in data management and operational speed to obtain accurate information so that it can be relied upon as a source of information. One of the systems resulting from technological advances that can be used to help solve these problems is an expert system, in this case an expert system in the health sector, especially for diagnosing hypothyroidism.

Hypothyroidism is a condition when the thyroid gland functions too much. Excess function of the gland increases the production of thyroid hormones that affect the body’s metabolism. Diagnosing hypothyroidism is difficult because the symptoms of hypothyroidism vary widely and depend on the ups and downs of thyroid hormones (Rodiah & Widodo, 2016). However, in this section, several problems will be found when people with hypothyroidism decide to consult a doctor or an internal medicine specialist who is an expert who is not available, the cost to consult an expert is quite expensive, and there are still limited experts in a certain area. Whereas in reality the one who has the authority to make a diagnosis is a doctor, so the diagnosis takes time so patients have to queue. The longer the treatment is carried out, the higher the possibility of the severity of the disease and does not rule out the possibility of causing death.

Based on the above background, it is necessary to have an expert system that can diagnose Hypothyroidism using Case Based Reasoning (CBR) method. This expert system will provide initial diagnostic assistance and treatment advice for the patient's illness based on the symptoms that the user will enter into the system.

2. Research Methodology
2.1 Expert System

An expert system is an artificial intelligence development that combines knowledge and data search to solve problems that normally require human expertise. The purpose of developing an expert system is not actually to replace the role of humans, but to substitute human knowledge into a system form, so that it can be used by many people (ZM et al., 2017).
2.2 Case Based Reasoning

Case Based Reasoning is a method for solving problems by remembering the same/similar events that have occurred in the past and then using that knowledge/information to solve new problems, or in other words solving problems by facing different solutions. been used in the past.

Parameter weight \((w)\):

\[
\text{Significant symptom} = 1 \\
\text{Normal symptom} = 0 \\
S_1 \ast W_1 + S_2 \ast W_2 + \ldots + S_n \ast W_n \\
W_1 + W_2 + \ldots + W_n
\]

description:

Similarity = (similarity value) that is 1 (same) and 0 (different)

\(W\) = weight (given weight)

In Case Based Reasoning there are four stages which include:

1. Retrieve the most similar/relevant (similar) case to the new case.
2. Reuse (use) old case knowledge and information based on the most relevant similarity weights into new cases.
3. Revise (review) review the solutions that have been obtained from the old case.
4. Retain parts of the experience that may be useful for solving future problems.

The process of case based reasoning can be seen below:

Source: (Soepomo, 2014)

3. Research Framework

To assist in the preparation of this research, it is necessary to have a framework work) with clear stages, this framework is the steps to be taken In solving the problems to be discussed, the research framework used is as shown in Figure 3.1
4. Research Results

4.1. Data analysis

Analysis of data needs is a whole in building an expert system for diagnosing Hypothyroidism. The analysis of data needs are:

Table 1: List of Diseases

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>P01</td>
<td>Goiter</td>
<td></td>
</tr>
<tr>
<td>P02</td>
<td>Hashimoto</td>
<td></td>
</tr>
<tr>
<td>P03</td>
<td>Hypothyroid</td>
<td></td>
</tr>
<tr>
<td>P04</td>
<td>Hyperthyroid</td>
<td></td>
</tr>
<tr>
<td>P05</td>
<td>Thyroid Cancer</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: List of Symptoms

<table>
<thead>
<tr>
<th>Code</th>
<th>Symptom</th>
<th>Type</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>G01</td>
<td>Swelling at the base of the neck</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G02</td>
<td>Decreased appetite</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G03</td>
<td>Nervous</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G04</td>
<td>Frequent nausea and vomiting</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G05</td>
<td>High body temperature</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G06</td>
<td>Hard to sleep</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G07</td>
<td>Fatigue</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G08</td>
<td>Constipation</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G09</td>
<td>Depression</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G10</td>
<td>Dry hair and skin</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G11</td>
<td>Chills</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G12</td>
<td>Weight gain</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G13</td>
<td>Muscle ache</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G14</td>
<td>Swollen face</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G15</td>
<td>Slow Sound</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G16</td>
<td>Stiff joints</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G17</td>
<td>Constipation (irregular bowel movements)</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G18</td>
<td>Excessive sleepiness</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G19</td>
<td>Concentration decreased</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G20</td>
<td>Swollen feet</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G21</td>
<td>Can’t stand the heat</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G22</td>
<td>Appetite increases</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G23</td>
<td>Weight loss</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G24</td>
<td>Enlarged thyroid gland</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G25</td>
<td>Shaking</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G26</td>
<td>Anxiety</td>
<td>Usual symptoms</td>
<td>0.5</td>
</tr>
<tr>
<td>G27</td>
<td>Fast heart rate</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G28</td>
<td>Losing weight</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G29</td>
<td>Irregular menstrual flow</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G30</td>
<td>Sudden swelling of the neck</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G31</td>
<td>Hard and rough lumps</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G32</td>
<td>The lump doesn’t move when swallowing</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
<tr>
<td>G33</td>
<td>There are some lumps around the neck</td>
<td>Important symptoms</td>
<td>1</td>
</tr>
</tbody>
</table>

