

Diagnosis of Facial Skin Problems with the Forward Chaining Reasoning Method and Tracing Certainty Factor Beliefs

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Abstract

Most people's dream is to have white, healthy, clean and well-maintained facial skin. However, the treatment does not pay attention to skin type, causing new problems such as acne, dry skin and others. Before carrying out skin care, determining the type of facial skin is very necessary because the determination of skin care must be adjusted to the type of facial skin. The role of a skin specialist is highly expected in determining the type of facial skin care according to skin type. The limited number of dermatologists, doctor's office hours, and the very long queue process and long travel distances result in obstacles that are often experienced. In order to make it easier for the public to recognize skin problems on the face, we need a system that can assist doctors in the initial diagnosis of facial skin problems. In this study, the forward chaining method and certainty factor were used in diagnosing facial skin problems to calculate the accuracy of the types of problems experienced based on the symptoms felt by the user. From the test results obtained in dealing with facial skin problems with an accuracy rate of 99.99 %. The resulting expert system can assist patients in consulting to deal with facial skin problems.

Keywords : Facial Skin, Expert System, Forward Chaining, Certainty Factor, Consultation.

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1. Introduction

The skin is the outermost organ of the body that lines the human body. The skin makes up 15% of the total body weight. On the outer surface of the skin there are pores (cavities) through which sweat comes out. The skin has many functions, including as a body protector, as a tool for the sense of touch or a means of communication, and as a means of controlling temperature [1]. The desire of most humans, especially women, to have white, healthy, clean and well-maintained facial skin. However, the treatment does not pay attention to skin type, causing new problems such as acne, dry skin and others. To do skin care requires sufficient knowledge.

Several studies related to skin care were carried out by Tobin in 2017 [2]. Other studies carried out treatments using corn and olive oil masks which resulted in a good effect based on observations for normal, dry, combination skin types. Meanwhile, for oily skin, the effect is less than optimal, seen from the pores, for oily skin, it may take a longer time to get maximum results. Treatment with corn and olive oil masks after 1 month makes the face look brighter, softer and more elastic [3].

Also research conducted by Nilforoushzadeh in 2017 [4] Before doing skin care, determining the type of facial skin is very necessary because the determination of skin care must be adjusted to the type of facial skin.

The role of a skin specialist is very necessary in determining the type of facial skin care according to skin type. The limited number of dermatologists and doctors' hours of practice, very long queues and long distances are obstacles that are often experienced by most women who seek treatment at beauty clinics.

An expert system is a system that seeks to adopt human knowledge into computers, in order to be able to solve problems that are usually done by experts [5]. Many studies have been carried out by utilizing expert systems, because as we all know that information technology has entered all fields, not only in the field of computers. Basically, this expert system was built to replace the role of an expert.

Research on the diagnosis of skin diseases using the Forward Chaining method was carried out with the aim of detecting early types and computerized treatment of facial skin. The results of this study are an application that is capable of detecting and tracing problems starting from the factors first, then it can be concluded what problems it is facing [6]. Another study was conducted by Riandari in 2017 with the title Expert System for Diagnosing Facial Skin Diseases [7].

Based on several previous studies, this expert system research uses the Certainty Factor (CF) and Forward Chaining methods. The way the Certainty Factor method works is to show a measure of certainty about a fact or rule. The CF method performs reasoning like an expert, and to get trust values [8] and Forward Chaining by determining the IF-THEN rule logic. The

process of calculating the CF method is carried out by calculating the multiplication value between the user's cf value and the expert's cf value and producing a combined CF value. The highest combined CF value becomes the final decision of the CF method.

Several studies using the CF method include detecting ENT disease [9] diagnosing disease in red pepper [10] diagnosing dental disease [11] diagnosing lung disease [12] diagnosing childhood disease [13] diagnosing sugarcane disease [14] diagnosing goat disease [15].

2. Research methodology

2.1 Research subject

The subject of this study is the application of an expert system in diagnosing skin problems on the face. By using the forward chaining method in tracing rules and the certainty factor as a determinant of the percentage of confidence. This expert system is implemented with the PHP programming language.

2.2 Expert system

An expert system or expert system is a part of artificial intelligence specifically for solving problems at the expert level by using knowledge [16]. The basic concept or idea of an expert system is expertise that is transferred to a computer, the expertise in the form of knowledge is stored and later used by the system to find solutions from the facts obtained. The main purpose of an expert system is not to replace the role of an expert or an expert, but rather as a bridge between an expert and a user who needs knowledge in that area of expertise. On the other hand, an expert system can be an assistant to an expert who can help the performance of an expert.

