

Expert System of Facial Skin Type Diagnosis and Skincare Recommendation Based on Certainty Factor

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Abstract - Facial treatment is an important need for everyone because the first sight of meeting someone is to see their face. Generally, facial skin type is just normal skin. However, several factors such as the environment, air, food, facial hygiene, and so on can affect the type of human facial skin. In this experiment, there were 5 types of facial skin, namely normal skin, dry skin, oily skin, combination skin, and sensitive skin. With the existence of various skin types, it makes some people confused in determining the type of facial skin. This also affects the selection of skincare or facial care according to the indications of each facial skin. Therefore an expert system was created to diagnose facial skin types. An expert system is a man-made system that is used to solve problems like an expert with knowledge from human to computer, although it does not give 100% absolute results, but expert systems are still helpful.

Keywords – Facial care, skin type, certainty factor, skincare

1. INTRODUCTION

The skin is the outermost part that is very important to coat and protect the human organs. In addition, the skin also acts as an indicator of a disease. In the human body there is a skin that protects the outermost organs. Facial skin is the skin that gets the most attention in treatment because it is a symbol of beauty. Facial skin protects important organs in the head such as the eyes, nose, mouth, facial muscles, and others. In general, human facial skin is of normal type but is influenced by several factors that make several types of facial skin, namely normal, oily, dry, combination, and sensitive skin. Facial care is now one of the important needs to maintain the beauty of facial skin. Not only among teenagers, even parents are now starting to realize the importance of maintaining and caring for facial skin beauty. Various efforts have been made to treat facial skin, namely by making threats or using skincare [1], [2]. The use of skincare consists of various stages such as the use of face wash, toner, sunscreen, night cream, serum, etc. The treatment provided must of course be adjusted to facial complaints and user needs.

Along with the development of the era, facial care products are very easy to find in the market. We can find a wide variety of beauty brand products at the nearest store. With the variety of facial skin types, some people are confused and even wrong in choosing the type of

skincare that suits their facial skin [3]–[7]. Consultation with a dermatologist is needed to get the right recommendation. However, many people are constrained by time if they have to wait and queue at the beauty clinic. Some beauty clinics sell skincare products online. Of course, the consultation is also carried out online through a beauty consultant for further submission to a skin specialist. Due to the large number of patients waiting for the results of the consultation, a system is needed to assist the dermatologist in carrying out the diagnosis [2], [6], [8]–[10]. This is intended to make the consultation process run more effectively and produce the right diagnosis. Based on these problems, a system was created that worked like an expert in making patient consultation decisions based on existing complaint data.

An expert system [2], [3], [11] is a human imitation system that is used to solve problems like an expert with knowledge from humans to computers. A job that can be repeatedly replaced by a computer system in helping to solve problems in everyday life. Forward Chaining Method, Certainty Factor Method, Naïve Bayes Method, are several methods that can be used to diagnose facial skin types. Certainty Factor (CF) [9], [12], [13] has been implemented in this experiment. The CF method performs human-to-computer reasoning to solve problems like an expert to get the results of a belief value diagnosis. In the calculation of the CF method, the result of combining the highest CF expert and user CF values will be the answer or diagnosis result. This method is suitable for use in expert systems that contain uncertainty and in one calculation process can only process 2 data so that the data can be maintained. However, it must be processed several times if using more than 2 data. For this reason, this study will only process data in one processing. This application is one of the expert systems created to assist the task of beauty specialist doctors in diagnosing the patient's skin type. Included in this system are the appropriate products to overcome these problems. Product recommendations currently only take one brand of beauty clinic, namely Drwskincare. Diagnosis and product recommendations are given according to the patient's complaints and needs during the consultation. So that online consultations through beauty consultants who are forwarded to doctors do not need to queue too long to wait for the results of the diagnosis.

2. RESEARCH METHOD

2.1. State of The Art

An initial review was carried out on Yovita Kinanti Kumarahadi's research has been resulted in a system that can help users or the public determine their skin type so that they get treatment that matches the identification of 91% [7]. However, there are also shortcomings in this study, namely when tested only the blackbox method was carried out and also had not cross-checked with the related esthetician as an expert. Further review of Indyah Hartami Santi's [8]. This test is intended for female respondents, all of whom are not familiar with their skin type. Produce 95% who need an expert system and 76% need the role of a dermatologist or aesthetic doctor. Whereas with this system 88% said the design was attractive, 91% said it was easy to use, and 98% said it was as desired. Then a review was carried out on Nia Nofia Mitra's research [5]. This study uses the Certainty Factor method to identify the type of allergic disease on the skin of toddlers. The test was carried out with 8 data. Identification of indications produces an accuracy rate of 100% which means the system is running very well. The fourth review of Suharjono's research [1]. In this study, testing was carried out on 8 data. Further research was conducted to produce an accuracy value of 87.5% which means this system is appropriate. The system runs and evaluates according to expert diagnoses. The results of the Certainty Factor value are also in accordance with the calculations carried out

manually when analyzing the expert system. The last review of Rangga Pebrianto's research [6]. The existence of this application makes it easier to consult and check because it is only by opening it via an android phone. The system will provide the right skincare recommendations as a solution to complaints during diagnosis using the Certainty Factor method. Consultation can be done in a timely manner because it is assisted by the system.

