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Application of the Certainty Factor Method In Expert System Design Web-Based Skin Disease Symptom Diagnosis

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Abstract— With advances in science and technology, especially in the field of medicine, more and more sophisticated medical devices have been developed to fight disease or to detect disease early so that it can be treated more quickly. One of them is human skin disease. The problem occurs when many people think that skin disease is easy, even though it seems they realize that skin disease is very dangerous and can cause skin cancer, skin infections. The purpose of this research is to develop an expert system application that is capable of diagnosing skin diseases based on the symptoms observed using the "Certainty factor" method. A useful method for creating an expert system is the certainty factor. making this expert system produces an appropriate diagnosis from manual calculations with a program by giving weight and certainty values from experts, helping people to diagnose the type of disease they are experiencing so that the treatment is easily known.

Keywords— Certainty Factor, Sistem Pakar, waterfall, Kulit

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I. INTRODUCTION

The skin is the largest organ of the human body and is located outside which plays an important role. The skin is the organ of most of the human body and functions to protect against collisions and is the most sensitive part of the body because the skin is the organ of touch. Skin

health is important for the human body, sometimes skin disease health is considered unimportant, many people ignore health [1].

Skin disease is a common disease that is often suffered by people until now. Patients with skin diseases are currently inversely proportional to the availability of medical personnel because of the high cost of treatment. [2], Certainty Factor was chosen because this method can be accurate for diagnosing skin diseases at this time. Due to the limitations of medical personnel, doctors have developed applications that can diagnose skin diseases that people suffer from. Therefore the Certainty Factor Program was chosen with the aim of being able to help patients diagnose skin diseases based on the type of symptoms they are feeling.

In diagnosing disease, a system is needed to adopt human knowledge, so the computer can work like an expert. This application allows users to diagnose skin diseases before further procedures using the Certainty Factor. [3] implemented in the PHP programming language and MySQL as supporting data storage, this application will display symptoms of any skin disease. Have the final result of the application form based on the symptoms of the selected disease. This method is used to determine the results and the whole system is using the Certainty Factor.

According to previous research, the results of system implementation in diagnosing measles-rubella in children using the CF (certainty factor) method have been tested using black-box testing techniques. [4]. Based on previous research, the implementation of an expert system using the certainty factor method resulted in a tentative diagnosis of panleu disease in cats with veterinarians as experts. [5]. According to previous research, this research serves to diagnose ASD by optimizing each degree of membership in the fuzzy logic method with the Mamdani method approach [6]. Previous research has resulted in identifying facial skin types and providing appropriate treatment solutions for each facial skin type. Expert system for identifying facial skin types Certainty Factory Method [7]. Based on previous research, the system applies forward chaining and certainty factor to diagnose disease in broilers. [8]. Based on previous research, this is a web-based system that was originally created using the previous chain algorithm, then refined by combining the certainty factor and the Dempster Shafer algorithm. [9].

Based on the background that has been described, an expert system is planned and built using the certainty factor method. By converting expert knowledge into web-based interpretation so that people can consult directly, an expert system is needed to implement factor certainty methods in the diagnosis of human skin diseases.

II. RESEARCH METHOD

2.1 Certainty Factor

The confidence factor (CF) is a method that can show a fact has a certain value. Can be expressed in percentage. In processing, the method uses a formula [10]. When faced with a problem, there are many answers that are not entirely certain. This certainty factor can be in the form of a probability that depends on the outcome of the event. Unsafe results are due to two factors, namely unsafe rules and unsafe user responses to questions submitted to the system.[11] This is easily known in the disease diagnosis system, experts cannot determine exactly the relationship between symptoms and factors, patients cannot feel the symptoms for sure. Therefore, there are many possible diagnoses [12].

Certainty Factor shows certainty by facts and rules. Has the following formula [13] :

Table 2.1 Certainty Factor Formula

$CF[h,e]$	$MB[h,e] - MD[h,e]$
$CF[h,e]$	Certainty Factor
$MB[h,e]$	The measure of confidence in the hypothesis h, given evidence e (between 0 and 1).
$MD[h,e]$	A measure of distrust of evidence h, if given evidence e (between 0 and 1).

