

# Expert System Implementation for the Diagnosis of Skin Diseases Using Forward Chaining Method

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**Abstract:** Expert system is a system that is trying to adopt human knowledge into a computer, so that the computer can resolve the issue as was done by experts. The purpose of this study to design an application of expert system for diagnosis the human skin diseases by using forward chaining method as one of inference technique that aims to discover symptoms of the disease that is displayed in the form of questions. The skin organ chosen because in the interaction between humans, skin is the first organ that used to shake hands, touch, kiss, etc, so that some diseases can be transmitted only through touch or by interaction of skin with skin, and many cases of skin diseases that resulted in death due to delayed handled. The expert system application design consists of seven stages: preliminary studies, data collection, data analysis, system design, system implementation, system evaluation (testing) and the last, drawing conclusions. Expert system software application built to recognize the type of skin disease after consultation by answering a few questions displayed by the system, and can infer the type of skin diseases suffered by the patient. Based on the results of black box testing, the expert system application has been running with good.

## 1 INTRODUCTION

Expert system is a software designed specifically based on Artificial Intelligence, where the system seeks to adopt human knowledge to the computer so that the computer can solve a particular problem by imitating the work of the experts. Expert systems development requires knowledge acquisition from people, involving both knowledge engineers and application domain experts in specialist interactions with computing systems. Expert systems may be used to provide support and advice to a user of any complex information system and hence to improve the human-computer interface (Brian, 2010).

One of the medical problems occurring recently is the imbalance between the number of patient and the number doctor. Limitations of an expert (doctor) sometimes become an obstacle for people who will consult to get the best treatment solution associated with the disease suffered. In addition, most people are not trained medically so they do not know what to do when they experience symptoms of illness. It is unfortunate when the symptoms which can

actually be dealt with early develop into a more serious disease due to lack of knowledge. People can obtain knowledge about health from books or internet sites. However, it is not easy to learn that way because it takes a long time. In addition, these sources cannot diagnose types of diseases as the doctors do. In this case, expert system is presented as an alternative in solving the problem.

There are different areas in medicine where an expert system has been designed and implemented to profers solution to health status stability in human. Among these diverse areas includes an expert system for Eye, Skin, Pregnancy, Blood Disorder and several other human diseases. In previous study, Gudu *et al* (2012) in their research for expert system to diagnosis and treat hypertension in pregnancy stated that the diagnostic and treatment expert system for hypertension in pregnancy has so far remained at the testing phase of its life cycle and is yet to be implemented. Ayangbekun *et al* (2014) develop an expert system for diagnosis of blood disorder. There were two hospital which was taken as the case study of the research. The information was gathered from the hematology department and

the blood department of the two hospitals respectively. The information gotten was analyzed and manipulated based on the symptoms and causes of the blood disorders and then turned into rules for easy programming into the computer. In addition, Ayangbekun *et al* (2015) also developed an expert system for diagnosing brain diseases, using the C#.NET programming language and Microsoft SQL Server 2012 served as the RDBMS. From the study, this application serves as a model tool that will enable hospitals to effectively monitor patients medical records without ambiguity.

The skin is the sense of touch and the widest organ making up the human body which is located at the outermost and covers the entire surface of the body. Because of its outer location, the skin first receives stimuli such as touch, pain, or bad influences from outside. In interaction between humans, the skin is the first organ used to shake hands, touch, kiss, etc. while some diseases can be transmitted only through touch, or the interaction of skin with skin, or through the used media (towels, clothes, jackets, handkerchiefs, etc.) by people who have infectious skin diseases. Maybe many people consider skin diseases to be trivial, but actually these skin diseases can be very dangerous if they are not handled. In fact, not a few cases of skin disease that resulted in death due to delayed handled,

This study aimed to design an expert system application for diagnosis skin diseases using forward chaining and analyze the software functionality requirements through blackbox testing. The scope of the study is extended to 15 types of skin diseases with 54 symptoms of the disease, arranged in 15 rules that were called the Rule-Based System.

The main contribution is the experts system for diagnosing skin disease has become an expert knowledge sharing tool to be used by other medical personnel who are not specialists in diagnosis of skin diseases, specially for hospitals that do not have a dermatologist. The research's novelty is the expert system based on web and user friendly so that can be accessed by everyone wherever and whenever easily and using PHP programming language and MySQL as the Relational Database Management System (RDBMS). The advantage of this research, as a guide for the patient in taking initial action if they know the possibility of suffering skin disease (early detection).