In this study, expert system had been made it easier for estheticians or dermatologists to diagnose facial skin types and proceed to skincare recommendations. Therefore, that online consulting services run more efficiently because they are supported by an expert system without waiting or queuing too long. This application uses the Certainty Factor method, which is one method that can identify a measure of certainty against facts to assess an expert's belief in solving a problem. This method was chosen because it is suitable for the identification process. This method performs calculations by multiplying the CF value on the expert and the CF value on the user so as to produce the final decision in the form of the combined value of the CF method. The results of the application of the Certainty Factor method are in the form of a percentage level of accuracy. As a consideration in this proposal, the conclusions of the studies that have been carried out by previous researchers has been included. The following table concludes the research that has been done by previous researchers as a consideration for the current research.

2.2. Expert System

An expert system is a computer-based system that takes events, reasoning and human knowledge so as to be able to solve existing problems as done by scientists or an expert in their field. In the 1970s, expert systems first appeared and were discovered by artificial intelligence scientists so that in the 1980s they were generally defined [3], [14], [15]. Expert systems are made based on existing rules in solving problems or making diagnoses. In the expert system has several characteristics in analyzing information on a problem, namely:

- a) Expert systems have limited capabilities according to experts or scientists' opinions.
- b) The results of the expert system diagnosis are not absolute yes or no. However, it contains a truth value based on the weights applied by scientists.
- c) Expert system refers to the rules that are in accordance with the direction of making and developing expertise.
- d) Have many answers or various solutions to the problems in the process.
- e) The expert system is able to perform uncertainty reasoning even though the data provided is incomplete.

The development of an expert system combines several rules with the value of expert certainty in drawing conclusions from expert opinions according to the field being studied. The expert in question is someone who is an expert in their field, for example a doctor, mechanic, psychologist, and so on. The purpose of the expert system is to assist the task of an expert in carrying out the diagnosis or recommendation process quickly and accurately. The conclusion or result of the answer still refers to the reasoning of the facts and data that have been used.

There are several main objectives of expert systems according to Lestari, 2012 namely Interpretation, Prediction, Diagnosis, Design, Planning, Monitoring, Debugging, Instruction, Control. Methods in the expert system include AHP (Analytical Hierarchy Process), Breadth First Search, BFS (Best First Search), DFS (Depth First Search), Forward Chaining, and Backward Chaining. The advantages of having an expert system can help effectiveness in a job that is done repeatedly. So that the results of the diagnosis or answer still provide accurate results according to expertise and can provide consistent results. The expert system works in real time so that it can provide reliability and fast response. With the existence of an expert system, consultations can be carried out easily and effectively, even if the distance is blocked. The

expert system cannot provide decision answers. This system will only perform diagnostic answers or recommendations that do not have an absolute yes or no value. In addition, the expert system also only handles a field according to the knowledge that has been applied. The costs involved in developing an expert system are quite expensive because of the limited data and experts.

2.3. Certainty Factor

The Certainty Factor method is a method for solving the problem of uncertainty with decision-making techniques and stating the results of answers or diagnoses based on data and opinions from scientists or experts. According to David McAllister's definition, Certainty Factor is a method in the form of a matrix used in processing the proof of definite and uncertain facts in an expert system [2], [9], [10]. Certainty Factor was first introduced by Shortliffe Buchanan in the manufacture of MYCIN. Certainty Factor is defined as the following equation (1).

$$CF(H,E) = MB(H,E) - MD(H,E) \quad (1)$$

Where :

CF (H, E): Certainty Factor from the value of H (Hypothesis) and to the effect of E (Evidence) so as to produce a value between -1 to 1. If -1 can mean a definite value of distrust while 1 means a definite confidence value.

MB (H, E): as a measure of increased belief to increase the size of the hypothesis's confidence in the evidence.

MD (H, E): as a measure of increased disbelief to increase the size of the hypothesis's distrust of evidence.

Therefore, it can be concluded that the basic conclusion of the Certainty Factor formula is the rule if Evidence (E) then appears the result of the Hypothesis (H) using equation (2). If all the values of E have known the certainty value, the equation can be changed as shown in equation (3).

$$CF(H,e) = CF(E,e) * CF(H,E) \quad (2)$$

Where

CF (H, e): the value of Certainty Factor on the Evidence affects the value of the hypothesis.