2.2 Sistem Pakar

Artificial intelligence is a subset of computing that makes computers behave like humans. The expert system itself is a computer system designed to emulate various aspects of an expert's abilities. The expert system retrieves knowledge optimally to imitate the problem-solving style of an expert [14][15].

2.3 Diagnosa Penyakit Kulit

Diagnosis is the process of examining something using certain methods and methods [16]. Diagnosis is done in order to find out whether a person has a disease, for example a human skin disease, based on the symptoms they are experiencing.

2.4 Jenis Penyakit Kulit

Skin disease is a skin condition caused by fungi, bacteria, viruses and infections. Skin disease is a very common infectious disease that affects people of all ages.[17] here I will make a diagnosis of skin disease in humans who have 22 types of skin disease.

2.5 Waterfall

The waterfall method is one of many SDLC models that are often used in developing information systems or software. This model adopts a structured and sequential approach.[18] Waterfall model steps include requirements, design, implementation, testing and maintenance.

2.6 Testing Scenario

There are two types of testing techniques, namely black box testing techniques (by executing programs) and data verification. The black box testing technique is done by simply running or maintaining a unit or model according to the running process. Data verification is a testing technique that compares the results of manual calculations with the results of applying an expert system to diagnose rice diseases, to see whether the results are normal or not. [19].

2.7 Research Place

This research conducted in Rumah Sakit Umum Haji Surabaya to collect data on symptoms of the disease, type of disease through a dermatologist or dermatologist at Hospital Umum Haji Surabaya.

2.8 Identification of problems

In the first step, the problems found in the research "Application of the certainty factor method in the diagnosis of human skin disease symptoms in a web-based expert system design" are identified or determined.

2.9 Data processing

When problem identification is complete, data collection occurs in two stages. Data collection was carried out based on books and journals regarding system planning, as well as interviews with skin disease experts and skin disease data.[20] In this research, the data collection stage was carried out in 2 ways, namely :

1. Interview

Disease data were obtained by this research through interviews with skin experts, namely Dr. Rahimah, SpKK Dermatologist at Hospital Umum Haji Surabaya.

2. Library Studies

Data collection in this study was carried out by library research by reviewing journals and references related to research, namely by gathering information about skin diseases, symptoms of diseases, as well as preventive measures and solutions for these diseases.

2.10 Use Case

The use case diagram is an illustration that shows the relationship between actors and systems. Use case diagrams can describe the communication that occurs between one or more actors with the system in question.[21].

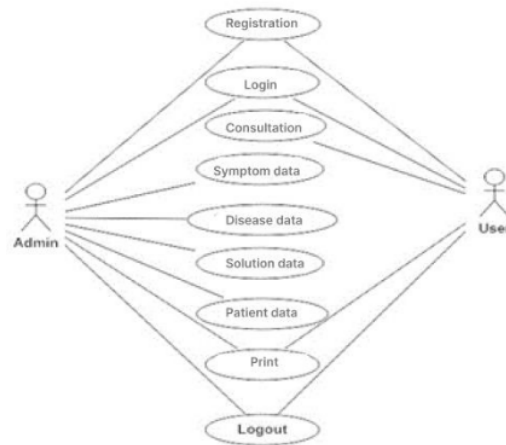


Figure 2.1 Use Case

2.11 Activity Diagram

This diagram shows the various functional flows by which the system is planned, with each flow being executed, what decisions can be made and how the results will be. [22] Activity diagrams can represent parallel processes that can occur across multiple operations. The following is an activity chart for diagnosing human skin diseases.

