

# Design and Build Expert System Application for Diagnosing Facial Skin Disease based on Android

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**Abstract:** Today, skin health is the main focus for women and men who want healthy, well-groomed and clean facial skin. The use of chemicals and other external materials allows potential disease for facial skin health. Diseases caused on the face are quite diverse from small to medium scale. The problem that often occurs in the community is the lack of knowledge and limited sources of information about facial skin health causing people to tend to let the disease happen. Based on the problems that have been described previously, this expert system was created to help the public understand the symptoms of facial skin diseases experienced and solutions to overcome these diseases. In the development of this expert system using the forward chaining method as the inference engine and the certainty factor method to determine the diagnostic confidence value. In designing this expert system application the user can choose the symptoms of facial skin diseases, then the output produced is the level of confidence, the possibility of the disease experienced and an explanation of the solution for the initial treatment of the facial skin disease. From the test results based on the Black Box, the results obtained 100% functionality runs according to the list of system requirements. In the accuracy test, a very good accuracy value is obtained, which is 100% of the 10 existing sample data.

**Keywords:** Android; Certainty factor; Expert system; Forward chaining; Facial skin disease.

## INTRODUCTION

Facial treatments are currently experiencing developments in the latest treatment methods. There are indications of the use of chemicals or other external materials that allow potential disease for facial skin health. Diseases caused on the face are so diverse ranging from small ones such as dry skin, dull face, acne to cancer (Santi & Andari, 2019). The problem that often occurs in the community is that they do not really understand if there are signs of disease on the facial skin and even tend to let it happen.

One of the factors that influence why many people just let things that interfere with facial health is the cost of consulting a skin specialist doctor is quite expensive (Aziz & Karpen, 2019). Then there are also limited hours of practical work as well as location, distance from experts or doctors. This situation can be resolved if they have knowledge related to facial health. This knowledge can be obtained from websites or books about facial skin health. However, to master and learn it is quite difficult because in addition to taking time to understand it, the available sources are not fully trusted when diagnosing the type of disease as a doctor does (Suryadi & M, 2015). Therefore we need a tool or technology that has the ability to diagnose diseases like a doctor.

Expert systems can be one solution to solve these problems because expert systems are able to adapt human knowledge (facial skin health experts) to implement problem solving abilities like an expert in the form of applications (Berliana, 2015). With an expert system, experts can treat patients more quickly and diagnose diseases effectively and accurately. Based on a study entitled "Combination of Certainty Factor and Forward Chaining Methods for Android-Based Facial Skin Type Identification" (Cahyaningsih, Triayudi, & Sholihati, 2021). In this study, the results obtained an accuracy of 99.45% which indicates that the expert system is functioning properly in accordance with expert diagnoses. With the level of accuracy that can be categorized as quite effective, it proves that the Forward Chaining method can be said to work quite well on Android-Based Facial Skin Type Identification.

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From the problems that have been described previously, the purpose of this research is to create a system that can replace an expert in the field of skin health in the process of diagnosing skin diseases on the face. The design of this expert system application uses the Forward Chaining and Certainty Factor methods. Forward chaining is used as a knowledge base, while the Certainty factor serves to provide a decision value based on the assessment of an expert. This system only limits 10 types of skin diseases on the face. The formulation of the problem in this study is how to design and implement an expert system for diagnosing facial skin diseases on Android-based smartphones with the intention that the wider community can detect diseases without having to meet with experts. This system is expected to help the general public who are not familiar with health sciences in diagnosing facial skin diseases in someone.

### LITERATURE REVIEW

Expert System is one part of Artificial Intelligence that contains knowledge and experience that is entered by one or many experts into a certain area of knowledge, so that everyone can use it to solve various problems that are specific (Darmayunata, 2018). Expert systems are applied to overcome problems that are difficult to overcome using conventional programming (Ginting & RMS, 2018). Expert systems have advantages which include allowing ordinary people to do the work of experts, and save time in decision making (Efendi & Sari, 2020). With an expert system, ordinary people can solve their problems or just look for quality information which can only be obtained with the help of experts in their fields (Ferdiansyah, Muflikhah, & Adinugroho, 2018). The components contained in the structure of the expert system are: User Interface, Knowledge Base, Knowledge Acquisition, Inferential Engine, Explanation Facility, and Knowledge Improvement (Kurniawan, 2018).