## 2 LITERATURE REVIEW

Expert system is a piece of software programmed using Artificial Intelligence (AI) techniques. Such systems use databases of expert knowledge to offer advice or make decisions in such areas as medical diagnosis and trading on the stock exchange (Munaiseche *et al.*, 2016). An expert system is a system that employs human knowledge captured in a computer to solve problems that ordinarily require human expertise. Expert system seeks and utilizes relevant information from their human users and from available knowledge bases in order to make recommendations. With the expert system, the user can interact with a computer to solve a certain problem. This can occur because the expert system can store heuristic knowledge. Generally to develop an expert system, a rule based method is required to analyze and compute the knowledge base (Patra *et al.*, 2010).

### 2.1 System Architecture

Expert system consists of domain expert, designer, inference engine, knowledge base, user interface and user. There is relationship between these subdivisions which makes it expert system. The domain expert is connected to the knowledge base in order to give rules and fact. The domain experts are normally the expert in the body or field. The knowledge base stores the rule and fact collected. The knowledge base is also connected to inference engine in which is used to process the rule to deduce another set of rule or fact.

The inference engine is normally designed by the programmer or designer. The inference engine is then connected to the user interface in which is used to collect data from the users. This is also developed by the designer. This trend can also be followed backward. The user interface gives information to the inference engine and the knowledge base for user data to be processed. Also for the knowledge base update, a need to contact the domain expert is needed. All this can be represented below (Figure 1).

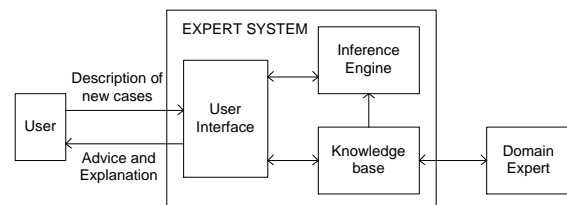


Figure 1: Expert system architecture (Ayangbekun, 2015)

## 2.2 Medical Knowledge

The medical knowledge of specialized doctor is required for the development of an expert system. This knowledge is collected in two phases. In the first phase, the medical background of skin diseases is recorded through the creation of personal interview with doctors and patients. In the second phase, a set of rules is created where each rule contains in IF part that has the symptoms and in THEN part that has the disease that should be realized. The inference engine (forward chaining) is a mechanism through which rules are selected to be fired. It is based on a pattern matching algorithm whose main purpose is to associate the facts (input data) with applicable rules from the rule base. The search is done by using rules whose premise matches the known facts to gain new facts and continue the process until the goal is reached or until there is no more rules whose premises match the known facts as well as the facts obtained. Finally, the skin diseases are produced by the inference engine.

## 3 RESEARCH METHOD

This document was research procedures consist of: preliminary study, data collection, data analysis, system design, system implementation, system evaluation, and drawing conclusion (Munaiseche *et al.*, 2018)

**Preliminary Study.** At this stage, the authors collected information, study materials and data sources related to expert systems, forward chaining methods, rule-based reasoning, the types of skin diseases in humans, symptoms of skin diseases and treatment or preventive solutions.

**Data Collection.** Data sources used in expert systems to diagnose skin diseases in humans include data of the skin disease type, skin disease symptoms, disease information and solutions provided. The data required in this study were obtained from Literature Study and Consultation/interview with experts, in this case dermatologist.

**Data Analysis.** Based on the collected data, the researcher conducted following analysis steps: 1) Made a list and coded eye diseases along with symptoms. This expert system software can diagnose 15 types of eye diseases with 54 symptoms of the disease; 2) Made Rule-Based System. In order to recognize the type of skin disease, rules in expert system tracing are required. There are 15 Rules and

a forward chaining hierarchy called the Rule-Based System.

**System Design.** The design of this system includes design process described by using decision tree, context diagram explaining the relationship between input / output between system with outer world, data flow diagram (DFD), the design of the database and user interface.

**System Implementation.** The activity performed at this stage was the programming or coding. This stage was the translation of the design into the form of computer programming language. This research employed PHP programming language.