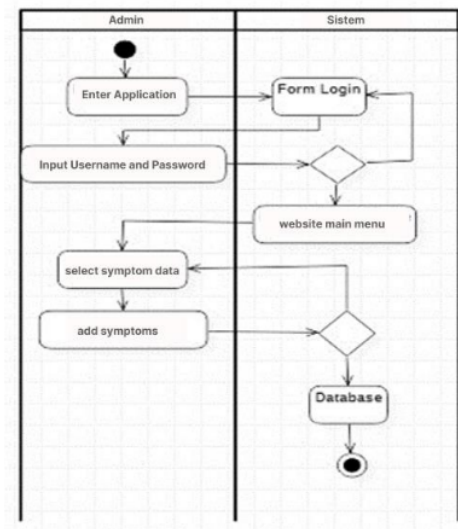


Figure 2.2 Activity Diagram

2.12 Sequence Diagram

Sequence diagrams are used to explain or show detailed interactions between objects in a system. Sequence diagrams can also show what messages or commands can be sent and how long they take [23].

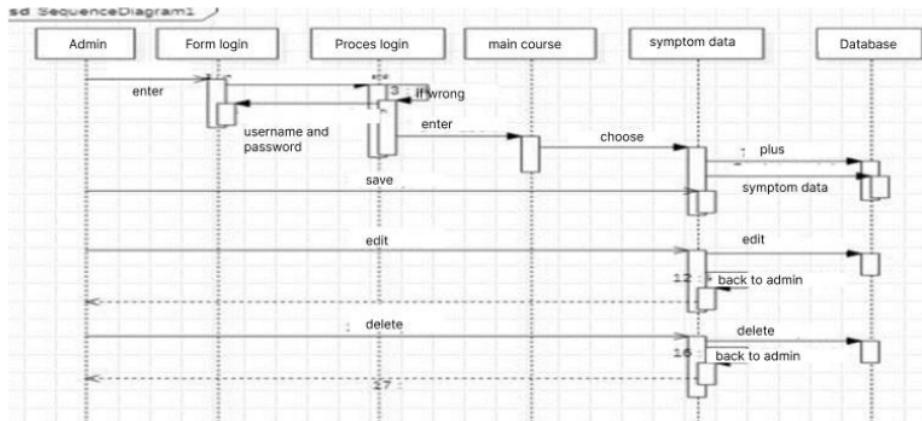


Figure 2.3 Sequence Diagram

2.13 Class Diagram

Class diagrams can help writers understand the structure of the system and make a good system design. Class diagrams show the static structure of several classes in a system [24].

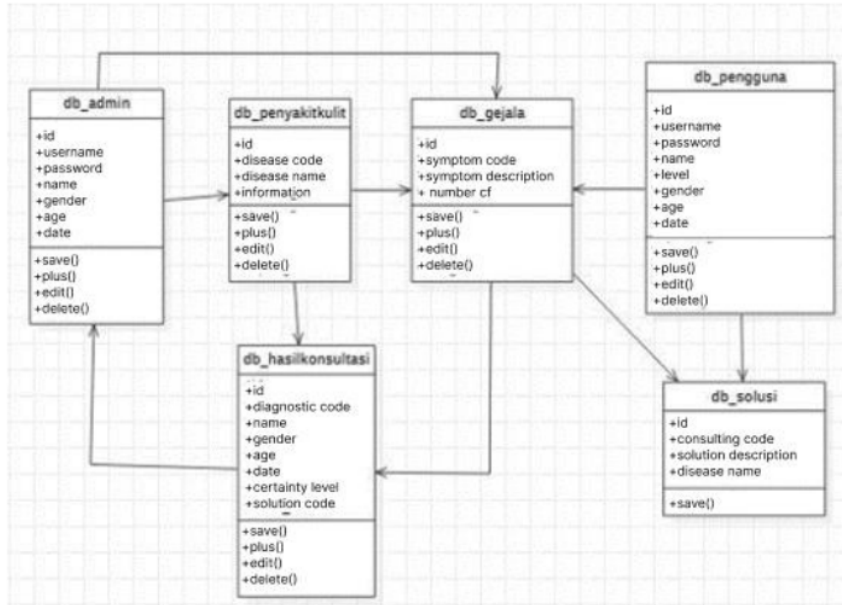


Figure 2.4 Class Diagram

III. RESULT AND DISCUSSION

3.1 Data processing

Qualitative method is a research technique that emphasizes analysis or descriptive. In the non-quantitative research process, the subjective perspective is more emphasized and theory is used as a guide by researchers to ensure that the research process is in accordance with the facts found in the field when conducting research. it adopts qualitative data processing methods as data processing methods.

