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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): Significant symptom = 1 Normal symptom = 0

S1 * W1 + S2 * W2 + ... + Sn *

*W*1+*W*2+....+*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:

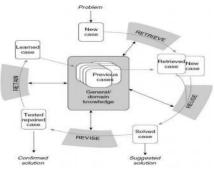


Fig. 1: Case Base Reasoning Cycle

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

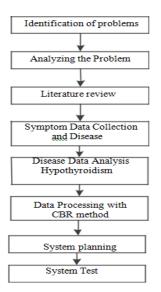


Fig. 2: Research Framework

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:

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

Table 1: List of Diseases

Table 2: List of Symptoms

Code	Symptom	Туре	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.

$$S1*W1+S2*W2+...+Sn*$$

Similarity (Problem Case) = -

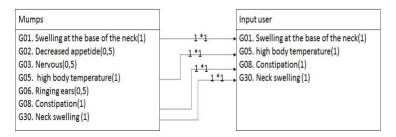
description:

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



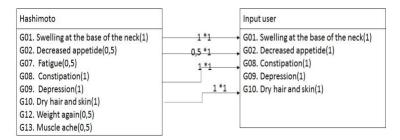
Symptoms that are similar between goiter and user input are only 4 symptoms, namely symptoms G01, G05, G08 and G30, so: Symptom similarity value G01 = 1Symptom similarity value G02 = 0Symptom similarity value G03 = 0Symptom similarity value G05 = 1Symptom similarity value G06 = 0

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 G08 = 1 Symptom weight G030 = 1 Similarity (problem case) = $\frac{51*W1+52*W2+\dots+Sn*Wn}{W1+W2+\dots+Wn}$ 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) = $\frac{1+0+0+1+0+1+1}{5,5}$ = 0,72 * 100 Similarity (level of similarity) = 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 = 1Symptom similarity value G07 = 0
- Symptom similarity value G07 = 0Symptom 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 = 0.5Symptom weight G07 = 0.5Symptom weight G08 = 1Symptom weight G09 =0.5 Symptom weight G10 = 1Symptom weight G12 = 0.5Symptom weight G13 = 0.5Similarity (problem case) = $\frac{S1*W1+S2*W2+\dots+Sn*Wn}{W1+W2+\dots+Wn}$ $W1+W2+\cdots+Wn$ 1+0,5+0,5+1+0,5+1+0,5+0,5 Similarity (problem case) = $\frac{1+0,5+0+1+1+1+0+0}{5} = 0.81 * 100$ 5,5 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

Hipotiroid		Input user
G02. Decreased appetide(0,5) G07. Fatigue(0,5) G08. Constipation(1) G09. Depression(1) G14. Swollen face(1) G15. Slow sound(0,5) G16. Stiff joints(0,5)	1*0,5 1*1 1*1 1*1 1*1	 → G02. Decreased appetide(0,5) → G09. Depression(1) → G14. Swollen face(1) → G16. Stiff joints(0,5)

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 = 1Symptom similarity value G07 = 0Symptom similarity value G08 = 0Symptom similarity value G09 = 1Symptom similarity value G14 = 1Symptom similarity value G15 = 0Symptom similarity value G16 = 1Symptom weight G02 = 0.5Symptom weight G07 = 0.5Symptom weight G08 = 0.5Symptom weight G09 = 1Symptom weight G14 = 1Symptom weight G15 = 0.5Symptom weight G16 = 0.5Similarity (problem case) = $\frac{S1*W1+S2*W2+\dots+Sn*Wn}{W1+W2+\dots+Wn}$ Similarity (problem case) = $\frac{1*0,5+0*0,5+0*0,5+1*1+1*1+0*0,5+1*0,5}{25+05}$ 0,5+0,5+0,5+0,5+1+0,5+0,5 Similarity (problem case) = $\frac{0,5+0+0+1+1+0+0,5}{45}$ = 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

