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

Dewinda Rimanti[1]*, Hasanul Fahmi[2]

[1]*Student of Informatics Engineering Program, STMIK Pelita Nusantara, Medan*
[2]*Lecturer of the Informatics Engineering Program, STMIK Pelita Nusantara, Medan*
[12]*Jalan Iskandar Muda No.1, Medan Baru North Sumatra*
dewindaaaa@gmail.com

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):
Significant symptom = 1
Normal symptom = 0

$$\frac{S1*W1+ S2*W2+....+ Sn*}{W1+W2+....+Wn}$$

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.
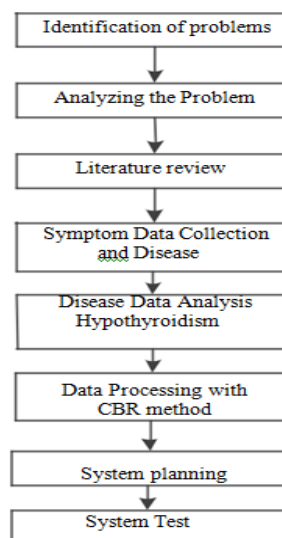The process of case based reasoning can be seen below:
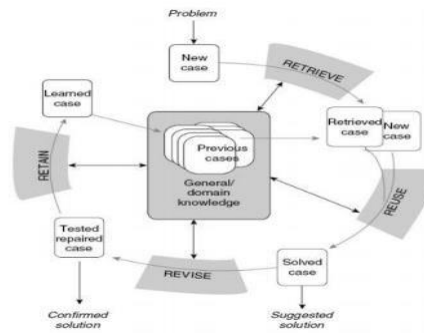
Fig. 1: Case Base Reasoning Cycle

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

Fig. 2: Research Framework

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

Code	Name Disease
P01	Goiter
P02	Hashimoto
P03	Hypothyroid
P04	Hyperthyroid
P05	Thyroid Cancer

Table 2: List of Symptoms

Code	Symptom	Type	Weight
G01	Swelling at the base of the neck	Important symptoms	1
G02	Decreased appetite	Usual symptoms	0,5
G03	Nervous	Usual symptoms	0,5
G04	Frequent nausea and vomiting	Important symptoms	1
G05	High body temperature	Important symptoms	1
G06	Hard to sleep	Usual symptoms	0,5
G07	Fatigue	Usual symptoms	0,5
G08	Constipation	Important symptoms	1
G09	Depression	Important symptoms	1
G10	Dry hair and skin	Important symptoms	1
G11	Chills	Important symptoms	1
G12	Weight gain	Usual symptoms	0,5
G13	Muscle ache	Usual symptoms	0,5
G14	Swollen face	Important symptoms	1
G15	Slow Sound	Usual symptoms	0,5
G16	Stiff joints	Usual symptoms	0,5
G17	Constipation (irregular bowel movements)	Important symptoms	1
G18	Excessive sleepiness	Important symptoms	1
G19	Concentration decreased	Usual symptoms	0,5
G20	Swollen feet	Important symptoms	1
G21	Can't stand the heat	Usual symptoms	0,5
G22	Appetite increases	Usual symptoms	0,5
G23	Weight loss	Usual symptoms	0,5
G24	Enlarged thyroid gland	Important symptoms	1
G25	Shaking	Usual symptoms	0,5
G26	Anxiety	Usual symptoms	0,5
G27	Fast heart rate	Important symptoms	1
G28	Losing weight	Important symptoms	1
G29	Irregular menstrual flow	Important symptoms	1
G30	Sudden swelling of the neck	Important symptoms	1
G31	Hard and rough lumps	Important symptoms	1
G32	The lump doesn't move when swallowing	Important symptoms	1
G33	There are some lumps around the neck	Important symptoms	1

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.