3.2 Disease Symptoms Data Value

The data on the symptoms of this skin disease has a value based on the weight of the disease given by an expert or dermatologist at the hospital Umum Haji Daerah Surabaya as follows:

3.1. Table Assess Symptoms of Skin Disease

No	Code	Symptom Name	Mark
1.	G01	Nodules – Red and watery nodules	0,8
2.	G02	Lumps (nodules) filled with solid matter (blackheads) around the face, shoulders, upper chest and upper back	0,8
3.	G03	swelling	0,8
4.	G04	Lumps full of nana	0,8

5.	G05	Discomfort when swallowing	0,8
6.	G06	White sores that appear on the tongue	0,8
7.	G07	The inside of the mouth and throat is red.	0,8
8.	G08	The scabs are yellow and oily	0,8
9.	G09	Wounds on forehead, face, nose and shoulders	0,8
10.	G10	fever	0,4
11.	G11	Red rash with small red nodules filled with fluid on the face, especially around the nose and mouth	0,8
12.	G12	Swelling in the area of lymph nodes (lymph) (neck, collarbone, armpits, and groin)	0,8
13.	G13	Itchy	0,8
14.	G14	The lump (Round) breaks easily and forms a Collarette (a shallow wound with scales on the edge)	0,8
15.	G15	Weak and unwell and uncomfortable swallowing	0,4
16.	G16	Painful	0,8
17.	G17	Dizzy	0,8
18.	G18	Blisters appear on one side of the body	0,8
19.	G19	Pain in the <u>dermato</u> /nerve area	0,8
20.	G20	Scaly, peeling or cracked skin between the toes.	0,8
21.	G21	Burning or stinging sensation.	0,8
22.	G22	Blister.	0,8
23.	G23	Dry and scaly skin on the bottom of the feet.	0,8
24.	G24	Inflamed skin that may appear reddish	0,8
25.	G25	Small (round) lumps, especially on the edges of the rash around the groin, armpit skin and breast folds	0,8
26.	G26	The rash is accompanied by reddish spots	0,8
27.	G27	The surface of the patches is flush with the skin	0,8
28.	G28	Spots appear which then spread to the surrounding body area	0,8
29.	G29	The skin becomes dry and scaly	0,8
30.	G30	The skin becomes thick, dry	0,8
31.	G31	There is a lesion on the back of the foot	0,8
32.	G32	The appearance of a rash on the skin anywhere	0,8
33.	G33	Painful	0,8
34.	G34	ingernail pain	0,8
35.	G35	redness around the nail	0,8

36.	G36	swollen toes around the nails	0,8
37.	G37	the appearance of pus around the nails	0,8
38.	G38	Permanent redness of the skin.	0,8
39.	G39	The blood vessels under the skin are clearly visible.	0,8
40.	G40	Itchy skin and burning sensation	0,8
41.	G41	The surface of the skin becomes rough.	0,8
42.	G42	There is an eye problem.	0,4
43.	G43	The skin is cracked and sometimes bleeds.	0,8
44.	G44	Thickened nails with an uneven texture.	0,8
45.	G45	Joints feel swollen and stiff.	0,8
46.	G46	Redness is shaped like a line	0,8
47.	G47	blisters, skin crusts appear,	0,8
48.	G48	exfoliation	0,8
49.	G49	Red scalp and dandruff	0,8
50.	G50	Flaking skin or dandruff that occurs in the <u>mustache</u> , beard, or eyebrows	0,8
51.	G51	The eyelids are crusty or reddish in <u>color</u>	0,8
52.	G52	The scaly skin is white or yellow	0,8
53.	G53	Affects children with familial or hereditary allergies	0,6
54.	G54	lesions appear on the face	0,8
55.	G55	The skin is cracked and sometimes bleeds.	0,8
56.	G56	Thickened nails with an uneven texture.	0,8
57.	G57	Changes to an existing mole.	0,8
58.	G58	Development of new pigments or growths that appear unusual on the skin.	0,8