CF (E, e): the value of Evidence e affects the value of evidence E

CF (H, E): the value of Certainty Factor will be definite if CF (E, e) is worth 1 with the assumption of evidence on the hypothesis.

$$CF(E,e) = CF(H,E) \quad (3)$$

Where :

The value of CF(H,E) is the value in a rule given by an expert as a certainty value as a reference. While the value of CF (E, e) is the value of user certainty that is used as a reference in solving problems through the indication data.

The results of the diagnosis with indications of smooth skin, not shiny, not oily, and easy to choose skincare are normal skin types with a CF weight of 0.8. In its processing, the Certainty Factor method can only perform one calculation with two data. For this reason, if the data exceeds two, several calculations must be carried out. With these specifications, the accuracy of using the Certainty Factor method can be maintained. The Certainty Factor

method is also suitable for use in solving definite or uncertain problems such as disease diagnosis, skin type, product recommendations, and others.

2.4. Facial Skin Type

The face as one of the assets that we must protect and care for as gratitude for the gift of the Almighty. The face is also an organ of expression for getting to know each other, giving expression, and communicating. Everyone certainly craves healthy skin, especially the face as a symbol of beauty. Healthy facial skin is skin that is free of complaints or minimal complaints. Complaints in question such as acne, black spots, dullness, spots, and others [3], [9].



Figure 1. Knowing the 5 Types of Facial Skin

To overcome various facial complaints of course in balance with the type of facial skin. Because humans have several types of facial skin. In general, humans have normal facial skin types. However, with several factors such as place of residence, weather, facial complaints, water and oil content in the face, skin sensitivity to certain substances, resulting in other types of facial skin. Other facial skin types are oily, sensitive, and combination skin types. Here are the characteristics of 5 types of facial skin that we need to know, such as :

1. Normal Skin. Normal skin is generally human skin. The content of water and oil in the skin is balanced so that the skin looks smooth, supple, not too dry or too oily. Usually normal skin types have minimal facial complaints and are easy to care for compared to other skin types. This type of skin also has small pores and does not have blackheads. Looks radiant but not shiny like oily skin.
2. Dry Skin. Dry skin generally looks rough and sometimes peels off smoothly due to low levels of moisture in the skin. This type of skin has small pores that are not even visible, but the texture of this skin tends to be rough and scaly. Complaints on dry skin types in general are the skin looks dull. It can be affected by hormonal changes, side effects of medications, sun exposure, and the effects of cold weather. For dry skin, you should be diligent in using a facial moisturizer to minimize complaints.
3. Oily Skin. Oily skin looks smooth and shiny due to excess oil production in the skin. Usually this skin type has large pores and is prone to complaints of acne or pimples. In addition, this skin type is usually accompanied by blackheads, black spots, and dullness due to clogged pores. Factors that affect oily skin are genetics, hormonal changes, and stress.
4. Combination Skin. Combination skin is a combination of oily and dry skin. This type of skin is only oily in the T-section, namely the forehead, nose, chin, and dry cheeks. Combination skin types are affected by the development of puberty and hormones. For this reason, combination skin care must be able to reduce oil levels in the T section but also moisturize the cheeks.

5. Sensitive Skin. Sensitive skin is one of the most difficult skin to treat. Because this skin tends to turn red when using the wrong product or in the treatment. Will cause irritation in certain parts such as the edge of the nose, the edge of the mouth, and under the mouth or chin. This type of skin is very easy to peel and itch and even sting with redness. Occurs due to several factors, namely the environment, food, or the use of certain products.

Before doing facial treatments, we must know our skin type because humans have various skin types. This is to avoid mistakes in skin care so that complaints will not increase. To find out the right skin type along with recommendations for skincare products, you must come to the nearest beauty clinic or be consulted with an esthetician for precise and accurate results.

2.5. Dataset

In this study, the dataset was taken from the drwskincare online consultation group on social media Facebook. The data was taken and collected as many as 200 drwskincare patient data. In this data there are several variables, namely name, age, skin type, skin indication, night cream suggestion, day cream suggestion, facial wash suggestion, toner suggestion, and serum suggestion. So that this data can be used as a reference for determining skincare recommendations that are in accordance with the patient's skin type and skin indications. There are 4 variants of suggested night cream, 2 variants of suggestion of day cream, 4 variants of suggestion of facial wash, 3 variants of suggestion of toner, and 4 variants of suggestion of serum as shown in Figure 2.