$$\text{Similarity (Problem Case)} = \frac{S1*W1+ S2*W2+....+ Sn*}{W1+ W2+....+ Wn}$$

description:
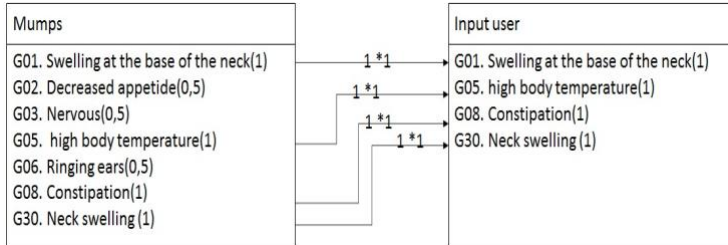Similarity = (similarity value) that is 1 (same) and 0 (different)
W = weight (given weight)

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

Symptoms that are similar between goiter and user input are only 4 symptoms, namely symptoms G01, G05, G08 and G30, so:
Symptom similarity value G01 = 1
Symptom similarity value G02 = 0
Symptom similarity value G03 = 0
Symptom similarity value G05 = 1
Symptom similarity value G06 = 0
Symptom similarity value G08 = 1
Symptom similarity value G30 = 1

Symptom weight G01 = 1
Symptom weight G02 = 0.5
Symptom weight G03 = 0.5
Symptom weight G05 = 1
Symptom weight G06 = 0.5
Symptom weight G08 = 1
Symptom weight G030 = 1

$$Similarity\ (problem\ case) = \frac{S1*W1+S2*W2+\cdots+Sn*Wn}{W1+W2+\cdots+Wn}$$

$$Similarity\ (problem\ case) = \frac{1*1+0*0,5+0*0,5+1*1+0*0,5+1*1+1*1}{1+0,5+0,5+1+0,5+1+1}$$

$$Similarity\ (problem\ case) = \frac{1+0+0+1+0+1+1}{5,5} \qquad = 0,72*100$$

$$Similarity\ (level\ of\ similarity) \qquad\qquad = 72\ \%$$

The level of similarity of symptoms with goiter with cases experienced by patients is 72%

2. Calculation of Hashimoto's Disease
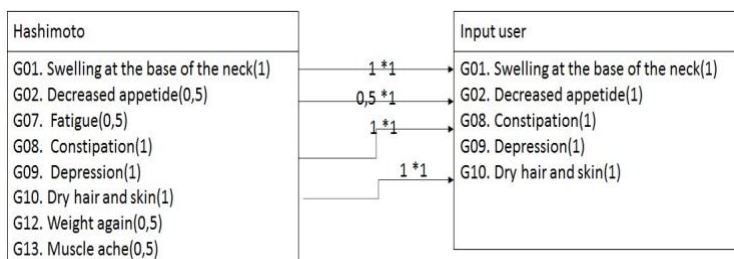
Similar symptoms between Hashimoto's disease and user input are only 5 symptoms, namely symptoms G01, G02, G08, G09 and G10, then:
Symptom similarity value G01 = 1
Symptom similarity value G02 = 1
Symptom similarity value G07 = 0
Symptom similarity value G08 = 1
Symptom similarity value G09 = 1
Symptom similarity value G10 = 1
Symptom similarity value G12 = 0
Symptom similarity value G13 = 0

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

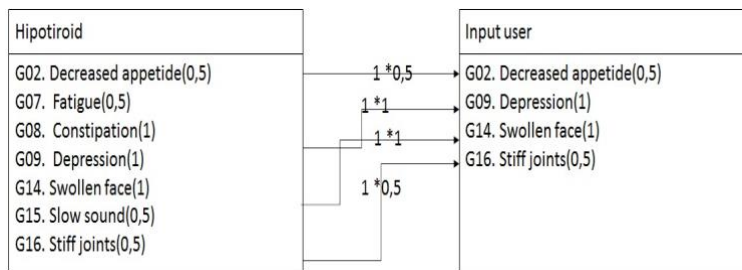*Similarity (problem case)* $= \dfrac{S1*W1+S2*W2+\cdots+Sn*Wn}{W1+W2+\cdots+Wn}$

Similarity (problem case) $= \dfrac{1*1+1*0,5+0*0,5+1*1+1*1+1*1+0*0,5+0*0,5+}{1+0,5+0,5+1+0,5+1+0,5+0,5}$