Forward Chaining (FC) is a method in the Expert System in doing reasoning starting from existing facts to get conclusions from these facts. That is by matching the premise with existing facts to get new facts and so on until the goal is reached or until there are no more premises that match the known facts or facts obtained (Sinaga et al., 2018). FC is a technique of tracking existing information and combining rules to produce a conclusion or goal. The FC method is very good if it works with problems that start from recording initial information and you want to achieve a final solution, because the entire process will be carried out in a forward sequence (Fanny, Hasibuan, & Buulolo, 2017).

Certainty Factor (CF) is a method of combining belief and distrust in a single number by using a value to assume the degree of confidence of an expert on a data, usually the result of the CF method is in the form of a percentage. CF theory is a theory used to accommodate the uncertainty of thought (inexact reasoning) from an expert (Sulistiani, Alita, Yasin, Hamidy, & Adriani, 2021).

Facial skin disease is a disease that attacks the surface of the face and is caused by various causes. Facial skin diseases have a variety that will show variants in symptoms and severity and may display some unique characteristics. Types of facial skin diseases can range from barely noticeable to life threatening (Pebrianto, Nugraha, & Gata, 2020). Facial skin can be caused by living things such as bacteria, viruses and fungi. Bacteria, viruses and fungi infect the skin and can damage facial skin (Aryani, Divayana, & Wirawan, 2017). Types of skin diseases include Rosacea, with symptoms of reddish skin, excessive spots appear, swelling, Skin Tag, the symptoms are small lumps in the form of enlarged oil glands, yellowish red color, Milia, the symptoms are small white spots, growing on the skin. eyelids and cheeks, acne, the symptoms are red lumps, and when it is ripe it will contain a yellow liquid (Efendi & Sari, 2020).

### METHOD

The research flow describes the sequence of research to be carried out starting from the data collection stage to system testing. The research flow is drawn in Figure 1 below.

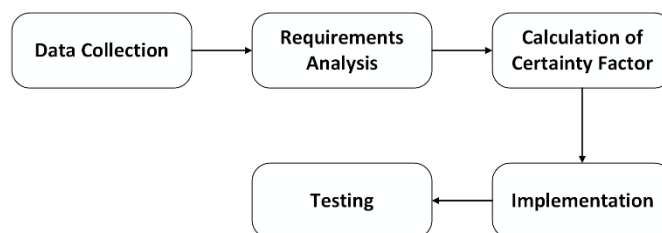


Fig 1. Research Framework

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### Data Collection

The data obtained in this study are symptom data and disease data to determine the value of expert CF from dermatologists and the methods of handling or solutions that have been given. In this step, collect data about the symptoms of diseases on the facial skin through interviews with an expert on facial skin diseases, namely dr. Irma Harahap, Sp.KK from Avicenna Beauty Clinic.

### Requirements Analysis

The system requirements used in the development of this expert system are: knowledge base, inferential engine, forward chaining method, and certainty factor method..

### Certainty Factor

To get the results of a fact using the CF method, it is used to determine the CF value of the Expert first a symptom of a facial skin disease to get the value of the CF rule. The confidence value obtained from the calculation is the value determined by the expert multiplied by the user's CF. The steps for calculating the CF method are: Determine parallel CF, Determine sequential CF, Determine combined CF, and Determine percentage CF.

### Implementation

The implementation stage is the process of converting the system design into program code. Writing program code using the Java and PHP programming languages. Programming is done using IDE Visual Studio Code and Android Studio.

### Testing

The tests that will be used are Black Box testing and Accuracy testing.

## RESULT

Recommendations are solutions given to the system for the results that have been carried out. Solutions are sourced from experts and several other literature studies. Solutions for facial skin diseases can be seen in Table 1.