2.3 Forward Chaining Method

The forward chaining method is described by way of arguing from facts that lead to conclusions. Reasoning is tested one by one in a certain order. Reasoning works with problems that start from recording the initial information to the final solution to be achieved, so that the whole process will be carried out sequentially.

2.4 Certainty Factor Method

Certainty factor or often called CF is a method used to measure the value of expert confidence. CF was introduced by shortliffe Buchanan through the MYCIN expert system. Certainty factor shows a measure of certainty about a fact [17].

To perform calculations using the certainty factor, a table is created that interprets the trem from the expert into the CF value.

Table 1. Certainty Factor Value		
No	Information	CF value
1	Not sure	0.2
2	Not sure	0.4
3	Sure enough	0.6
4	Certain	0.8
5	Very confident	1

The combination of certainty factors on the premise with the following rules :

Certainty factor with a single premise

$$CF_{gejala} = CF_{[user]} * CF_{[pakar]} \quad (1)$$

If there are rules with similarly concluded rules or more than one symptom, then CF is then calculated by the equation:

$$CF_{combine} = CF_{old} + CF_{gejala} * (1 - CF_{old}) \quad (2)$$

Meanwhile, to calculate the percentage of disease, the equation is used:

$$CF_{persentase} = CF_{combine} * 100\% \quad (3)$$

2.5 Method of collecting data

In this study, several methods were used in collecting the necessary data. First, library research was library research, by studying various literature related to this research to obtain information from previous studies. Furthermore, field research is conducting interviews with experts, in this case, beauty doctors. Direct interviews were conducted at the doctor's clinic, which is the object of this study. Finally, laboratory research is a stage in processing existing data, in order to achieve predetermined targets. At this stage it is supported by computer hardware and software.

2.6 Framework

So that the research does not go off track, it is necessary to have a framework in charge of guiding this research so that the desired goals are achieved. This expert system framework can be seen in Figure 1 below:



Figure 1. Framework

3. Results and Discussion

3.1 Data analysis

Based on the research subject, the data needed in this study is data on facial skin types as well as symptoms and solutions obtained from interviews with experts. In addition to skin type data, patient data is also needed to test this expert system. The following presents data that has been recapitulated based on the results of interviews with experts in the research object. the first data type of facial skin.

Table 2 . Table of Facial Skin Types

No	Skin Type Code	Skin Type Name
1	P1	Normal Skin
2	P2	Oily skin
3	P3	Dry skin
4	P4	Combination Skin
5	P5	Sensitive Skin

5 common types of facial skin problems were obtained, each type of facial skin problem was initialized with a code P1 to P5 as shown in Table 2. Furthermore, symptom data is symptom data which is summarized from the 5 types of facial skin problems in Table 2. This data was obtained from experts, namely cosmetic specialists on the research object.

Table 3 . Symptom Table

No	Symptom Code	Skin Type Name
1	G01	Facial skin is not oily
2	G02	Fresh and smooth facial texture
3	G03	Cosmetic ingredients easily stick to the face
4	G04	Skin looks healthy
5	G05	No pimples face
6	G06	Easy to choose cosmetics
7	G07	Large skin pores, especially in the area of the nose, cheeks and chin
8	G08	Facial skin looks shiny
9	G09	Acne often occurs on the face
10	G10	Have whiteheads
11	G11	Small facial pores
12	G12	Thin facial skin texture
13	G13	Quickly reveal wrinkles
14	G14	Part of the face looks greasy
15	G15	Part of the face looks dry
16	G16	Sometimes pimples
17	G17	It's hard to get the perfect cosmetic polish
18	G18	Easily allergic to new products
19	G19	Easily irritated and injured
20	G20	The skin looks red easily
21	G21	Blood vessels are sometimes visible from the surface of the facial skin
22	G22	The skin experiences breakouts when using a new product
23	G23	Having <i>blackhead problems</i> on the face
24	G24	When you wake up, your face looks shiny
25	G25	Oily skin if a few minutes after using facial washing soap
26	G26	<i>Make-up</i> smudges around the nose, cheeks and chin
27	G27	The face looks dull
28	G28	Itchy face in the sun

29	G29	The skin gets burned in the sun
30	G30	The face darkens quickly when exposed to sunlight
31	G31	Skin feels dry after using facial wash

There are 31 symptoms that are the cause of 5 types of skin problems on the face in Table 2. These symptoms are initialized with the code G01 to G31.