No	Nama pasien	Usia	Jenis kulit	Indikasi Kulit	Saran Krim Malam	Saran Krim Siang	Saran Facial Wash	Saran Toner	Saran Serum
1	Ana	33	Kering	Bintik hitam, kusam	R Brightening	Sunscreen glowing	Pink Strawberry	Strawberry	Brightening Glow
2	Telia	35	Berminyak	Flek, beruntus	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Aha Bha
3	Evi	33	Normal	Flek, beruntus	R Acne Brightening	Sunscreen acne	White normal	Strawberry	Aha Bha
4	Ibaf	50	Kering	Flek tebal, kusam	R Brightening	Sunscreen glowing	Pink Strawberry	Chamomile	Brightening Glow
5	A Manik	62	Normal	Flek hitam, keriput	R Brightening	Sunscreen glowing	White normal	Strawberry	Brightening Glow
6	Ester	35	Normal	Kusam, banyak flek kecil	R Brightening	Sunscreen glowing	White normal	Strawberry	Brightening Glow
7	Ina	40	Berminyak	Wajah kusam, flek hitam	R Brightening	Sunscreen glowing	Hijau oily	Lime	Brightening Glow
8	Aisyah	29	Berminyak	Bekas jerawat, flek tipis	R Brightening	Sunscreen glowing	Hijau oily	Lime	Brightening Glow
9	Azkiyatul Aufi	28	Normal	Bintik hitam, beruntus, pori besar	R Acne	Sunscreen acne	White normal	Strawberry	Serum Acne
10	Asri Yuniati	30	Normal	Kusam, pori besar	R Glow	Glow sunscreen	White normal	Strawberry	Vit CE collagen
11	Siti Soniatun	24	Kering	Kusam parah	R Glow	Glow sunscreen	Pink Strawberry	Chamomile	Vit CE collagen
12	Amir	27	Berminyak	Bekas jerawat	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Aha Bha
13	Een rohaniah	34	Berminyak	Jerawat, flek	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Aha Bha
14	Ani	34	Berminyak	Flek, Jerawat	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Serum Acne
15	lia	32	Berminyak	Jerawat, bekas jerawat	R Acne	Sunscreen acne	Hijau oily	Lime	Aha Bha
16	Siska	27	Berminyak	Jerawat, kusam	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Aha Bha
17	Erna	36	Berminyak	Jerawat, bekas jerawat, kusam, flek tipis	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Aha Bha
18	Yessy Rahmawati	17	Kombinasi	Bekas jerawat, kusam	R Acne Brightening	Sunscreen acne	Tea tree oil	Lime	Aha Bha
19	Desi Ratnasari	26	Kombinasi	Jerawat	R Acne	Sunscreen acne	Tea tree oil	Lime	Serum Acne
20	Yuli	28	Normal	Beruntus, jerawat	R Acne	Sunscreen acne	White normal	Strawberry	Serum Acne
21	Yenni	62	Kering	Flek menahun, pori besar, kusam	R Brightening	Sunscreen glowing	Pink Strawberry	Chamomile	Brightening Glow
22	Ninik	30	Berminyak	Bekas jerawat, pori besar, flek sedikit	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Aha Bha
23	Purwanti	33	Normal	Beruntus	R Acne	Sunscreen acne	White normal	Strawberry	Serum Acne
24	Prapti	50	Normal	Flek hitam	R Brightening	Sunscreen glowing	White normal	Strawberry	Brightening Glow
25	Nur Karomah	21	Berminyak	Beruntus, bekas jerawat, komedo, kusam	R Acne	Sunscreen acne	Hijau oily	Lime	Serum Acne
26								
27								
.....									
.....									
.....									
.....									
170	Lidya Novitasari	22	Kombinasi	Kusam, kulit gelap	R Glow	Sunscreen glowing	Tea tree oil	Lime	Vit CE collagen
171	Rohmah	23	Normal	Flek hitam	R Brightening	Sunscreen glowing	White normal	Strawberry	Aha Bha
172	Novi nur	27	Berminyak	Kadang berjerawat, kusam	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Vit CE collagen
173	Kartika enggar	24	Berminyak	Jerawat, bekas jerawat	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Vit CE collagen
174	Kanaya	44	Sensitif	Kadang berjerawat, memerah	R Acne Brightening	Sunscreen acne	Pink Strawberry	Chamomile	Serum Acne
175	Rahma sani	27	Normal	Kusam dan kurang cerah	R Glow	Sunscreen glowing	White normal	Strawberry	Vit CE collagen
176	Lintir riyani	54	Normal	Flek di pipi	R Brightening	Sunscreen glowing	White normal	Strawberry	Brightening Glow
177	Mia safitri	23	Berminyak	Bekas jerawat, merah di pipi	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Aha Bha
178	Syifa izzatin	22	Normal	Kusam, kurang cerah	R Glow	Sunscreen glowing	White normal	Strawberry	Vit CE collagen
179	Siswati	38	Berminyak	Berjerawat	R Acne	Sunscreen acne	Hijau oily	Lime	Serum Acne
180	Atika	40	Normal	Flek hitam, kusam	R Brightening	Sunscreen glowing	White normal	Strawberry	Brightening Glow
181	Siswanti	35	Normal	Pori besar, kusam	R Glow	Sunscreen glowing	White normal	Strawberry	Vit CE collagen
182	Anis syafa	20	Kombinasi	Sensitif berjerawat, bekas jerawat	R Acne Brightening	Sunscreen acne	Tea tree oil	Chamomile	Aha Bha
183	Bella graceva	24	Kombinasi	Bekas jerawat di pipi	R Acne Brightening	Sunscreen acne	Tea tree oil	Lime	Aha Bha
184	Yuni	22	Normal	Kusam, warna tidak merata	R Glow	Sunscreen glowing	White normal	Strawberry	Brightening Glow
185	Ngatini	50	Berminyak	Jerawat ringan, bekas jerawat	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Aha Bha
186	Naswa	33	Berminyak	Jerawat, bekas jerawat, kusam	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Aha Bha
187	Aprianto	45	Normal	Flek hitam, bintik hitam	R Brightening	Sunscreen glowing	White normal	Strawberry	Brightening Glow
188	Aira	41	Normal	Bintik hitam banyak	R Brightening	Sunscreen glowing	White normal	Strawberry	Brightening Glow
189	Atika	38	Normal	Flek hitam	R Brightening	Sunscreen glowing	White normal	Strawberry	Brightening Glow
190	Rikha	25	Normal	Komedo, kusam	R Glow	Sunscreen glowing	White normal	Strawberry	Vit CE collagen
191	Ana disyana	27	Berminyak	Jerawat, bekas jerawat	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Serum Acne
192	Susi	35	Kombinasi	Bekas jerawat, pori besar	R Acne Brightening	Sunscreen acne	Tea tree oil	Lime	Aha Bha
193	Ella	28	Normal	Kusam, kurang cerah	R Glow	Sunscreen glowing	White normal	Strawberry	Vit CE collagen
194	Okta tegal	33	Normal	Flek hitam	R Brightening	Sunscreen glowing	White normal	Strawberry	Brightening Glow
195	Umi sholikatus	45	Berminyak	Jerawat, bekas jerawat	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Aha Bha
196	Siti wedari	34	Berminyak	Pori besar, kusam, bekas jerawat	R Acne Brightening	Sunscreen acne	Hijau oily	Lime	Aha Bha
197	Dian Putri	46	Normal	Flek membandel	R Brightening	Sunscreen glowing	White normal	Strawberry	Brightening Glow
198	Noventiro	25	Normal	Noda hitam, kusam	R Glow	Sunscreen glowing	White normal	Strawberry	Vit CE collagen
199	Jihantika	23	Kombinasi	Bintik hitam di pipi	R Glow	Sunscreen glowing	Tea tree oil	Strawberry	Brightening Glow
200	Vita ayu	36	Berminyak	Jerawat meradang, bekas jerawat	R Acne	Sunscreen acne	Hijau oily	Lime	Aha Bha