Table 1. Recommended Solution

Disease	Solution
Acne Vulgaris	The initial treatment solution is do not get rid of pimples by squeezing them, because that will spread bacteria and cause scar tissue. The best way to deal with it is to keep the area around it free of bacteria and dead skin cells, reduce the activity of staying up late and reduce the consumption of eating junk food
Melasma	The first solution for melasma can be treated in various ways, reducing or stopping the use of contraceptives and birth control pills. However, if these spots are experienced for years, you should immediately seek treatment and medical action
Nevus Melanositik	The first solution of this disease if you want to be removed it is necessary to do therapy. The treatment itself is simple excision of the nevus
Syringoma	Solutions to treat this disease include the use of drugs from trichloroacetic acid, laser surgery with red light waves, cryotherapy, demabrasion and surgical excision
Milia	The first solution to this disease is to regularly clean your face, reduce the use of heavy make-up, and regularly consume fruits and vegetables.
Rosacea	The first solution to this disease is to clean the facial skin carefully on a regular basis, using sunscreen before going outside. Compress the diseased area with cold water and eat healthy foods such as fruits and vegetables
Xanthelasma	The first solution to this disease is to perform medical procedures in the form of surgical excision, chemical cauterization, cryotherapy, and laser ablation.
Keratosi Seboroik	The solution for this disease is to perform medical procedures including cryosurgery, electrosurgery, curettage and ablation
Basalioma	The solution for this disease is to carry out medical procedures in the form of electrodefication and curettage, surgical separation, cryotherapy, and Mohs surgery
Melanoma	The solution to this disease is surgical removal of melanoma cells. The level of

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surgery also depends on the level of the stage

With the discovery of disease symptoms on the facial skin and the inference method used, namely Forward Chaining, then the symptoms that arise or appear will make it easier to make a Decision Tree or a decision tree about disease determination. Figure 2 is a Decision Tree image to determine the disease based on the symptoms that appear.

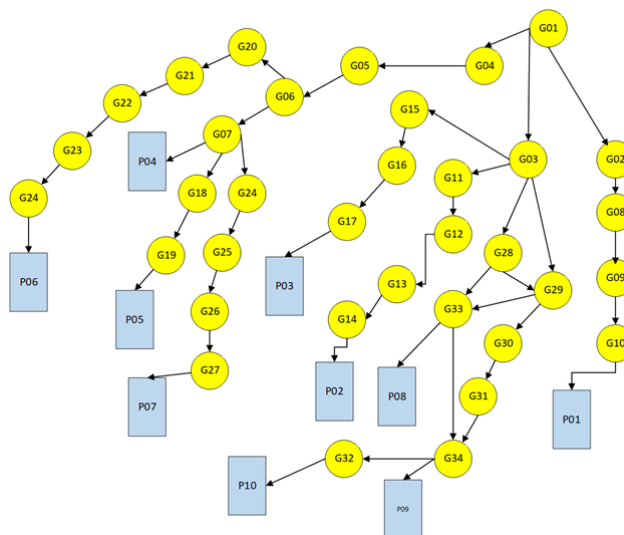


Fig 2. Decision Tree

In this application, to perform a diagnosis using the inference method, namely forward chaining. The data used in the inference is obtained from the answers provided by the users. the application displays all symptom data, so that later if the user uses the quick diagnosis menu, it will be directed to choose a symptom option based on the perceived "Yes" or "No" symptoms according to the symptoms experienced. Meanwhile, if you choose an accurate diagnosis menu, the user will be directed to choose a symptom option based on the user's level of confidence in the symptom, where there are options such as "No", "Not Sure", "Slightly Sure", "Quite Sure", "Sure", "Very sure". The table used in the inference process is the rule table.

