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Expert System for Diagnose Diabetes by Using the Certainty Factor Method

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ABSTRACT

Diabetes mellitus is a chronic autonim disease caused by interruption of blood sugar regulation, or commonly referred to as diabetes or diabetes. If the disease is not treated with proper care, it can cause dangerous complications, can even threaten the lives of sufferers. Implementation of expert system for diagnosing diabetes mellitus using a web-based certainty factor aims to explore the symptoms displayed in the form of questions - questions that can diagnose different types of diabetes mellitus. Results from this study is a web-based expert system that can detect whether a person's disease or diabetes mellitus. Based on the manual calculation, showed the highest value of 0.

1. Introduction

Diabetes mellitus is something that can not be poured in a clear and concise answers, but in general it can be said as a collection of anatomical and chemical problems that are the result of a number of factors. Patients with diabetes mellitus requiring very dynamic therapeutic modalities. It should be understood by both the underlying pathology and the impact of chronic hyperglycemia on organ damage, as well as a good understanding of the agent - pharmacological agent in accordance with a diabetic disease state. [1]

Based on the above considerations it would require an expert system diagnosis of diabetes mellitus. Limitation of problems of this expert system design is the ability to apply an expert in systems that can help provide solutions for information diabetes mellitus. This expert system is made by using the programming language PHP and MySQL as a database.

The purpose of this study was to design an expert system to be able to search for information about diabetes mellitus in humans using certainty factor. So that every patient diabetes mellitus can easily determine the type of diabetes mellitus without having to see a doctor first. The first journal literature study, based on tests made by experts, the level of application keakurat 80%. [2]

Journal literature two studies entitled Eye Disease Diagnosis Expert System Using Android-Based Methods Certainty factor that has been created has a diagnosis accuracy rate of 75% with the details of 15 illnesses and 52 symptoms. [3]

The third literary journal, diagnosis conclusion is the value of CF (rule), the largest obtained from diagnosis is 0.88. So the diagnosis is likely to be diagnosed with damage to the upper ball joint. [4]

Journal of the fourth literature, the average value of the successful application of expert system which has been built in the diagnosis of tropical diseases based on test results with medical record data comparison comes from two sources amounted to 86.65%. [5]

Journal fifth literature, expert systems have pendiagnosa tuberculosis disease diagnosis accuracy rate of 85%. [6] Journal of the sixth literature, this expert system application using certainty factors that provide a level of confidence in the diagnosis of diseases suffered by the user. The output of the expert system is not the result of the disease diagnosis. [7]

Journal seventh literature, the measurement accuracy system tests performed by 20 patients, there were 19 cases suite and 1 cases that do not fit. So, from system testing performed by 20 patients resulted in 95% accuracy rate. As for suggestions on further research to adopt the expertise of a doctor entered through the android that allows the physician to monitor this application. [8]

Journal eighth literature, from this study can be concluded that the expert system developed using certainty factor method can generate the acupoint output in accordance with the patient's

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symptoms of insomnia. Furthermore, the value of the accuracy of the results of expert systems on the expertise of the acupuncturist treating patients with insomnia is 93.33% [9].

Journal ninth literature, expert systems for pre-diagnosis disease of pigs which is important gastrointestial 2 symptoms are used, the rate of severe illness, age range and stool for the diagnosis of the disease; diagnostic accuracy was 75.4% [10]

Journal tenth literature, the rate of diagnosis of truth can not be proven because it depends on the truth value of hypotheses and evidence, and if the object of study is animal, vegetable or nonhuman then assumptions can be taken only in accordance with the physical symptoms or symptoms that may be used. viewed directly on the object of further research should be done if there is more than one disease that has similar symptoms. [11]

Journal eleventh literature, based on testing that has been done on the application of expert system decision contraceptives have a 75% accuracy rate. [12]

Journal twelfth literature, this study shows the development and application of a rule-based expert system trust (BRBES) with the ability to handle various types of uncertainties associated with the signs, symptoms, and risk factors for dengue fever. [13]

Thirteenth literature journals, web-based expert system models can be used as well as database and archiving tool by physicians, where the site has features beyond the diagnosis of psychological illness, can be easily detected by observers. It is worth mentioning that the proposed expert system is not a substitute for human doctor but it certainly is an important tool for decision support diagnosis by a physician. [14]

Fourteenth journal literature, based on research and the description given above, it can be concluded that the application of the method of Certainty Factor can be used to identify intestinal diseases with 99.82% accuracy rate. [15].