5. Discussion and Results

In this discussion, a calculation process will be carried out to look for similarities in the old case, namely the case that is used as existing knowledge in the system with the new case.

\[
\text{Similarity (Problem Case)} = \frac{S_1W_1 + S_2W_2 + \ldots + S_n}{W_1 + W_2 + \ldots + W_n}
\]

description:
Similarity = (similarity value) that is 1 (same) and 0 (different)
W = weight (given weight)
A patient is known to have the following symptoms:
1. Swelling at the base of the neck (G01)
2. Body temperature (G05)
3. Constipation (G08)
4. Sudden swelling of the neck (G30)

Manual calculation on a case-by-case basis:

1. Calculation of goiter

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Similarity Value</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>G01</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>G02</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>G03</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>G05</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>G06</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>G08</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>G30</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Similarity (level of similarity) = 72 %

2. Calculation of Hashimoto's Disease

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Similarity Value</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>G01</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>G02</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>G07</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>G08</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>G09</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>G10</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>G12</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>G13</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Similar symptoms between Hashimoto's disease and user input are only 5 symptoms, namely symptoms G01, G02, G08, G09 and G10, then:

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Similarity Value</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>G01</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>G02</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>G08</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>G09</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>G10</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>G12</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>G13</td>
<td>0</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Similarity (level of similarity) = 72 %
Symptom weight G01 = 1
Symptom weight G02 = 0.5
Symptom weight G07 = 0.5
Symptom weight G08 = 1
Symptom weight G09 = 0.5
Symptom weight G10 = 1
Symptom weight G12 = 0.5
Symptom weight G13 = 0.5

Similarity (problem case) = \frac{S_1 W_1 + S_2 W_2 + \ldots + S_n W_n}{W_1 + W_2 + \ldots + W_n}

Similarity (problem case) = 0.81 * 100

Similarity (level of similarity) = 81%

The level of similarity of symptoms with Hashimoto’s disease with cases experienced by patients is 81%

3. Calculation of Hypothyroidism

Symptoms that are similar between Hypothyroid disease and user input are only 4 symptoms, namely symptoms G02, G09, G14 and G16, then:
Symptom similarity value G02 = 1
Symptom similarity value G07 = 0
Symptom similarity value G08 = 0
Symptom similarity value G09 = 1
Symptom similarity value G14 = 1
Symptom similarity value G15 = 0
Symptom similarity value G16 = 1

Symptom weight G02 = 0.5
Symptom weight G07 = 0.5
Symptom weight G08 = 0.5
Symptom weight G09 = 1
Symptom weight G14 = 1
Symptom weight G15 = 0.5
Symptom weight G16 = 0.5

Similarity (problem case) = \frac{S_1 W_1 + S_2 W_2 + \ldots + S_n W_n}{W_1 + W_2 + \ldots + W_n}

Similarity (problem case) = 0.66 * 100

Similarity (level of similarity) = 66%

The level of similarity of symptoms with hypothyroid disease with cases experienced by patients is 66%

4. Calculation of Hyperthyroidism
Symptoms that are similar between Hyperthyroidism and user input are only 5 symptoms, namely symptoms G07, G16, G22, G24 and G26, then:

Symptom similarity value G07 = 1
Symptom similarity value G16 = 1
Symptom similarity value G21 = 0
Symptom similarity value G22 = 1
Symptom similarity value G23 = 0
Symptom similarity value G24 = 1
Symptom similarity value G25 = 0
Symptom similarity value G26 = 1

Symptom weight G07 = 0.5
Symptom weight G16 = 0.5
Symptom weight G21 = 0.5
Symptom weight G22 = 0.5
Symptom weight G23 = 0.5
Symptom weight G24 = 1
Symptom weight G25 = 0.5
Symptom weight G26 = 0.5

\[ \text{Similarity (problem case)} = \sum_{i=1}^{n} S_i W_i \]

\[ \text{Similarity (problem case)} = 0.5 \times 0.5 + 1 \times 1 + 0.5 \times 1 + 1 \times 1 + 0.5 \times 1 = 0.66 \]

\[ \text{Similarity (tingkat kemiripan)} = 66\% \]

The level of similarity of symptoms with Hyperthyroidism with cases experienced by patients is 66%.