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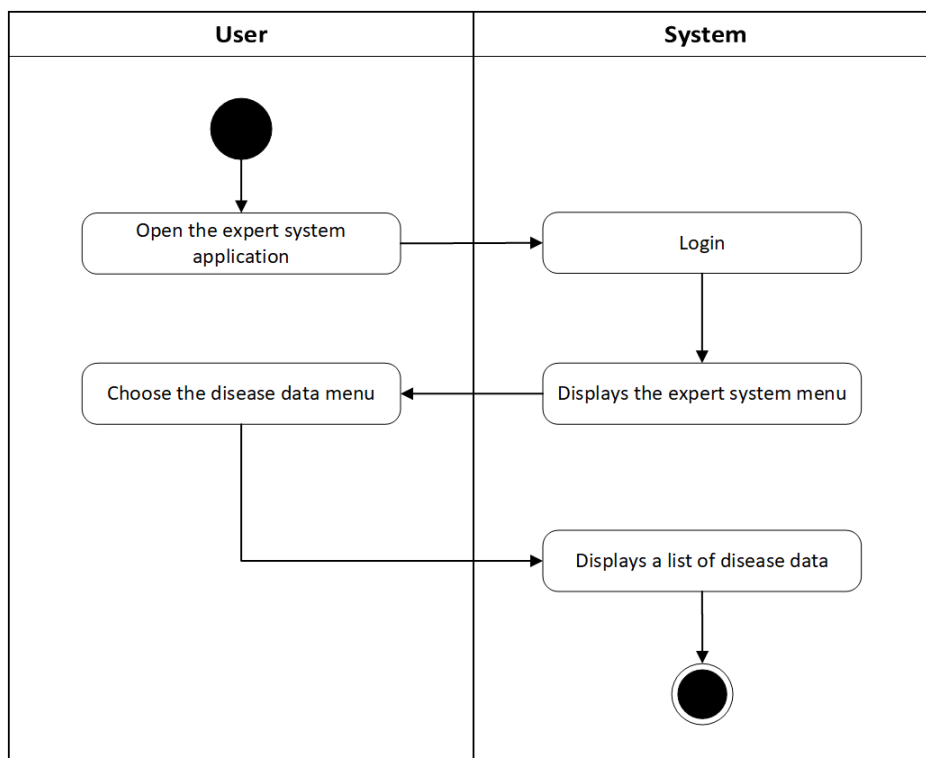


Fig 3. Activity Diagram List of Diseases

Activity diagram of the disease list to explain the sequence of activities or program flow on the disease list feature for the user. Activity Diagram disease list has two partitions, namely user and system.

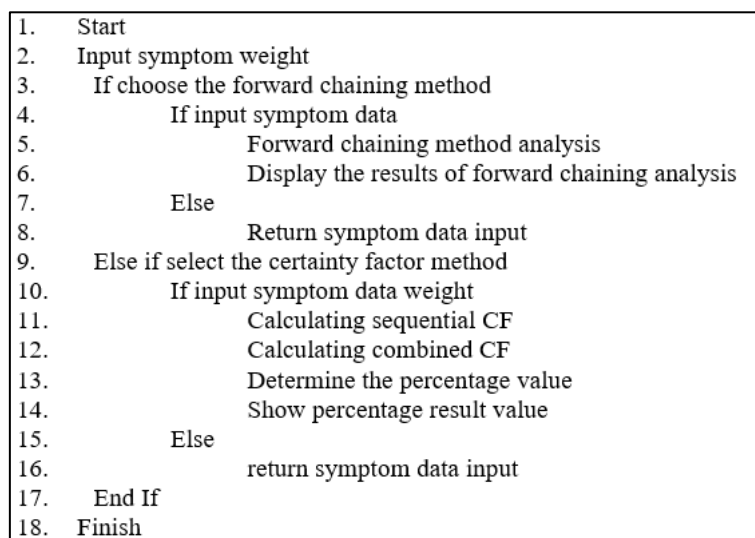


Fig 4. Expert System Algorithm

Expert system algorithms are used to explain the expert system process in a structured manner based on the flow of the expert system program that is applied.

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Fig 5. Dashboard User

Figure 5 is a screen display of the user dashboard page or the main display, this display will appear the first time when the user successfully logs in there are several option buttons to move to other menus such as quick diagnosis, accurate diagnosis, disease data, diagnostic history list, application guide for user and logout. The purpose of this user dashboard is as navigation for users in this application.

Black Box testing is done by testing every activity contained on the login page. Tests and results of the login page Black Box test in Table 2.