Figure 2. Sample Datasets

2.6. Proposed Method

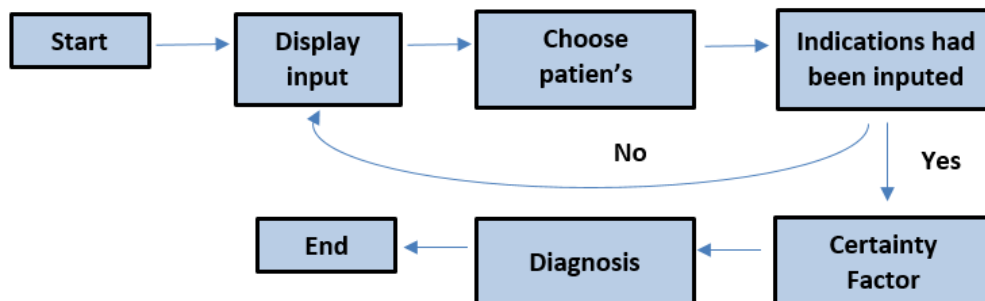


Figure 3. Proposed Method

Based on Figure 3, the proposed method has been describe as follows :

1. Starting from displaying the question display that contains indications that may occur.
2. After that, with the choice of indications, the user chooses according to the patient's complaints.
3. Furthermore, if the indications run out or have been filled in all, the system will process it by calculating the CF, if not then repeat to the original question until you find the appropriate complaint.
4. Calculation of CF by the system with existing algorithms and calculations according to the expert system.
5. To further display the results of the diagnosis that have been processed by CF and are in accordance with expert opinion.
6. Done. The system has been running smoothly with the results of values with weight considerations.

