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WEB-BASED SKIN DISEASE DIAGNOSIS EXPERT SYSTEM

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Abstract. In tropical nations, such as Indonesia, skin diseases are a common ailment. Skin conditions are typically not lethal illnesses, thus patients frequently disregard them and don't take them seriously. Skin conditions can, however, become uncomfortable and threaten the sufferer's survival if they are left untreated for an extended period of time. The result of this research is the creation of a web-based expert system for identifying skin disorders, which can aid in more accurate and timely diagnosis of skin diseases as well as offer treatment advice.
The development of a web-based expert system for diagnosing skin diseases uses the forward chaining method. While the development methodology uses ESDLC (Expert System Development Life Cycle), with the phases of Assessment, Knowledge Acquisition, Design, Test, Documentation, and Maintenance

Contribution/ Originality: This study aims to develop a web-based expert system for skin diseases, especially those caused by viruses, using the forward chaining method. This is different from previous research

Keywords: Expert System, Diagnosis, Skin Disease

Introduction

The skin is a very important organ for humans, apart from being a sense of taste, the skin is also the outer shell of the human body. Skin that is not kept healthy can get infections which are usually caused by viruses, bacteria, fungi, and parasites. Apart from having an impact on appearance, skin diseases can also interfere with the sufferer's activities.

Skin disease is a disease that is often found in tropical countries, such as Indonesia. In general, skin disease is not a fatal disease, so it is often ignored by sufferers and not taken seriously. In Indonesia, there are still many sufferers who do

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not care about skin diseases. If this disease is left for too long and without proper treatment, this disease will cause discomfort to the appearance or survival of the sufferer. Unfortunately, many sufferers do not have adequate knowledge or information about the skin disease they suffer from, so they do not know the appropriate initial treatment for their disease.

In the medical field, tools are needed to diagnose a disease, such as artificial intelligence applications to facilitate disease diagnosis. So, the author conducted research entitled "Web-Based Skin Disease Diagnosis Expert System" to make it easier to diagnose skin diseases.

Expert systems are a scope of artificial intelligence (AI) which seeks to adopt human knowledge to computers, so that computers can solve problems as experts usually do. Computers are used as a means of storing expert knowledge. In this way, computers will have the expertise to solve problems by imitating the skills possessed by experts.

Expert systems can assist in decision making by explaining the reasons for taking certain actions[1]. Expert Systems are defined as computer programs that use specialized symbolic reasoning to solve difficult problems well. An expert system is a system that tries to adopt human knowledge to a computer, so that the computer can solve problems as experts usually do. A good expert system is designed to be able to solve a particular problem by imitating the work of experts

Expert systems are tasked with: storing and disseminating scarce expertise and solving problems that hinder traditional programs. Martin and Oxman explain that an expert system is a computer-based system that uses knowledge, facts and reasoning techniques to solve problems that can usually only be solved by an expert.[2]

Artificial intelligence is defined as the study of how to make computers do many things for humans in terms of decision making, intelligent information retrieval and making it easier to use computers with natural language interfaces.[3]

So, expert system is a system that represents an expert, who can solve problems in a certain field like an expert. Expert system means that expertise is transferred from an expert (or other source of expertise) to a computer, the existing knowledge is stored

[1] Laudon, Kenneth C. & Laudon, Jane P, *Managemen Information System: Organization and Technology*, 4th ed, New Jersey: Prentice Hall Inc, 1996.
[2] Kusrini, Expert System: Theory and Application, Yogyakarta: ANDI Offset, 2006, p. 11
[3] Turban, Efraim, *Expert System & Applied Artificial Intelligence*, New York: Macmillan Publishing Co., 1992.

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in the computer, and the user can consult the computer for advice, then the computer can make inferences (concludes) like an expert, then explain it to the user, if necessary with reasons.