Table 2. Black Box Testing Login Page

Testing Activities	Expected Output	Results
Enter the correct login data, then click the 'Login' button	The system receives login access and then immediately displays the admin/user form. According to their respective roles	Success
Entering with the wrong password conditions, then clicking the 'Login' button	The system will deny login access and display the message "Invalid Password!"	Success
Entering with only one username form and then clicking the 'Login' button	The system will deny login access and display the message "Username cannot be empty!"	Success
Entering only one form password and then clicking the 'Login' button	The system will deny login access and display the message "Password cannot be empty!"	Success
Click Register	Go to the Register page	Success

The accuracy test aims to determine the level of accuracy of the expert system in providing diagnostic results for facial skin diseases. The data tested amounted to 10 samples of expert analysis data. The results of the recommendations obtained from the system will be compared with the results of expert analysis. The results of expert system accuracy testing from 10 samples that have been tested are shown in Table 3. In the table there are all test sample data based on symptom input based on user CF.

Table 3. Accuracy Test

CF User Symptoms and Values	Diagnostic Results			Compatibility
	Expert	Application	Manual	
(G01[0,6]); (G02[0,8]); (G08[0,4]); (G09[0,8]); (G10[0,8]);	Acne Vulgaris	93.38%	93.38%	1
(G01[0,8]); (G03[0,6]);	Melasma	95.5%	95.5%	1

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(G11[0,2]); (G12[0,4]); (G13[0,6]); (G14[0,6]);				
(G01[0,8]); (G03[0,6]); (G15[0,6]); (G16[0,8]); (G17[0,8]);	Nevus Melanu sitik	95.69%	95.69%	1
(G01[0,6]); (G04[0,8]); (G05[0,6]); (G06[0,8]); (G07[0,6]);	Syringoma	97.37%	97.37%	1
(G01[0,6]); (G04[0,8]); (G06[0,6]); (G07[0,6]); (G18[0,8]); (G19[0,8]);	Milia	98.63%	98.63%	1
(G01[0,6]); (G06[0,8]); (G20[0,8]); (G21[0,6]); (G22[0,6]); (G23[0,6]); (G24[0,6]);	Rosacea	97.93%	97.93%	1
(G01[0,6]); (G07[0,4]); (G24[0,8]); (G25[0,8]); (G26[0,6]); (G27[0,6]);	Xanthe lasma	96.56%	96.56%	1
(G01[0,6]); (G03[0,6]); (G28[0,8]); (G33[0,8]);	Keratosi Seboroik	93.77%	93.77%	1
(G01[0,6]); (G03[0,8]); (G29[0,8]); (G30[0,6]); (G31[0,8]); (G34[0,6]);	Basalioma	99.19%	99.19%	1
(G01[0,4]); (G03[0,8]); (G28[0,6]); (G29[0,4]); (G32[0,8]); (G33[0,6]); (G34[0,4]);	Melanoma	98.04%	98.04%	1

The result of accuracy in facial skin disease is worth 1, meaning that the system diagnosis is the same as expert diagnosis and is in accordance with manual calculations. On the other hand, if the accuracy value is 0, it means that the output from the system is not the same as the output from the expert.

## DISCUSSIONS

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Based on a series of tests that have been carried out, it was found that the advantages and disadvantages that still exist in the system are:

- System Advantages
  - a. Users can choose the type of diagnosis according to their needs.
  - b. Each symptom found during the diagnosis process has a solution that can assist users in diagnosing skin diseases on the face.
  - c. The user can view the history of the diagnostic results, namely the diagnosis that has been made by the user, the information will be recorded such as the method of diagnosis, values, solutions and the time the user made the diagnosis.
  - d. Admin can manage the rules that will be set in this application.
- System Disadvantages
  - a. Presentation of disease information is very simple because it is not accompanied by pictures or photos related to the disease.
  - b. Diseases that exist in this expert system are still very common.
  - c. Determination of the value of CF Experts is only limited to sources from an expert.

### CONCLUSION

Based on the results of the analysis and trials that have been carried out, it can be concluded that an expert system for diagnosing facial skin diseases using the forward chaining method and certainty factor based on Android is good, and can provide results in the form of initial diseases experienced by users or the wider community. Making it easier for users or the wider community to find information about symptoms, diseases, and early treatment solutions for facial skin diseases. The developed facial skin disease diagnosis expert system application can diagnose 10 types of diseases.

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