3. RESULTS AND DISCUSSION

3.1. Determination of Indication Weighting

After collecting data on indications into a table, the CF value is weighted. The weight value ranges from 0 to 1. A value of 0 is for those who do not know, a value of 0.2 is not sure, a value of 0.4 is not sure, a value of 0.6 is quite sure, a value of 0.8 is sure, and a value of 1 is very sure. Based on Figure 2, the weighting for each skin type can be carried out as shown in Table 1 and Table 2. The MB (Measure of Increased Belief) value is a measure of the increase in the confidence of an expert in diagnosing skin type based on existing indications. While the value of MD (Measure of Increased Disbelief) is a measure of distrust of these indications.

Table 1. Knowledge Based

No.	Skin Type	Code	Skin Indication	Measure of Increased Belief	Measure of Increased Disbelief
1	Normal skin	I001	Not shiny & not slippery	0.8	0.2
2	Normal skin	I002	Smooth & healthy	0.6	0.0
3	Normal skin	I003	No acne / breakouts	0.6	0.2
4	Normal skin	I004	Fine pores	0.8	0.4
5	Normal skin	I006	Easy to choose skincare	0.8	0.4
6	Normal skin	I017	Black spots / black spots	0.6	0.4
7	Dry skin	I001	Not shiny & not slippery	0.8	0.0
8	Dry skin	I004	Fine pores	0.8	0.2
9	Dry skin	I007	Looks dull and rough	0.8	0.4
10	Dry skin	I008	Skin looks scaly	0.6	0.2
11	Dry skin	I009	Smooth wrinkles	0.8	0.2
12	Dry skin	I020	Thin skin texture	0.6	0.4
13	Oily skin	I005	Big pores	0.6	0.2
14	Oily skin	I010	Glowing skin	0.8	0.2
15	Oily skin	I011	comedoan	0.4	0.0
16	Oily skin	I012	Small pimples or breakouts	0.6	0.4
17	Oily skin	I013	Acne skin	0.8	0.2
18	Oily skin	I015	Acne scars	0.6	0.0
19	Combination skin	I005	Big pores	0.6	0.0
20	Combination skin	I011	comedoan	0.6	0.2
21	Combination skin	I014	Sometimes acne	0.4	0.0
22	Combination skin	I015	Acne scars	0.6	0.2
23	Combination skin	I016	Oily in the T	0.8	0.2
24	Sensitive skin	I004	Fine pores	0.6	0.4
25	Sensitive skin	I013	Acne skin	0.6	0.2
26	Sensitive skin	I018	Easy to blush	0.8	0.0
27	Sensitive skin	I019	Itchy and sore	0.8	0.2
28	Sensitive skin	I020	Thin skin texture	0.8	0.4

There are 5 types of facial skin and some indications of facial skin. These indications are also accompanied by complaints, therefore, in this system or application, knowledge of the description of each skin type is added. Because each skin type certainly has a different treatment. Therefore, there are some suggestions in facial care according to the type of skin.

Table 2. Skin Type Description and Suggestions

No.	Skin Type	Description	Suggestion
1	Normal Skin	Normal skin is generally human skin. The content of water and oil in the skin is balanced so that the skin looks smooth, supple, not too dry or too oily. Usually, normal skin types have minimal facial complaints and are easy to care for compared to other skin types. This type of skin also has small pores and does not have blackheads. Looks radiant but not shiny like oily skin.	Normal skin types are also easier to care for than other skin types. If your skin is normal skin type, you just need to regularly use a water-based moisturizer that is light and non-sticky to maintain the skin's natural moisture.
2	Dry skin	Dry skin generally looks rough and sometimes peels off smoothly due to low levels of moisture in the skin. This type of skin has small pores that are not even visible, but the texture of this skin tends to be rough and scaly. Complaints on dry skin types in general are the skin looks dull. It can be affected by hormonal changes, side effects of medications, sun exposure, and the effects of cold weather. For dry skin, you should be diligent in using a facial moisturizer to minimize complaints.	<ul style="list-style-type: none"> - Regularly use moisturizer for dry skin - Use bath products made from soft - Use a humidifier - Do not rub the skin too hard
3	Oily Skin	Oily skin looks smooth and shiny due to excess oil production in the skin. Usually, this skin type has large pores and is prone to complaints of acne or pimples. In addition, this skin type is usually accompanied by blackheads, black spots, and dullness due to clogged pores. Factors that affect oily skin are genetics, hormonal changes, and stress.	<ul style="list-style-type: none"> - Diligently wash your face with facial wash - Use astringent or toner after washing your face - Avoid touching your face with your hands - Using parchment paper - Opt for oil-free care products - Diligent shampooing
4	Combination Skin	Combination skin is a combination of oily and dry skin. This type of skin is only oily in the T-section. Combination skin types are affected by the development of puberty and hormones. For this reason, combination skin care must be able to reduce oil levels in the T section but moisturize the cheeks.	<ul style="list-style-type: none"> - Using special care products for oily skin on oily skin - Use moisturizer only on dry or normal skin - Choose products that contain AHA BHA
5	Sensitive Skin	Sensitive skin is one of the most difficult skins to treat. Because this skin tends to turn red when using the wrong product or in the treatment. Will cause irritation in certain parts such as the edge of the nose, the edge of the mouth, and under the mouth or chin. This type of skin is very easy to peel and itch and even sting with redness. Occurs due to several factors, namely the environment, food, or the use of certain products.	Identify and avoid factors that trigger skin irritation, such as hot or cold temperatures, exposure to dust, or irritating chemicals Use cleansers with natural ingredients that are good for sensitive skin, such as aloe vera, chamomile, or green tea