Expert System Components

Expert system consists of four components, first the user interface, the connecting part between the expert system program and its users. In this section, a dialogue will occur between the program and the user. The expert system will draw conclusions in the form of information or recommendations according to the nature of the expert system.[4]

Second, the knowledge base is a database of expert knowledge, the core part of the expert system program. Meanwhile, knowledge representation is a method of presenting expert knowledge through certain schemes/diagrams so that the relationship between facts or knowledge can be known and can be used to test the correctness of his reasoning. This method aims to enable computer systems to think about real-world events as humans do - interpreting data efficiently without having the previous experience to make informed decisions.

The author acts as a knowledge engineer whose main task is to translate and represent knowledge obtained from an expert. To obtain this knowledge, knowledge engineers will interact directly with experts. This process is called knowledge acquisition. Knowledge acquisition is the process of collecting, transferring and transforming knowledge about certain skills in solving a problem from knowledge sources into a knowledge base. Sources of knowledge include human expertise, reference books, journals, research reports, or other documents and information available on the internet.[5]

Third, working memory is part of an expert system that contains facts, problems obtained/discovered during the operation of the system, both initial facts when the system starts operating and facts when conclusions are drawn or consultation sessions are being held. During the operation, the database, in this case the facts, is in working memory

[4] Hayadi, *Expert System*, Yogyakarta: Deepublish, 2018, p. 6-8. Also see Rafdhi, *Expert System for Determining Inheritance*, Thesis, STT Benarif Indonesia, 2004, p. 29
[5] Sri Harti, *Artificial Intelligence on Knowledge Based*, Yogyakarta: Gadjah Mada University Press, 2021, h. 46

Fourth, the inference engine, the part that contains the thinking function mechanisms and system reasoning patterns used by an expert. This mechanism will analyze a particular problem and then look for the best answer or conclusion.

There are two methods used in inference engines to infer new knowledge, namely backward chaining and forward chaining reasoning methods. The backward chaining method is a technique that starts tracking from the conclusion by making a hypothesis, then analyzing it towards the facts that support the hypothesis, so it is called goal-driven. [6]

The forward chaining method is a search method or forward tracking technique that starts with existing data and combines rules to produce a conclusion or goal, so it is called data-driven. Forward chaining starts with known facts and uses them to create new facts. This method starts with known facts, then matches these facts with the IF section and IF_THEN rules. If there is a fact that matches the IF part, then the rule is executed. When a rule is executed, a new fact (THEN part) is added to the database. Each rule can only be executed once.[7]

Production Rules

Rules provide a formal way to present recommendations, directions, or strategies. Production rules are written in IF-THEN form. The IF-THEN rule connects the antecedent with the resulting consequence. Various IF-THEN rule structures that connect objects or attributes are as follows:

IF premise THEN conclusion

IF input THEN output

IF condition THEN Action

IF antecedent THEN consequent

IF data THEN results

IF action THEN goal

Premises refer to facts that must be true before a certain conclusion can be reached. Input refers to the data that must be available before output can be obtained. Conditions refer to circumstances that must apply before action can be taken. Antecedent refers to a situation that occurs before a consequence can be observed. Data

[6] Faiz Rafdhi, *Expert System for Determining Inheritance*, p. 30
[7] Hayadi, *Expert System*, Yogyakarta: Deepublish, 2018, p. 9-10

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refers to the activities that must be performed before results can be expected. Actions refer to activities that must be performed before results can be expected.[8]

Research Objectives

In general, the research objective is to develop a product or software in the form of a web-based skin disease diagnosis expert system. In particular, the aim of the research is to complement similar and previous research, especially on types of skin diseases caused by viruses.

Research Methods

The development of this expert system uses research and development methods. A process or steps to develop a new product or improve an existing product, which can be accounted for. This method is used to produce certain products, programs or applications, and test the effectiveness of these products. To manipulate knowledge from an expert, the author acquired knowledge using literature study techniques from trusted and credible references written by a dermatologist.

Research Procedures

The phases of developing this expert system use the ESDLC (Expert System Development Life Cycle) method[9], consisting of six steps. First, the assessment phase, was carried out to determine important things as the basis for the problem of this expert system for diagnosing skin diseases. The steps taken are analysis of equipment needs, availability of knowledge sources and required systems.