2. Research Methods

A. Data collection

1) Literature review
   Perform a search and collect data - data about the symptoms of diabetes mellitus kind of books, journals, and articles.
2) Interview
   Interviewing is collecting data by conducting interviews to the experts to get an explanation of the symptoms and diabetes.

B. Diabetes Melltius

Diabetes mellitus is something that can not be poured in a clear and concise answers, but in general it can be said as a collection of anatomical and chemical problems that are the result of a number of factors. Patients with diabetes mellitus requiring very dynamic therapeutic modalities. It should be understood by both the underlying pathology and the impact of chronic hyperglycemia on organ damage, as well as a good understanding of the agent - pharmacological agent in accordance with a diabetic disease state.

C. Expert System

Expert systems (expert systems) is a software package or computer program package intended as a provider of advice and aids in solving problems in certain specialist fields such as science, engineering mathematics, medicine, education and so on. Such computers can be used as consultants or experts in their field. [16]

D. Certainty Factor

Factors certainty (certainty factor) is a trust in an event or fact based on the evidence or expert judgment. Certainty factor using an assumed value for the degree of belief an expert to the data. Certainty factor calculation rule can be presented as follows:

1) Calculating the value CF
   CF [H, E] = MB [H, E] - MD [H, E]

Information :

CF: certainty factor of the hypothesis H that is affected by symptoms (evidence) E.

MB: measure of confidence (measure of Increased belief) of the hypothesis H that are affected by the symptoms of E.

MD: distrust size (measure of Increased disbelief) against the hypothesis H that are affected by the symptoms of E.

2) Calculating the Value CFcombine

CF combines the value of each - each symptom with the following formula:

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CFcombine 1.2 CF CF = CF 1 + 2 * (1 - CF [H, E] 1)
Ket:

E. Interpretation Value Certainty Factor

Table 1.
Interpretation of Certainty Factor.

Number	Term certainty	value CF
1.	definitely Not	-1
2.	Almost Definitely Not	-0.8
3.	Possible Big No	-0.6
4.	Probably not	-0.4
5.	Do not Know / Not Sure	-0.2
6.	Maybe	0.4
7.	Most likely	0.6
8.	almost definitely	0.8
9.	Certainly	1.0

Based on Table 1, the value of the interpretation certainty factor which must not have a value cf of -1.0, -0.8 almost certainly not, most likely not be -0.6, -0.4 may not, do not know -0.2, maybe 0.4, 0.6 most likely, almost certainly 0.8 , certainly 1.0.

3. Results and Discussion

A. Flowchart Design Research

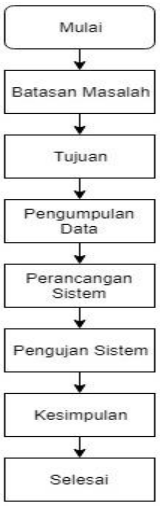

Fig 1. flowchart Research

In Figure 1, explaining that the flowchart of research in which the first to discuss the formulation of boundary problem in diabetes mellitus, in the second stage to know the purpose of the study, in the third stage does the data collection process in which the author searches multiple readings associated with expert system diagnosis of disease diabetes mellitus or by coming directly to the doctor, at the fourth stage does the system design process in which the author describes the design of the system will be used to find information diabetes mellitus, in the fifth stage does the system design process in which the author makes a system for diagnosing diabetes mellitus, on stage sixth to be fully tested system where the author conducted testing of the system that has been made,the seventh stage peringkasan doing research.