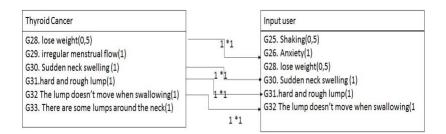
Hipertiroid		Input user
G07. Fatigue(0,5)	1 *0,5	→ G07. Fatigue(0,5)
G16. Stiff joints(0,5)	1 *0,5	G16. Stiff joints(0,5)
G21. Can't stand the heat(1)	1 *0,5	G22. Increased appetite(0,5)
G22. Increased appetite(0,5)		 G24 Enlarged tyroid gland(1)
G23. Weight loss(0,5)	1*1	G26. Anxiety(1)
G24 Enlarged tyroid gland(1)		04/06/00/
G25. Shaking(0,5)	1 *1	
G26. Anxiety(1)		L

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 = 1Symptom similarity value G16 = 1Symptom similarity value G21 = 0Symptom similarity value G22 = 1Symptom similarity value G23 = 0Symptom similarity value G24 = 1Symptom similarity value G25 = 0Symptom similarity value G26 = 1Symptom weight G07 = 0.5Symptom weight G16 = 0.5Symptom weight G21 = 0.5Symptom weight G22 = 0.5Symptom weight G23 = 0.5Symptom weight G24 = 1Symptom weight G25 = 0.5Symptom weight G26 = 0.5Similarity (problem case) = $\frac{S1*W1+S2*W2+\dots+Sn*Wn}{W4}$ Similarity (problem case) = $\frac{1*0,5+1*0,5+0*0,5+1*0,5+0*0,5+1*1+0*0,5+1*0,5}{2}$ 0,5+0,5+0,5+0,5+0,5+1+0,5+0,5 Similarity (problem case) = $\frac{0.5+0.5+0+0.5+0+1+0+0.5}{4\pi}$ = 0,66 * 100 4.5 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 Similarity (problem case) = $\frac{51*W1+52*W2+\dots+5n*Wn}{W1+W2+\dots+Wn}$

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.

Usemame Password	Login Admin admi Login <u>Kembali</u>	

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.

Home	Penyakit &	Solusi Gejala	Rule Base L	aporan Gejala	Laporan User	Lo	gout
Data P	enyakit	dan Solusi F	Penanganann	ya			
Kode Penya Nama Penya							
Definici	12						
Solusi	12						
	Simp	an Reset					
No.	Kode Penyakit	Nama Penyakit	Definisi		Solusi	Edit	Нари
	P01	Gondok	Penyakit gondek adala permengakan kelenja troid yang umumnya menyebatkan benjolan pada leher.	 untuk meng- meng-acika: (kortikoster pada kasu, kelenjar tudo adaleh pilih tumbuh teri merespon h Yodium radi dengan gon mutinodula (RAI) mung berupa oba kerundian m airan darah 	i yang digunakan i yang digunakan i gondok yahu Cbal Jodi Untuk menguangi Jodi Untuk menguangi Hordetis (radion aki) Copertian apat Itodektom, apat Itodektom,	8	3

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.

	_{ata R}	Penyakit & Solusi	Gejala	Rule Base	Laporan Gejala		Laporan	User	Logou
Kod	la	[Daftar E	amiakii 1						
Kode [Daftar Penyakit] Gejala [Daftar Gejala]				v					
Bob	ot								
		Simpan]						
No	Gejala		-					Nama	Penyakit
1	G01	Pembengkakan di pa	ngkal leher		1	Edit	Hapus	P01	Gondok
	G02	Nafsu makan berkura	0.5	Edit	Hapus	1			
	G03	Gugup	0.5	Edit	Hapus				
	G05	Suhu badan tinggi	dan tinggi 1 Edit Həpu				Hapus]	
	G06	Sulit tidur	0.5	Edit	Hapus				
	G08	Konstipasi			1	Edit	Hapus	1	
	G30	Pembengkakan leher	tiba-tiba		1	Edit	Hapus]	
2	G01	Pembengkakan di pa	ngkal leher		1	Edit	Hapus	P02	Hashimoto
	G02	Nafsu makan berkura	ing		0.5	Edit	Hapus		
	G07	Kelelahan			0.5	Edit	Hapus	1	
	G08	Konstipasi			1	Edit	Hapus		
	G09	Depresi			1	Edit	Hapus	1	
	G10	Rambut dan kulit keri	ng		1	Edit	Hapus	1	