The products taken in this research are Drwskincare products. So that skincare recommendations that are in accordance with the results of the diagnosis, all come from drwskincare products referring to existing datasets. Product recommendations are only for basic treatments including Night Cream, Sunscreen, Facial Wash, Toner, and Serum. Some product criteria will be described in the following Table 3.

Table 3. Skincare Recommendation

No.	Skin Type	Night Cream	Sunscreen	Facial Wash	Toner	Serum
1	Normal Skin	RB, RG	Sunscreen glowing / acne	White	Strawberry	Bright glow
2	Dry Skin	RA, RAB	Sunscreen glowing / acne	Pink	Chamomile	Vit CE
3	Oily Skin	RA, RAB, RB	Sunscreen glowing / acne	Hijau oily	Lime	Acne
4	Combination Skin	RA, RAB, RB, RG	Sunscreen glowing / acne	Tea Tree Oil	Lime	Aha Bha
5	Sensitive Skin	RA, RAB	Sunscreen glowing / acne	Pink	Strawberry	Aha Bha

3.2. Certainty Factor Calculation

Certainty Factor (CF) is a method used to diagnose. This method was chosen because it is suitable for calculating the uncertainty in a problem. In calculating CF there are several conditions in different rules so that there are several formulas that can be used in calculations in this application according to the existing conditions:

Calculation Formula

1. If the values of CF1 and CF2 are both positive

$$CF_c(CF1,CF2) = CF1 + CF2 (1 - CF1)$$

2. If the values of CF1 and CF2 are both negative

$$CF_c(CF1,CF2) = CF1 + CF2 (1 + CF1)$$

3. If one of the values of CF1 and CF2 is negative

$$CF_c(CF1,CF2) = \{CF1 + CF2\} / (1 - \min\{|CF1|, |CF2|\})$$

Mrs. Wati wants to know the type of her facial skin so that she doesn't make the wrong treatment. The indications or characteristics of Mrs. Siswati's face are large pores, maybe yes, shiny facial skin is almost certain, blackheads are definitely yes, and acne prone skin is definitely yes. Based on the knowledge, then we got indication as shown in Table 4.

Table 4. Example Knowledge Based on Case

Code	Indication	Option	CF rule
I005	Big pores	Maybe yes	0.4
I010	Glowing skin	Almost sure	0.8
I011	comedoan	sure yes	1.0
I014	Acne skin	sure yes	1.0

A. Oily Skin

- Indication 1

Large pores : CFrule = 0.4

MB 0.6 ; MD 0.2

$CF_{lama} = MB - MD$

$$= 0.6 - 0.2 = 0.4$$

New CF = old CF * CFrule

$$= 0.4 * 0.4 = 0.16 \text{ (positive)}$$

- Indication 2

Glowing facial skin : CF rule 0.8

MB 0.8 ; MD 0.2

$CF_{lama} = MB - MD$

$$= 0.8 - 0.2 = 0.6$$

New CF = old CF * CFrule

$$= 0.6 * 0.8 = 0.48 \text{ (positive)}$$

- Indication 3

Comedo : CF rule 1.0

MB 0.4 ; MD 0.0

$CF_{lama} = MB - MD$

$$= 0.4 - 0.0 = 0.4$$

New CF = old CF * CFrule

$$= 0.4 * 1.0 = 0.4 \text{ (positive)}$$

B. Combination Skin Type

- Indication 1

Large pores : CF rule 0.4

MB 0.6 ; MD 0.0

$CF_{lama} = MB - MD$

$$= 0.6 - 0.0 = 0.6$$

New CF = old CF * CFrule

$$= 0.6 * 0.4 = 0.24 \text{ (positive)}$$

- Indication 3

Comedo : CF rule 1.0

MB 0.6 ; MD 0.2

$CF_{lama} = MB - MD$

$$= 0.6 - 0.2 = 0.4$$

New CF = old CF * CFrule

$$= 0.4 * 1.0 = 0.4 \text{ (positive)}$$

Indications 2 and 4 do not need to be calculated because there are no such indications in combination skin types.