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B. Flowchart Design System

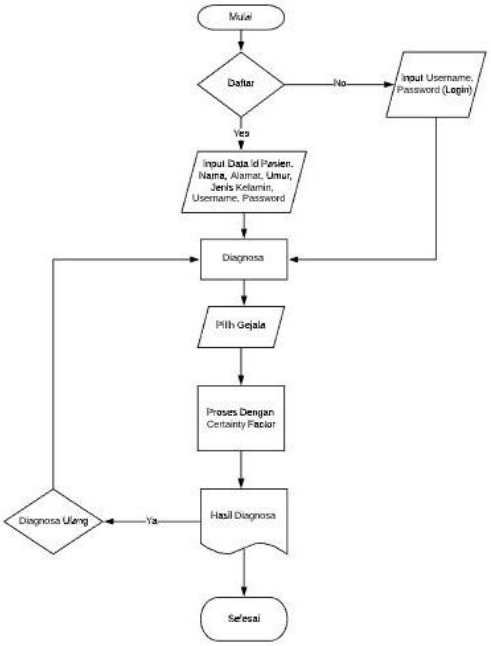

Fig 2, flowchart System

In this study begins with registration in advance by filling in the id of the patient, the name, address, age, gender, username, password, after registering the user must login, after login user selects the menu diagnosis and choosing the symptoms - symptoms that arise and the system will search diagnosis of diabetes mellitus of fact symptoms - symptoms that have been selected. Once the disease memeilih system will perform calculations using certainty factor. Then the system will display the diagnostic results. After the user to log out of the system.

C. Use Case Diagram

Use Case describes the functionality expected from a system. A use case represents an interaction between the actors and the system to be created. In the expert system constructed involves only two actors that users and administrators. Use case diagrams in an expert system can be seen in Figure 3.

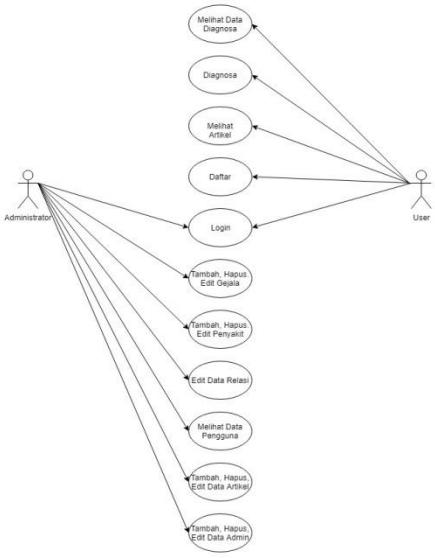

Fig 3. Use Case Diagram

From Figure 3 shows that the admin can add, delete, edit symptom data, disease data, data relationships, the data user, admin data, the article data, while users can only perform diagnostics and see the results of the diagnosis.

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D. Level of Accuracy

Testing the intended level of accuracy is to find the percentage of accuracy in classifying the data testing process tested. This level of accuracy is calculated using the following formula:

$$\text{Accuracy} = \frac{\Sigma match}{\Sigma tp} \text{ X } 100\%$$

Information :

$\Sigma match$ = Number of correct classification

Σtp = The amount of data testing

E. Database Design

Facts and knowledge related to the symptoms - symptoms of diabetes mellitus will be used in the manufacture of an expert system. The facts and the knowledge obtained from the study of literature and interviews. Each type of diabetes mellitus certainly have symptoms - symptoms that can be identified based on the knowledge of experts. Each - each symptom and the value of CF experts can be seen with the code as described in Table 2.

Table 2,
List of Symptoms

Symptoms Code	Symptom	Value CF
G001	many urination	0.8
G002	Rasa Haus	0.8
G003	Weight loss	0.8
G004	Such taste and Weak Flu	0.8
G005	Blurred outlook	0.6
G006	Difficult Wounds That Heal	0.6
G007	Red and Swollen Gums	0.6
G008	Dry and Itchy Skin	1.0
G009	Affected easy Infections	1.0
G010	Itching On Pubic	0.8
G011	The Hunger Can not Explain	1.0
G012	Increased Blood Glucose	1.0
G013	Dehydration	1.0
G014	Dry eyes	0.8
G015	Dry mouth	0.6
G016	Confused	0.6
G017	Diabetes Can not Resist	0.4
G018	High blood pressure	0.4
G019	Depression	0.4
G020	Feeling tired and Fatigue	0.6
G021	Nausea	0.4
G022	Gag	0.4
G023	More Frequently Fall	0.8
G024	Tingling In Legs	1.0
G025	dermatitis	0.4
G026	Feel sleepy	1.0
G027	joint pain	0.8
G028	Numb At the Feet and Hands	0.4
G029	Blackened skin	0.4
G030	Erection Disorders in Men	0.4
G031	Decreased muscle mass	1.0
G032	Strange Changes In Skin	0.8
G033	Respiratory Tract Infections	0.6
G034	Infection In Mouth	0.8
G035	breath Odor	0.8
G036	Experiencing Sexual Dysfunction	1.0
G037	Suffering from Urinary Tract Infection	0.4
G038	Hormone Balance Disorders	0.4
G039	Quick Being Angry	0.6
G040	difficulty Breathing	0.8
G041	loss of Consciousness	0.4
G042	Itching feel Unending	0.4
G043	Tingling In Hand	0.6
G044	Frequent Dizziness	0.6
G045	Moist skin	0.4
G046	ear Ringing	0.4
G047	Infection In Leg	0.6
G048	agitated	0.4
G049	Insomnia	0.8
G050	Not Irregular Heartbeats	0.6

Each type of diabetes mellitus can be seen with the code as described in Table 3.