3.2 Formation Rules with the Forward Chaining Method

a rule is made using the *forward chaining* method , along with the rules resulting from processing data on types of skin problems and symptom data in Table 4.

Table 4 . Table Rules

Code Rules	rules
R1	IF [G01] AND [G02] AND [G03] AND [G04] AND [G05] AND [G06] AND [G11] AND [G30] THEN P1
R2	IF [G07] AND [G08] AND [G09] AND [G16] AND [G23] AND [G24] AND [G25] AND [G26] AND [G27] THEN P2
R3	IF [G01] AND [G05] AND [G10] AND [G11] AND [G12] AND [G13] AND [G20] AND [G27] AND [G30] AND [G31] THEN P3
R4	IF [G07] AND [G14] AND [G15] AND [G16] AND [G17] AND [G23] AND [G25] AND [G26] THEN P4
R5	IF [G09] AND [G12] AND [G18] AND [G19] AND [G20] AND [G21] AND [G22] AAND [G28] AND [G29] THEN P5

From the processing results obtained 5 rules as shown in Table 4.

3.3 Calculations Using the Certainty Factor Method

From the rules obtained by the *forward chaining method*, calculations are carried out using the *certainty factor* method to obtain the expert system confidence level. The following is the calculation of the *certainty factor* using the rule from the *forward chaining process* . The rules that have been obtained will be given a cf value, as shown in Table 5.

Table 5 . Rule Value Table and CF

Code Rules	rules
R1	IF [G01 : 0.8] AND [G02 : 0.8] AND [G03 : 0.8] AND [G04 : 0.8] AND [G05 : 0.8] AND [G06 : 0.8] AND [G11 : 0.8] AND [G30 : 0.4] THEN P1
R2	IF [G07 : 0.8] AND [G08 : 0.8] AND [G09 : 0.8] AND [G16 : 0.8] AND [G23 : 0.8] AND [G24 : 0.8] AND [G25 : 0.6] AND [G26 : 0.8] AND [G27 : 0.6] THEN P2
R3	IF [G01 : 0.6] AND [G05 : 0.6] AND [G10 : 0.8] AND [G11 : 0.6] AND [G12: 0.6] AND [G13 : 0.8] AND [G20 : 0.2] AND [G27 : 0.8] AND [G30 : 0.4] AND [G31 : 0.8] THEN P3
R4	IF [G07: 0.6] AND [G14 : 0.8] AND [G15 : 0.8] AND [G16 : 0.4] AND [G17: 0.8] AND [G23 : 0.8] AND [G25: 0.6] AND [G26 : 0.6] THEN P4

R5 IF [G09 : 0.8] AND [G12 : 0.8] AND [G18: 0.8]
AND [G19 : 0.8] AND [G20 : 0.8] AND [G21: 0.6]
AND [G22 : 0.8] AAND [G28 : 0.6] AND [G29 :
0.6] THEN P5

Furthermore, the CF user value is needed which is obtained based on the symptoms felt by the patient, the CF user value can be seen in Table 6

Table 6 . Values Table CF Users

No	Gender	Symptom Code & CF User
1	Woman	G9[0.8]; G12[0.8]; G18[0.8]; G19[0.8]; G20[0.8]; G21[0.4]; G22[0.6]; G28[0.6]; G29[0.6]; G7[0.6]; G8[0.4]; G9[0.2]; G14[0.8];
2	Woman	G15[0.6]; G16[0.4]; G17[0.4]; G23[0.6]; G25[0.6]; G26[0.8]; G1[1]; G5[0.2]; G10[0.6]; G11[0.4]; G12[0.4]; G13[0.6]; G20[0.2];
3	Woman	G27[0.4]; G30[0.4]; G31[0.2]; G1[0.6]; G2[0.8]; G3[0.6]; G4[0.8]; G5[0.8]; G6[0.2]; G11[0.4]; G30[0.6]; G7[0.4]; G8[0.6]; G9[0.6]; G16[0.4];
4	Man	G23[0.4]; G24[0.6]; G25[0.6]; G26[0.4]; G27[0.4];
5	Man	

After searching all the rules , a calculation is carried out using the fifth rule because of all the existing rules the conditions that are met are the conditions in the fifth rule , then based on the fifth rule a certainty factor is calculated as shown in table 7 below:

R5 = IF [G09 : 0.8] AND [G12 : 0.8] AND [G18: 0.8]
AND [G19 : 0.8] AND [G20 : 0.8] AND [G21: 0.6]
AND [G22 : 0.8] AAND [G28 : 0.6] AND [G29 : 0.6]
THEN P05

Table 7 . Sequential Data CF Calculation Table 1

Symptom Code	CF Expert	CF Users	CFexpert * CFuser
G09	0.8	0.8	0.8 * 0.8 = 0.64
G12	0.8	0.8	0.8 * 0.8 = 0.64
G18	0.8	0.8	0.8 * 0.8 = 0.64
G19	0.8	0.8	0.8 * 0.8 = 0.64
G20	0.8	0.8	0.8 * 0.8 = 0.64
G21	0.6	0.4	0.8 * 0.4 = 0.24
G22	0.8	0.6	0.8 * 0.6 = 0.48
G28	0.6	0.6	0.6 * 0.6 = 0.36
G29	0.6	0.6	0.6 * 0.6 = 0.36

After all the symptoms in Rule 5 are calculated, then proceed with the following equation, namely CF combine. As calculated in table 8.

Table 8 . Sequential Data CF Calculation Table 1

Iteration	Cf combine = Cf1 + Cf2 * (1-Cf1)
1	0.64+0.64*(1-0.64) = 0.8704
2	0.8704+ 0.64*(1-0.8704) =0.95334
3	0.95334+0.64*(1-0.95334) =0.9832
4	0.9832+0.64*(1-0.9832) =0.99395
5	0.99395+0.24*(1-0.99395) =0.9954
6	0.9954+0.48*(1-0.9954) =0.99761
7	0.99761+0.36*(1-0.99761) =0.99847
8	0.99847+0.36*(1-0.99847) =0.999902

The final step is to find the percentage level of the confidence factor:

Cf percentage = 0.999902 * 100% = 99.99 %

From the process of tracing the rule and calculating the certainty factor, it was found that the patient was identified as experiencing a type of sensitive facial skin problem with a confidence level of 99.99%.

3.4 Results

The results of the expert system can be seen in the application via a computer device with a web browser (Mozilla or Google Chrome), users of the expert system can easily consult on facial skin problems experienced, before conducting patient consultations, they are required to create an account first, and continue to consultation. The following is the display of an expert system for diagnosing facial skin problems:

1. Home Page Display

This page will display the main page of the expert system which contains several menus that can be selected by visitors and users such as homepage, information, instructions, register, and login. Here's a picture of the home page view :

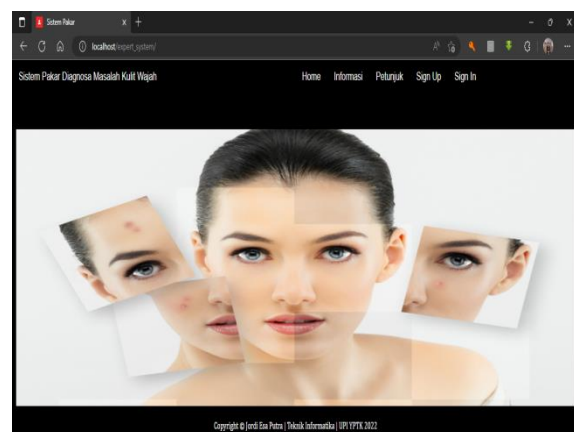


Figure 2Display Main Page

2. Display Instructions Page

The instructions page will appear after visitors press the instructions menu in the header section, the following is the instructions page display:

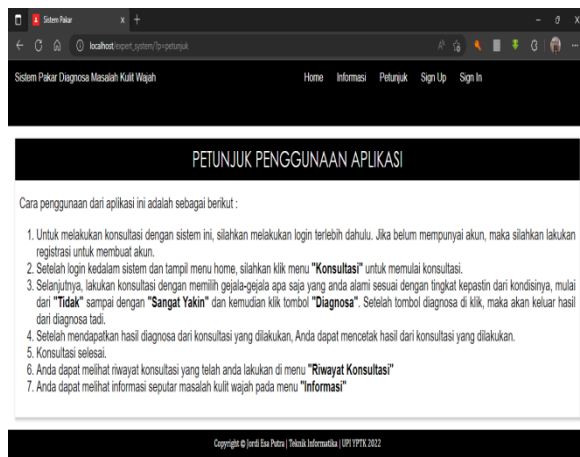


Figure 3 Display Instructions Page

3. Display Registration Page

Sign-up page will appear after the visitor presses the *sign up* menu on the *header* section , the following is the display of the *sign up* page .