Similarity (problem case) $= \dfrac{1+0,5+0+1+1+1+0+0}{5,5}$ $= 0,81 * 100$

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) $= \dfrac{S1*W1+S2*W2+\cdots+Sn*Wn}{W1+W2+\cdots+Wn}$

*Similarity (problem case)* $= \dfrac{1*0,5+0*0,5+0*0,5+1*1+1*1+0*0,5+1*0,5}{0,5+0,5+0,5+0,5+1+0,5+0,5}$

Similarity (problem case) $= \dfrac{0,5+0+0+1+1+0+0,5}{4,5}$ $= 0,66 * 100$

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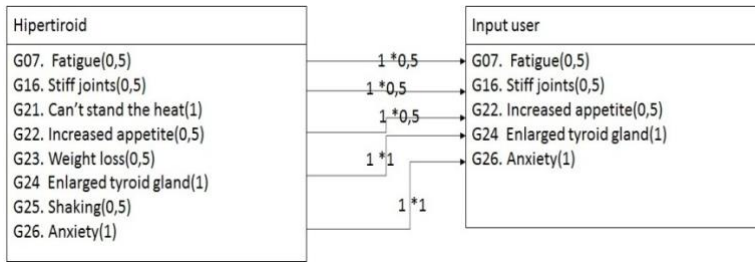
Symptoms that are similar between Hyperthyroidism and user input are only 5 symptoms, namely symptoms G07, G16, G22, G24 and G26, then:

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

$Similarity\ (problem\ case) = \dfrac{S1*W1+S2*W2+\cdots+Sn*Wn}{W1+W2+\cdots+Wn}$

$Similarity\ (problem\ case) = \dfrac{1*0,5+1*0,5+0*0,5+1*0,5+0*0,5+1*1+0*0,5+1*0,5}{0,5+0,5+0,5+0,5+0,5+1+0,5+0,5}$

$Similarity\ (problem\ case) = \dfrac{0,5+0,5+0+0,5+0+1+0+0,5}{4,5} = 0{,}66 * 100$

$Similarity\ (tingkat\ kemiripan)\qquad\qquad = 66\ \%$

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

5.   Calculation of thyroid cancer
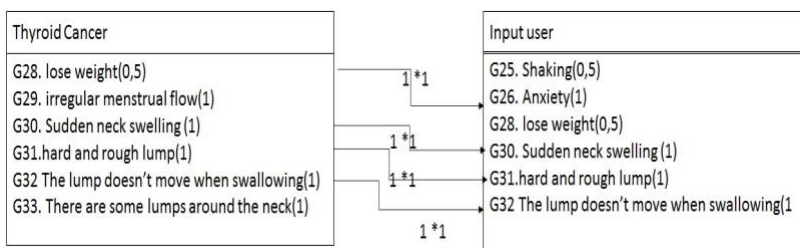
Symptoms that are similar between Thyroid Cancer and user input are only 6 symptoms, namely symptoms, G28, G30, G31 and G32, then:
Symptom similarity value G28 = 1
Symptom similarity value G29 = 0
Symptom similarity value G30 = 1
Symptom similarity value G31 = 1
Symptom similarity value G32 = 1
Symptom 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

$Similarity\ (problem\ case) = \dfrac{S1*W1+S2*W2+\cdots+Sn*Wn}{W1+W2+\cdots+Wn}$

Similarity (problem case)$= \frac{1*0,5+0*1+1*1+1*1+1*1+0*1}{0,5+1+1+1+1+1}$

Similarity (problem case) $= \frac{0,5+0+1+1+1+0}{5,5}$ $= 0,63 * 100$

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

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

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

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

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

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

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

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

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

[1] Alhogbi, B. G. (2017). *Journal of Chemical Information and Modeling*, *53*(9), 21–25. http://www.elsevier.com/locate/scp
[2] Andriani, A. (2017). *Media Kom Pemrograman Sistem Pakar*. Andi Yoyakarta.
[3] Apriliana, R., Damayanti, A., & Pratiwi, A. B. (2020). Sistem Pakar Diagnosa Hipertiroid Menggunakan Certainty Factor dan Logika Fuzzy. *Contemporary Mathematics and Applications (ConMathA)*, *2*(1), 57. https://doi.org/10.20473/conmatha.v2i1.19302