5. Calculation of thyroid cancer

Symptoms that are similar between Thyroid Cancer and user input are only 6 symptoms, namely symptoms, G28, G30, G31 and G32, then:

Symptom similarity value G28 = 1
Symptom similarity value G29 = 0
Symptom similarity value G30 = 1
Symptom similarity value G31 = 1
Symptom similarity value G32 = 1
Symptom similarity value G33 = 0

Symptom weight G28 = 0.5
Symptom weight G29 = 1
Symptom weight G30 = 1
Symptom weight G31 = 1
Symptom weight G32 = 1
Symptom weight G33 = 1

\[ \text{Similarity (problem case)} = \frac{S_1 W_1 + S_2 W_2 + \ldots + S_n W_n}{W_1 + W_2 + \ldots + W_n} \]

\[ \text{Similarity (problem case)} = \frac{1 \times 0.5 + 1 \times 0.5 + 0.5 \times 1 + 1 \times 1 + 0.5 \times 1}{0.5 + 0.5 + 0.5 + 1 + 0.5 + 0.5} = 0.66 \times 100 \]

\[ \text{Similarity (tingkat kemiripan)} = 66\% \]
Similarity (problem case) = \frac{1+0.5+0+1+1+1+1+1+1+0+1}{0.5+1+1+1+1+1} = 0.63 \times 100

Similarity (tingkat kemiripan) = 0.63 \%

The level of similarity of symptoms with thyroid cancer with cases experienced by patients is 63%.

6. System Implementation

1. Home Page Display
The home page is the first page that appears when the application is run.

![Fig. 3: Home Page Display](image)

2. Login Page Display
The login page is the initial stage that system users must do. In this case the user can login by entering the correct username and password, then the user can then enter the main menu page.

![Fig. 4: Login Page Display](image)

3. Main Menu Page Display
The main menu is the page that we will see when the user/admin is successfully logged in. The main menu page contains a header as the page title, system name, and menus that we can choose and use.

![Fig. 5: Main Menu Page Display](image)
4. Display Disease Menu
The disease menu display contains data on hypothyroidism. On this page users can add, change, edit, and delete disease data.

![Fig. 6: Display of Disease Menu](image)

5. Symptoms Menu Display
The symptom menu display contains symptom data for hypothyroidism. On this page users can add, change, edit, and delete symptom data.

![Fig. 6: Symptoms Menu Display](image)

6. Rule Base Menu Display
In the Rule Base menu display of each disease based on symptoms by inputting the type of disease, symptoms and weights, on this page the user/admin can change the rule or delete the rule.

![Fig. 7: Rule Base Menu Display](image)
7. Consultation Page View

On this page, users or experts can use the system without having to login to the system. This page is used to conduct a consultation by entering your name, gender, age, address and email, and selecting the symptoms you are experiencing.

![Fig. 8: Consultation Menu Display](image)

8. Consultation Results Page Display

On the page display, the results of the consultation are obtained after entering the name, gender, age, address and email data, as well as selecting the symptoms experienced. Then the results of the diagnosis will display the percentage value of the case base reasoning.

![Fig. 9: Display of the Consultation Results Menu Page](image)

7. Conclusion

Based on the results of testing and discussion of the expert system for diagnosing hypothyroidism using the case base reasoning method, it can be concluded:

1. With the application of the Case Based Reasoning method on the Hypothyroidism Disease Diagnosis Expert System being able to solve new problems by using data on past disease symptoms that have similarities that have been stored and using these solutions to solve new problems, from the results of calculating the similarity level of old disease symptoms and symptoms The new disease has an 81% similarity to Hashimoto's disease

2. This research has succeeded in helping the Melati II Village Health Center in tackling hypothyroidism and making it easier for the general public to find out the types of hypothyroidism in patients quickly without having to see a doctor directly, and can provide temporary treatment related to hypothyroidism.

References