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Table 3,
List of Diseases

Diseases code	Disease name
P1	Diabetes Mellitus Type 1
P2	Diabetes Mellitus Type 2

Furthermore, from each - each of the symptoms of diabetes mellitus can be divided into a type of diabetes mellitus as shown in Table 4.

Table 4,
Grouping Symptoms and Disease

Diseases Code	Disease Name	Symptoms Name
P001	Diabetes Mellitus Type 1	many urination
		Rasa Haus
		Blurred outlook
		Red and Swollen Gums
		Dry and Itchy Skin
		Affected easy Infections
		Increased Blood Glucose
		Dehydration
		Confused
		Depression
		dermatitis
		Blackened skin
		Decreased muscle mass
		Strange Changes In Skin
		breath Odor
		Quick Being Angry
		difficulty Breathing
		loss of Consciousness
		Frequent Dizziness
		ear Ringing
		agitated
		Insomnia
		Not Irregular Heartbeats
P002	Type 2 Diabetes Mellitus	Weight loss
		Such taste and Weak Flu
		That is hard to Heal Wounds
		Itching On Pubic
		The Hunger Can not Explain
		Dry eyes
		Numb At the Feet and Hands
		Dry mouth
		Diabetes Can not Resist
		High blood pressure
		Feeling tired and Fatigue
		Nausea
		Gag
		More Frequently Fall
		Tingling In Legs
		Feel sleepy
		joint pain
		Erection Disorders in Men
		Respiratory Tract Infections
		Infection In Mouth
		Experiencing Sexual Dysfunction
		Suffering from Urinary Tract Infection
		Hormone Balance Disorders
		Itching feel Unending
		Tingling In Hand
		Moist skin
		Infection In Leg

Information :
P001 = Diabetes Mellitus Type 1
P002 = Type 2 Diabetes Mellitus

F. Certainty Factor Calculation Methods Manual

Included Included Diseases Manual calculation:

a) Diabetes Mellitus Type 1

1) Symptoms code G01

CF [H, E] 1 = MB [H, E] 1 - MD [H, E] 1
= 0.8 - 0.2
= 0.6

2) For symptom code G02

CF [H, E] 2 = MB [H, E] 2 - MD [HE] 2

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= 0.8 - 0.6
= 0.2

b) Type 2 Diabetes Mellitus

3) Symptoms code G03

CF [H, E] 3 = MB [H, E] 3 - MD [H, E] 3
= 0.8 - 0.2
= 0.6

4) Symptoms code G04

CF [H, E] 4 = MB [H, E] 4 - MD [H, E] 4
= 0.8 - 0.6
= 0.2

Furthermore, combining the values of CF of each - each disease:

1) Diabetes Mellitus Type 1
CFcombine CF [H, E] 1.2 = CF [H, E] 1 + CF [H, E] 2 * (1 - CF [H, E] 1)
= 0.8 + 0.2 * (1 - 0.8)
= 0.2
2) Type 2 Diabetes Mellitus
CFcombine CF [H, E] 3.4 = CF [H, E] 3 + CF [H, E] 4 * (1 - CF [H, E] 3)
= 0.8 + 0.2 * (1 - 0.8)
= 0.96

From the above calculation can be generated the highest value is 0.96 or 96% which is a type 2 diabetes mellitus.

G. Interface System

Display design expert system diagnoses diabetes mellitus using a web-based certainty factor can be seen from the following explanation:

1) Display User Login

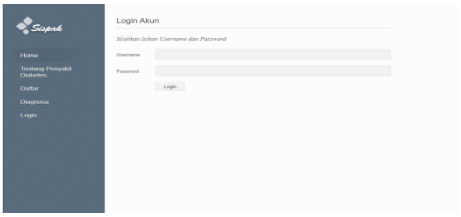

Fig 4. Display User Login

User login menu is a menu that is reserved for user and administrator can not pass the logged on user login.