59.	G59	It can occur on skin that looks abnormal.	0,8
60.	G60	patches of discoloration to whiter	0,8
61.	G61	skin lesions in the form of lumps.	0,8
62.	G62	symptoms of numbness in that part and muscle weakness	0,8
63.	G63	Fatigue.	0,8
64.	G64	Joint pain, stiffness and swelling.	0,8
65.	G65	Butterfly-shaped rash anywhere	0,8
66.	G66	Skin lesions that appear or worsen with sun exposure.	0,8
67.	G67	Fingers and toes that turn white or blue when exposed to cold or during periods of stress.	0,8
68.	G68	Hard to breathe.	0,6
69.	G69	Pain in the chest	0,6
70.	G70	Dry eyes	0,8
71.	G71	Red Spots	0,4

3.2. Table of Skin Diseases

No	Nama Penyakit
P1	Acne Vulgaris (Jerawat)
P2	Abses (Bisul)
P3	Sariawan
P4	Impetigo Krustosa
P5	Impetigo Bulosa
P6	Varicella (Cacar Air)
P7	Herpes Zoster (Cacar Api)
P8	Tinea Pedis (Kurap Kaki)
P9	Candidosis Cutis
P10.	Pityriasis versicolor (Panu)
P11	Liken Simplek Kronis
P12	Urtikaria (Biduran)
P13.	Ingrown nails
P14.	Rosacea
P15.	Psoriasis
P16.	Dermatitis venenata
P17.	Dermatitis serboroik
P18.	Dermatitis Atopik
P19.	Psoriasis vulgaris
P20.	Melamona
P21.	Lepra
P22.	Lupus

3.3 Calculation of Certainty Factor

The Certainty factor algorithm will be used to find the confidence value. With MB and MD values taken from experts [25]. Consultants and Experts have the right to choose answers, each answer is weighted as follows:

3.3 Table of Disease Symptom Weights

Weight	Mark
No	0
Possible	0,2
Most likely	0,4
Almost certainly	0,6
Certain	0,8
Very Certain	1

Expert Certainty Value

G08	0,8
G09	0,8
G13	0,8
G10	0,4
G11	0,8

User certainty value

G08	0,8
G09	0,8
G13	0,8
G10	0,4
G11	0,8

$$\begin{aligned}
 CF[H,E] &= CF[H]_{G08} * CF[E]_{G08} && = 0,64 \\
 &= 0,8 * 0,8 \\
 &= 0,64 && CF[H,E] = CF[H]_{G10} * CF[E]_{G10} \\
 &&& = 0,4 * 0,4 \\
 CF[H,E] &= CF[H]_{G09} * CF[E]_{G09} && = 0,16 \\
 &= 0,8 * 0,8 \\
 &= 0,64 && CF[H,E] = CF[H]_{G11} * CF[E]_{G11} \\
 &&& = 0,8 * 0,8 \\
 CF[H,E] &= CF[H]_{G13} * CF[E]_{G13} && = 0,64 \\
 &= 0,8 * 0,8
 \end{aligned}$$

CFcombine CF [H,E]G08, G09

$$\begin{aligned}
 &= CF [H,E]_{G08} + CF[H,E]_{G09} * (1-CF[H,E]_{G08}) \\
 &= 0,64 + 0,64 * (1-0,64) \\
 &= 0,64 + 0,64 * 0,36 \\
 &= 0,64 + 0,2304 \\
 &= 0,8704
 \end{aligned}$$