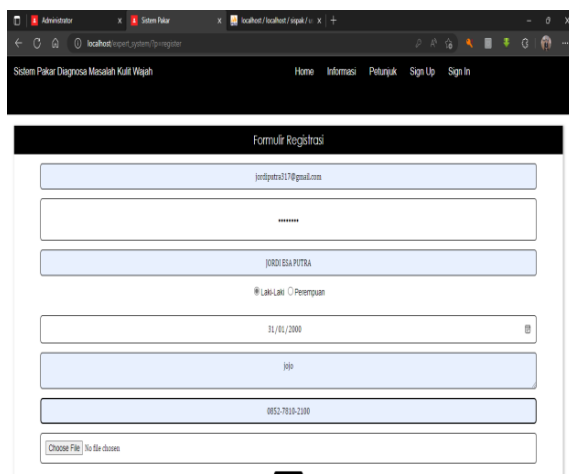


Figure 4 Display of the Registration Page

4. Login Page Display

sign-in page will appear after the visitor presses the *sign-in* menu in the *header* section, the following is the *sign-in* in page display :

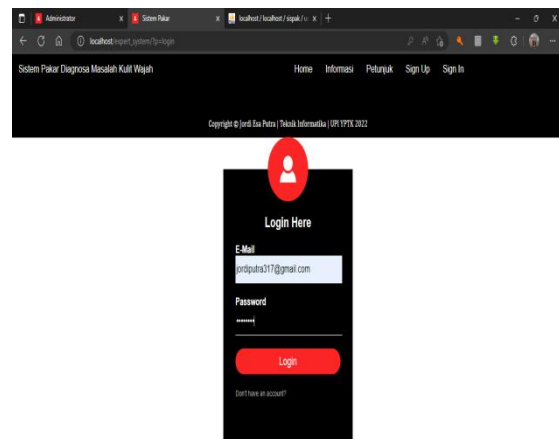


Figure 5 Display of the Login Page

5. Consultation Page Display

The consultation page will appear after *the user* presses the consultation menu in the *header* section *user* , the following is the view of the consultation page:

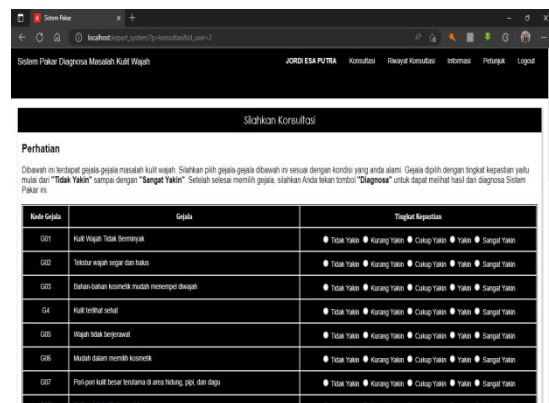


Figure 6 Display of the Consultation Page

6. Display Consultation Results Page

The consultation results page will appear after *the user* consults on the *header* section *user* , the following is a page view of the results of the consultation:

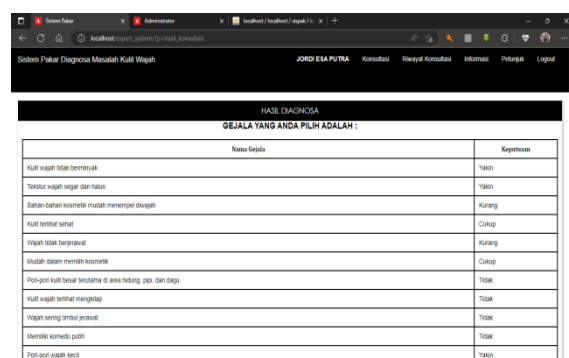


Figure 7 Display of Consultation Results

4. Conclusion

An expert system has been built to diagnose facial skin problems in humans, where this expert system is able to identify 5 types of facial skin problems in humans based on the symptoms experienced. This expert system can be an alternative to consulting to find out the types of facial skin problems and treat them early. This expert system has an accuracy rate of 99.90% based on expert interpretation.

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