[R1] : IF Large pores THEN combination skin
{Cf : 0.24}

[R3] : IF Komedoan THEN combination skin
{Cf : 0.4}

- Indication 4

Acne skin : CF rule 1.0

MB 0.8 ; MD 0.2

CFIama = MB – MD

$$= 0.8 - 0.2 = 0.6$$

New CF = old CF * CFrule

$$= 0.6 * 1.0 = 0.6 \text{ (positive)}$$

[R1] : IF Large pores THEN oily skin {Cf : 0.16}

[R2] : IF Glossy skin THEN oily skin {Cf : 0.48}

[R3] : IF Komedoan THEN oily skin {Cf : 0.4}

[R4] : IF acne prone skin THEN oily skin {Cf : 0.6}

Therefore :

- R1 and R2

$$CFc(CF1,CF2) = CF1 + CF2 (1 - CF1)$$

$$= 0.16 + 0.48 (1 - 0.16) = 0.5632 \text{ pers 1}$$

- R3 and R4

$$CFc(CF1,CF2) = CF1 + CF2 (1 - CF1)$$

$$= 0.4 + 0.6 (1 - 0.4) = 0.76 \text{ pers 2}$$

- pers1 and pers2

$$CFc(CF1,CF2) = CF1 + CF2 (1 - CF1)$$

$$= 0.5632 + 0.76 (1 - 0.5632)$$

$$= 0.895 \text{ or } 90\%$$

- Then R1 and R3

$$CFc(CF1,CF2) = CF1 + CF2 (1 - CF1)$$

$$= 0.24 + 0.4 (1 - 0.24)$$

$$= 0.544 \text{ or } 54\%$$

Notes :

Dry, sensitive, normal skin types are not counted because there is no indication for these facial skin types.

The results of the calculation are oily facial skin with the highest CF value of 90% and another possibility is combination skin type with a CF value of 54%.

3.3. Testing

Testing is done by comparing manual calculations with the system in the application. The results of manual diagnostics and CF values on the system are the same. In addition to testing by comparing the results, the expert system was also tested with several cases on the dataset. This expert system also includes a consultation history chart to find out the majority of the patient's facial skin as shown in Table 5.

Table 5. Testing Data

No	Patient's Name	Age	Skin Type	Skin Indication
1	A	18	Dry Skin	Dark spots, dull
2	B	22	Dry Skin	Thick flecks, dull
3	C	34	Dry Skin	Black spots, wrinkles
4	D	61	Oily Skin	Dull face, black spots
5	E	52	Normal Skin	Dark spots, freckles, large pores
6	F	44	Normal Skin	Dull, large pores
7	G	40	Oily Skin	Acne, acne scars, dullness, thin spots
8	H	21	Normal Skin	Black spots, smooth

9	I	20	Oily Skin	Blemishes, acne scars, blackheads, dullness
10	J	24	Sensitive Skin	Pimples, reddened, sore
11	K	32	Normal Skin	Black spots, prone to breakouts
12	L	38	Combination Skin	Dull, large pores, acne scars
13	M	37	Normal Skin	Black spots, no acne, smooth
14	N	40	Normal Skin	Black spots, no streaks
15	O	52	Normal Skin	Dull, acne scars

Based on 15 test data, the system produces 12 correct data according to the patient's skin type and 3 incorrect data or less according to skin type. The percentage of test results get 80% accuracy results so it can be concluded that the system is very good and has a high accuracy value.

4. CONCLUSION

An expert system for diagnosing facial skin types using the Certainty Factor Method can be used anywhere and anytime as long as there is an internet connection. This system can be used to help a beautician or beauty clinic to help diagnose the patient's facial skin type during a consultation. This system is not only for determining the type of facial skin but also contains material and knowledge about facial skin, both definitions and complete descriptions as well as handling and solutions if you have that skin type. There are recommendations for skincare brand Drwskincare that have been adapted to complaints and needs according to the indications of the patient's skin. The results of this study produce an expert system with a high accuracy value of 80% so that this system is very good for diagnosing according to experts.

This research cannot be separated from errors and shortcomings both in terms of writing, how to analyze, and the research process due to time constraints. For further research, other data mining methods can be used or by analyzing the comparison of several methods to find out which method is superior. This research can also be developed with other platforms for example for Android and also the system can be developed more complex accompanied by ways of dealing with or special treatment for the indications of the patient's face.

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