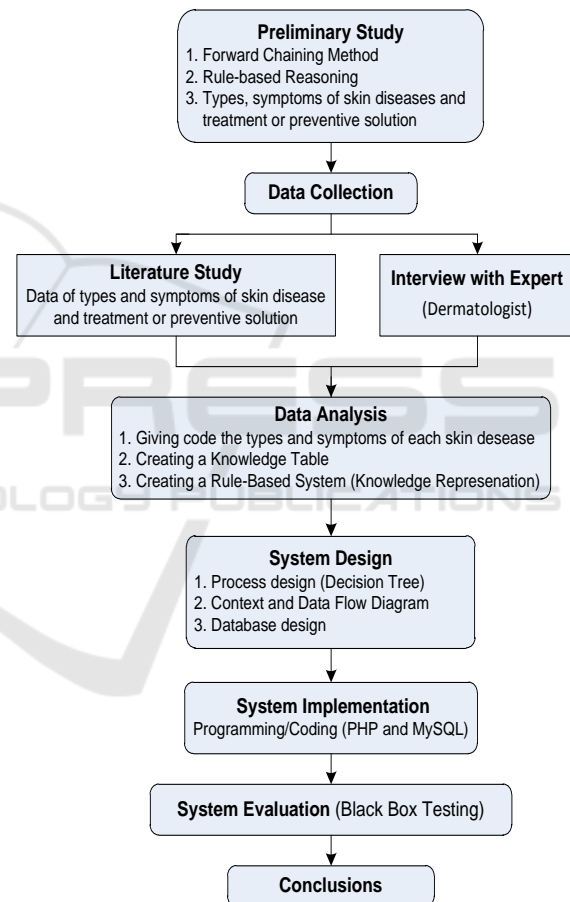


Figure 2: Research procedures

**System Evaluation.** The evaluation of this expert system uses black box testing. This evaluation aims to find out a function error on the software that has been built. In addition, this test was carried out by trying all the possibilities that happened and done repeatedly. If the test found an error, it will be traced and corrected all errors that occur.

**Conclusion.** A conclusion will be drawn from the results of these evaluations based on the results of testing (black box testing) of the expert system. The research proessedure is shown in Figure 2.

## 4 RESULT AND DISCUSSION

### 4.1 Result

This research results in a web-based expert system that can recognize the type of skin disease in humans based on the symptoms experienced by patients.

This system performs analysis based on the dialogue between the system with the user/patient. The web-based expert system of skin disease diagnosis is designed by using PHP programming language and MySQL for database processing. Some interfaces from the skin disease diagnosis expert system are shown in Figure 3 and Figure 4.



Figure 3: The main page interface (home menu)

The main page interface of the application (Figure 3) consist of five Menus (Home, Daftar Penyakit, Konsultasi, Login Pakar and Kontak).



Figure 4: Interface of admin menu

Interface of admin page (Figure 4) consist of eight menus (Input Penyakit, Input Gejala, Input Relasi, Ubah Penyakit, Ubah Gejala, Laporan Penyakit, Laporan Gejala dan Logout).

### 4.2 Discussion

Testing is an important part of a software development. Testing is intended to find errors on the system and ensure that the system built is in accordance with what is pre-planned. Tests are carried out to ensure quality and also find out the weaknesses of the software. The purpose of this test is to ensure that the software built has quality reliable, namely being able to present the principal studies of the analysis specifications, design and coding of the software itself.

Tests performed on the functionality of this software use the Black Box method. This test is a test that focuses on the functional requirements of software. The purpose of testing with the Black Box method is to find malfunctions in the software that has been built. In addition, this test is done by trying all the possibilities that occur and are done repeatedly. If an error is found in the test, a search and repair will be carried out to correct the error.

Blackbox testing includes: expert login testing, data filling, expert consultation and testing of system diagnostic results, which are made in several test scenarios. Based on the results of black box testing, the expert system application has been running with good. However, it does not rule out the possibility of errors when the application is used in a real environment. In addition, the software built is free of syntax errors and according to expected functionality.

## 5 CONCLUSIONS

From this study some conclusions can be drawn, namely:

1. Build an expert system applications to diagnose skin diseases in humans can use the search process with the forward chaining as a inference method.
2. Patients can immediately consult a software system without having to consult with a expert (dermatologist) on condition that they have to register as a patient first.
3. The system can only diagnose one patient in consultation and can only recognize and

diagnose the type of skin disease in the truth table of the disease.

4. Admin can manipulate data rules or rules.
5. Based on the results of black box testing that has been done, it can concluded that this application that has been built has been running with good. However, it does not rule out the possibility of errors when the application is used in a real environment.

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