CFcombine CF [H,E]Old, G13 S

$$\begin{aligned}
 &= CF [H,E]_{Old} + CF[H,E]_{G13} * (1-CF[H,E]_{Old}) \\
 &= 0,8704 + 0,64 * (1-0,8704) \\
 &= 0,8704 + 0,64 * 0,1296 \\
 &= 0,8704 + 0,082944 \\
 &= 0,953344
 \end{aligned}$$

CFcombine CF [H,E]Old2, G10

$$\begin{aligned}
 &= CF [H,E]_{Old2} + CF[H,E]_{G10} * (1-CF[H,E]_{Old2}) \\
 &= 0,953344 + 0,16 * (1-0,953344) \\
 &= 0,953344 + 0,16 * 0,046656 \\
 &= 0,953344 + 0,00746496
 \end{aligned}$$

$$= 0,953344 + 0,00746496$$

$$= 0,96080896$$

$CF_{combine} CF [H,E]_{Old3,G11}$

$$= CF [H,E]_{Old3} + CF[H,E]_{G11} * (1-CF[H,E]_{Old3})$$

$$= 0,96080896 + 0,64 * (1-0,96080896)$$

$$= 0,96080896 + 0,64 * 0,03919104$$

$$= 0,96080896 + 0,0250822656$$

$$= 0,9858912256$$

$CF_{Presentase} = CF_{Combine} * 100\%$

$$= 0,9858912256 * 100\%$$

$$= 98,59\%$$

14
Diagnosis of Crust Impetigo. Based on the results of the calculation above, the value of Crust Impetigo disease is 98.59%

3.4 Program View

- Prediction Results

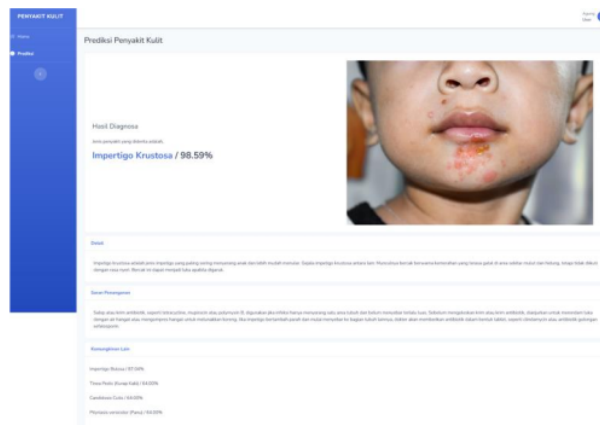


Figure 4.1 Prediction Results

From the display above is the result of the prediction of Crust Impetigo disease with a diagnosis of 98.59% as in the manual calculation above with the same result of 98.59%

- User Dashboard View



Figure 4.2 User Dashboard Display

In the display above is the dashboard menu on the user section which has a predictive feature for diagnosing skin diseases in humans

- Skin Disease Prediction Display



Figure 4.3 Display of Skin Disease Prediction

In the display above is the Skin Disease Prediction menu which contains a form for the user to fill in the symptoms of the skin disease being suffered, then after that the results of the percentage of the disease will appear as in the prediction results menu

- Admin Dashboard view



Figure 4.4 Display of the Admin Dashboard

In the view above is the dashboard menu in the admin section which contains several features, namely prediction features, diseases, symptoms, beliefs Assign Beliefs. Inside this application has a total of 22 diseases, 71 symptoms.

IV. CONCLUSION

Based on this research, it can be concluded that the implementation of an expert system using the Certainty Factor resulted in a diagnosis of skin disease by a dermatologist as an expert at the Regional Hajj Hospital in Surabaya. Where the value of symptom confidence and symptom classification at the level of skin disease is determined by an expert with a predetermined weight. The diagnosis of this skin disease has 22 kinds of diseases and 71 symptoms of skin diseases with the same results in the manual calculation matching experiment with program output with the same result of 98.59%. This proves that the diagnosis of this skin disease has been functioning properly. Suggestions for further research can make a diagnostic system with other methods and produce results that are more suitable and more complex.

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