[4]   Ayu Mahessya, R., Panggranatama, N., & Pratiwi, M. (2018). Desaign Dan Implementasi Sistem Informasi Penjualan Berbasis Website Pada Toko Celcius House Of Original Padang. *Jurnal Sains Dan Informatika*, *4*(1), 1–10. https://doi.org/10.22216/jsi.v4i1.3270

[5]   Aziz, A. (2012). Pemanfaatan Teknologi Informasi dalam Pengembangan Bisnis Pos information technology utilization in business post. *Buletin Pos Dan Telekomunikasi Volume*, *10*(1), 35–50.

[6]   Dona. (2021). Sistem Pakar Diagnosa Penyakit Jantung dengan Metode Case Based Reasoning (CBR). *Jurnal Sistem Informasi*, *3*(1), 1–12.

[7]   Idam Harinda Putra. (2012). Sistem Informasi Penjualan Berbasis Web Pada Yours Store Semarang. *Universitas Dian Nuswantoro*, 1–6.

[8]   Marbun, Murni S.Si., MM., M. K., & Sinaga, Bosker S, Kom.., M. K. (2019). *Buku Ajar Sistem Pendukung Keputusan Penilaian Hasil Belajar | 1 STMIK Pelita Nusantara Medan*.

[9]   Maulidia, T. R. (2017). Membuat Sistem Pakar Jauh Lebih Besar Dari Pada Pembuatan Sistem Biasa . Pakar Digunakan Untuk Memecahkan Masalah Yang Memang Sulit Untuk Dipecahkan Dengan Pemrograman Biasa , Mengingat Biaya Yang Diperlukan Untuk. *Coding Jurnal Komputer Dan Aplikasi Untan*, *05*(03).

[10]   Nugraha, D. W. (2020). *Menggunakan Metode Case Based Reasoning Berbasis Web*. *5*(1).

[11]   Purwandari, F. R. (2018). Sistem Informasi Penjualan Berbasis Web pada PT. Mustika Jati. *Sistem Informasi Penjualan Berbasis Web Pada PT. Mustika Jati Farhan*, *1*(4393), 43–57. http://research.kalbis.ac.id/Research/Files/Article/Full/ET722JFJEKQYRF2PKZC1UBQOU.pdf

[12]   Pusat Data dan Informasi Kementerian Kesehatan RI. (2015). *Situasi dan Analisis Tiroid.pdf* (pp. 1–8).

[13]   Rini Asmara. (2016). *SISTEM INFORMASI PENGOLAHAN DATA PENANGGULANGAN BENCANA PADA KANTOR BADAN PENANGGULANGAN BENCANA DAERAH (BPBD) KABUPATEN PADANG PARIAMAN*. *3*(June).

[14]   Rodiah, & Widodo, R. (2016). Implementasi Fuzzy Inference System Sebagai Penunjang Diagnosis Hipertiroid. *Seminar Nasional Teknologi Informasi Dan Komunikasi Terapan (SEMANTIK)*, *January 2015*, 471–476.

[15]   Siregar, H. F., & Melani, M. (2019). Perancangan Aplikasi Komik Hadist Berbasis Multimedia. *Jurnal Teknologi Informasi*, *2*(2), 113. https://doi.org/10.36294/jurti.v2i2.425

[16]   Soepomo, P. (2014). Sistem Pakar Untuk Mendiagnosa Penyakit Lambung Dengan Implementasi Metode Cbr (Case-Based Reasoning) Berbasis Web. *JSTIE (Jurnal Sarjana Teknik Informatika) (E-Journal)*, *2*(1), 119–129. https://doi.org/10.12928/jstie.v2i1.2609

[17]   ZM, A. P., Ernawati, & Erlansari, A. (2017). Sistem Pakar Diagnosa Penyakit Tiroid Menggunakan Metode Naive Bayes Berbasis Android. *Jurnal Rekursif*, *5*(3), 270–284.

[18]   Zulfian Azmi, ST, M.Kom & Verdi Yasin, ST., M. K. (2017). *PENGANTAR SISTEM PAKAR DAN METODE*. Mitra Wacana Media.