2) Dashboard display

Fig 5, Dashboard display

On the web dashboard page there is a menu of diabetes, lists, diagnosis, login.

3) Diagnosis views

Fig 6, Diagnosis views

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Before performing diagnostics user must select any symptoms are felt, after selecting symptom, the user selects the button, then the diagnosis of diabetes that affects will appear.

4) Diagnosis Result Display

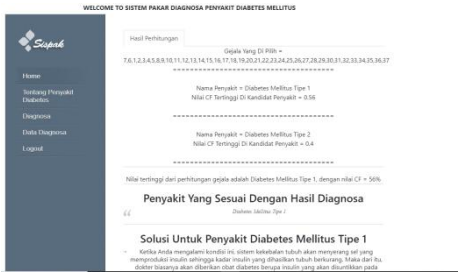

Fig 7. Diagnosis Result Display

In view diagnostic results are the highest values of the calculation of the symptoms to the value cf whether the user is suffering from diabetes type 1 or type 2 and its solution.

5) Views Admin Login

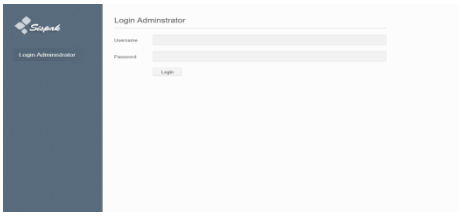

Fig 8. Views Admin Login

Admin login menu is a menu that is reserved for the administrator and the user can not login pass admin login.

6) Admin Dashboard Display

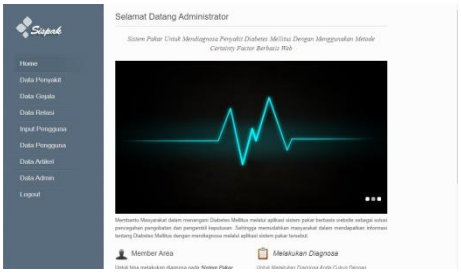

Fig 9. Admin Dashboard Display

On the dashboard display admin, admin can modify, delete data symptoms, disease data, user data, articles, user input, logout.

H. Testing Accuracy

Calculation of accuracy in this study the authors compared the results of the output of the expert system with a certainty factor method Dempster Shafer method. Comparison of the accuracy of performed using test data and calculated the accuracy of the method and Dempster Shafer certainty factor. Here is a test of the accuracy of an expert system with a certainty factor method:

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Table 5.
Accuracy Testing Method of Certainty Factor.

No	Nama Gejala	Diagnosa Pakar	Diagnosa Sistem	Hasil
1	Banyak Kencing	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
2	Rasa Haus	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
3	Berat Badan Turun	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
4	Rasa Seperti Flu dan Lemah	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
5	Pandangan Kabur	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
6	Luka Yang Susah Sembuh	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
7	Gusi Merah dan Bengkak	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
8	Kulit Kering dan	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
9	Mudah Terkena Infeksi	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
10	Gatal Pada	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
11	Kelaparan Yang Tidak Bisa	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
12	Peningkatan Glukosa Darah	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
13	Dehidrasi	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
14	Mata Kering	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
15	Mulut Kering	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
16	Bingung	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
17	Tidak Dapat Menahan Kencing	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
18	Tekanan Darah	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
19	Depresi	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
20	Merasa Lelah dan Lesu	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
21	Mual	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
22	Muntah	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
23	Lebih Sering Jatuh	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
24	Kesemutan Pada	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
25	Infeksi Kulit	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
26	Merasa Ngantuk	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
27	Sakit Sendi	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
28	Mati Rasa Pada Kaki dan Tangan	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 1	Tidak Sesuai
29	Kulit Menghitam	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
30	Gangguan Ereksi Pada Pria	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 2	Tidak Sesuai
31	Massa Otot Berkurang	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
32	Perubahan Aneh Pada Kulit	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
33	Infeksi Saluran Pernapasan	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
34	Infeksi Pada Mulut	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
35	Nafas Bau	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
36	Mengalami Disfungsi Seksual	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
37	Menderita Infeksi Saluran Kemih	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
38	Gangguan Keseimbangan Hormon	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
39	Menjadi Cepat	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
40	Kesulitan Bernapas	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
41	Kehilangan Kesadaran	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
42	Merasa Gatal Tanpa Henti	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
43	Kesemutan Pada Tangan	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
44	Sering Pusing	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
45	Kulit Lembab	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
46	Telinga Berdenging	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
47	Infeksi Pada Kaki	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
48	Gelisah	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
49	Susah Tidur	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
50	Detak Jantung Tak Beraturan	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai

The results of testing the accuracy of the system with the diagnosis of experts involving 50 data testing is as follows:

Σmatch = 48 correct classification data

Σtp = 50 data testing

So the results of the calculation accuracy testing certainty factor method is as follows:

$$\text{Accuracy} = \frac{48}{50} \text{ X } 100\% = 96\%$$

Furthermore, the calculation accuracy of expert systems Dempster Shafer method:

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Table 6.
Accuracy Testing Methods Dempster Shafer.

No	Nama Gejala	Diagnosa Pakar	Diagnosa Sistem	Hasil
1	Banyak Kencing	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
2	Rasa Haus	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
3	Berat Badan Turun	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
4	Rasa Seperti Flu dan Lemah	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Tidak Sesuai
5	Pandangan Kabur	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
6	Luka Yang Susah Sembuh	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
7	Gusi Merah dan Bengkak	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
8	Kulit Kering dan	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
9	Mudah Terkena Infeksi	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
10	Gatal Pada	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
11	Kelaparan Yang Tidak Bisa	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
12	Peningkatan Glukosa Darah	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
13	Dehidrasi	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
14	Mata Kering	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
15	Mulut Kering	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
16	Bingung	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
17	Tidak Dapat Menahan Kencing	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
18	Tekanan Darah	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
19	Depresi	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
20	Merasa Lelah dan Lesu	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
21	Mual	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
22	Muntah	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
23	Lebih Sering Jatuh	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
24	Kesemutan Pada	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
25	Infeksi Kulit	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
26	Merasa Ngantuk	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
27	Sakit Sendi	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
28	Mati Rasa Pada Kaki dan Tangan	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 1	Tidak Sesuai
29	Kulit Menghitam	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
30	Gangguan Ereksi Pada Pria	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 2	Tidak Sesuai
31	Massa Otot Berkurang	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
32	Perubahan Aneh Pada Kulit	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
33	Infeksi Saluran Pernapasan	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
34	Infeksi Pada Mulut	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
35	Nafas Bau	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
36	Mengalami Disfungsi Seksual	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
37	Menderita Infeksi Saluran Kemih	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
38	Gangguan Keseimbangan Hormon	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
39	Menjadi Cepat	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
40	Kesulitan Bernapas	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
41	Kehilangan Kesadaran	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
42	Merasa Gatal Tanpa Henti	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
43	Kesemutan Pada Tangan	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
44	Sering Pusing	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
45	Kulit Lembab	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
46	Telinga Berdenging	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
47	Infeksi Pada Kaki	Diabetes Mellitus Tipe 2	Diabetes Mellitus Tipe 2	Sesuai
48	Gelisah	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
49	Susah Tidur	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai
50	Detak Jantung Tak Beraturan	Diabetes Mellitus Tipe 1	Diabetes Mellitus Tipe 1	Sesuai

The results of testing the accuracy of the system with the diagnosis of expert testing involves 50 data is as follows:

Σmatch = 48 correct classification data

Σtp = 50 data testing

So the results of the calculation accuracy testing Dempster Shafer method is as follows:

$$\text{Accuracy} = \frac{47}{50} \text{ X } 100\% = 94\%$$

Table 7.
Comparison of Accuracy Level

Accuracy	certainty Factor	Dempster Shafer
	96%	94%

Table 7 degree of accuracy based on a comparison method with Dempster Shafer certainty factor. Certainty factor method has the advantage with an accuracy level of 94%.

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4. Conclusion

Based on the results of research on diagnosis expert system of diabetes mellitus using certainty factor method, it can be concluded that:

a. The system can diagnose the type of diabetes mellitus in the suffering by symptoms selected by the user.
b. Based on the manual calculation showed the highest value of 0.96 or 96%, which is a disease of type 2 diabetes mellitus.
c. Based on testing the accuracy of the system, it can be concluded that the certainty factor is more accurate method for each - each symptom compared with Shafer Demster method is 96%.
d. By using this system can be used as an alternative solution for the community to conduct an initial assessment before consulting a specialist (doctor).

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