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

HK	3641	PROSES DIAGNOSA	DAFTAR PENYAKIT	LOGIN
D	ata F	Pengguna		
	ama			
Gender		Sudarianto		
		Lais-lais 🗸		
	mar	45		
AJ,	amat	Dusun Salak		
En	nail	Sudari@gmail.com		
		Daftar Reset		
			Pilih Gejala Ya	ng Dialami
Fo	orm Kor	sultasi :		
_		nbengkakan di pangkal lehe		
:		nbengkakan di pangkal lehe Isu makan berkurang		
:	Gu	su makan perkurang		
		ing mual dan muntah		
		ing muai dan muntan iu badan tinggi		
	C) Sul			
:	- Kel			
		istipasi		
	Dep			
2		mbut dan kulit kering		
		has Dingin		
		at badan naik		
	NY			
		jah membengkak		
2		nbelit (BAB tidak teratur)		
	- Sui	ira Lambat		
		idi kaku		
		antuk yang berlebihan		
		sentrasi menurun		
	- Kak	i kaki yang membengkak		
		ak tahan panas		
	Naf	su makan meningkat		
	Ber	at badan turun		
		enjar tirold membesar		
		notaran		
		pelisahan		
		yut jantung yang cepat		
•		silangan berat badan		
•		an menstrual yang tidak teri	atur	
•		nbengkakan leher tiba-tiba		
•		ijolan keras dan kasar		
		njolan tidak bergerak saat m		

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.

Home	Penyakit & Solusi	Gejala	Rule Base	Laporan Gejala	Laporan User	L	ogout
Data Gej Kode gejala	ala-gejala						
Sejala	Simpan Re	set					
Kode Gejala			Gejala			Edit	Нари
G01	Pembengkakan di pa	ingkal leher					
G02	Nafsu makan berkura	ang					9
G03	Gugup						9
G04	Sering mual dan mur	ntah					9
G05	Suhu badan tinggi						9
G06	Sulit tidur						9
G07	Kelelahan						9
G08	Konstipasi						9
G09	Depresi						
G10	Rambut dan kulit ker	ing					9
G11	Panas Dingin						9
G12	Berat badan naik						3

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.

HOME	PROSES DIAGNOSA	DAFTAR PENYAKIT	LOGIN
Hasil Dia	agnosa		
Identitas Pa	isien :		
Umur: 45	in : Laki-laki		
Alamat : Du	sun Salak		
1 Pembengi 2 Suhu bada 3 Konstipasi			
4.Pembeng	kakan leher tiba-tiba		
Persentase	Setiap Penyakit :		
Persentase Persentase Persentase	Pasien Menderita Penyakit C Pasien Menderita Penyakit H Pasien Menderita Penyakit H Pasien Menderita Penyakit H Pasien Menderita Penyakit H	lashimoto Sebesar 33,33% Canker Tiroid Sebesar 18,189 lipotiroid Sebesar 11,11%	6
Hasil Diagn	osa:		
	hasil persentase setiap pe ondok sebesar 72.72 %	nyakit yang tertera, pasien	terjangkit
Solusi Pen	gobatan :		
yaitu Obat (kasus tiroidi sebagai tiro merespon te beracun mu yang ditelar	kortikosteroid) untuk mengur tis (radang kelenjar tidoid). C idektomi, adalah pilihan jika arhadap terapi obat. Yodium itinodular, Radioactive Iodine	gatasi kondisi ini untuk meng- angi peradangan dapat digur operasi pengangkatan tiroid, gondok tumbuh terlalu besar radioaktir. Pada orang denga e (RAI) mungkin diperlukan. F d melalui aliran darah, di mar I.	nakan pada yang dikenal atau tidak in gondok RAI berupa oba

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.

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