Second, the knowledge acquisition phase. This phase collects data on the disease and its symptoms as well as how to treat it. Data obtained from reference books on skin diseases can support research, and will then be created into a knowledge base.

Third, the design phase. This phase uses UML (Unified Modeling Language) for system design, then designing the database that will be used in the system, and designing the appearance using wireframes. This phase is in accordance with the previous phase and is then implemented into the system.

[8] Kusrini, *Expert System: Theory and Application*, p. 32-33
[9] Turban, Efraim, *Expert System & Applied Artificial Intelligence*, New York: 1992. Also see Nurdiawan et.al, *Development of a Visual-Prolog Based Tomato Plant Disease Diagnosis Expert System*, Journal Algoritma, 2016

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Fourth, the testing phase, using the black box testing method to check whether the system is as desired and check for any failures or errors in the system. Fifth, documentation phase, creating product documentation such as user documentation and system documentation. This documentation covers how the system is operated by the user. Sixth, the maintenance phase, maintenance and evaluation of the system that has been created is carried out, both for system improvements and knowledge updates

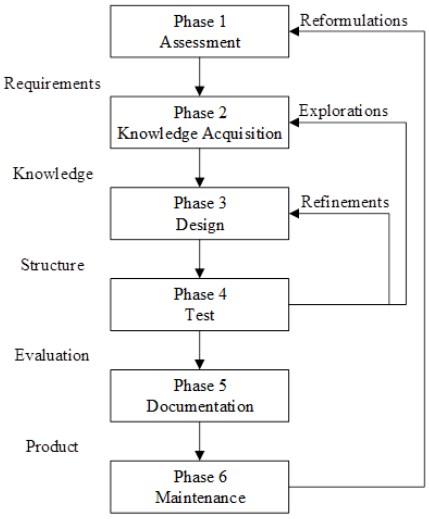

Figure 1. ESDLC Methods

Research Results

Based on the results of knowledge acquisition and system design, this development research produces an expert system for diagnosing skin diseases as shown in the dashboard page, diagnosis page and diagnosis results page. See figure:

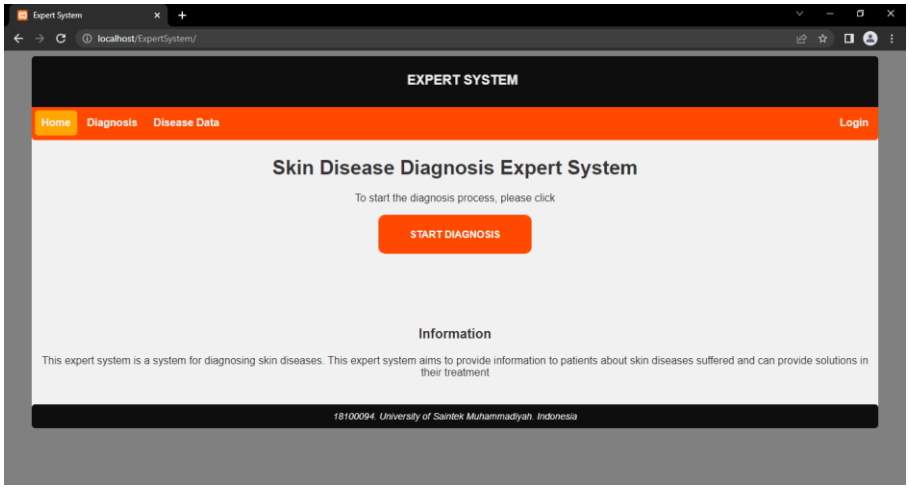

Figure 2. Dashboard Page

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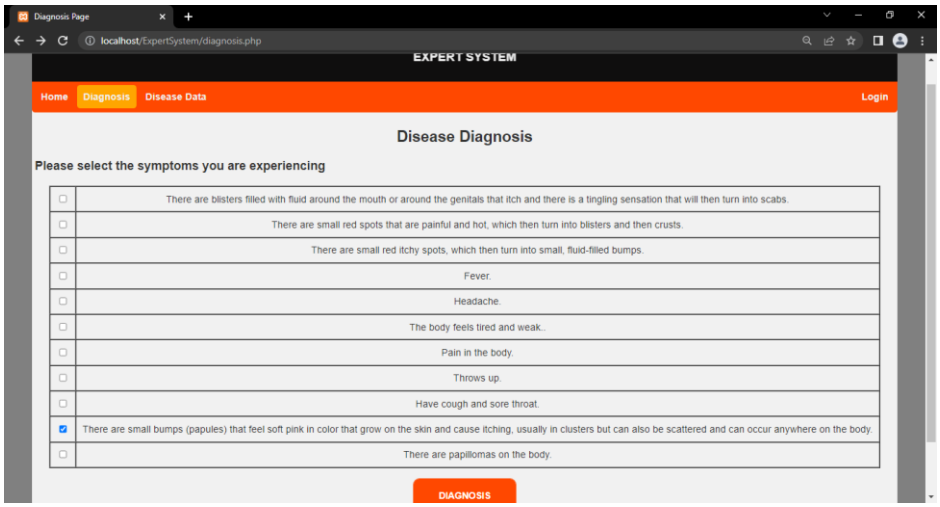

Figure 3. Diagnosis Page

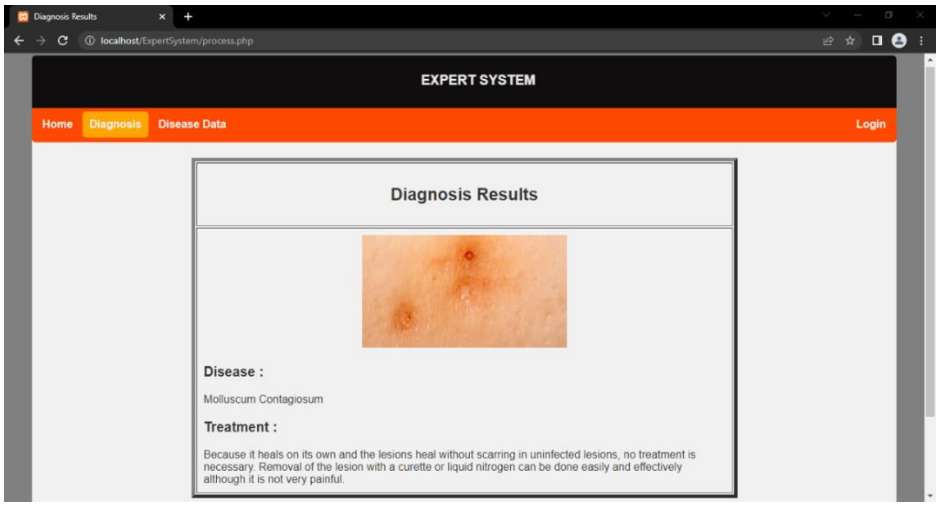

Figure 4. Diagnosis Result Page

Discussion

Assessment Phase

At this phase the author determines two basic needs in building a system, namely knowledge sources and device requirements. Knowledge sources obtained through literature study from sources or books about skin diseases written by a specialist doctor, Prof. dr. Marwali Harahap, Ph.D entitled Skin Diseases, published in Jakarta by Gramedia Co.

Meanwhile, device needs are related to hardware and software. The details of the hardware requirements used to run this expert system are as follows:

Hardware Requirements	Minimum Requirements	Recommended Requirements
Processor	Intel Core i3 1.5 GHz	Intel Core i3 di atas 1.5GHz
Hard Disk	120GB	120GB atau lebih
Memori RAM	2GB	2GB atau lebih

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Kartu Grafis	256 MB	512MB atau lebih
Keyboard	Standard	Standard
Mouse	Standard	Standard

Table 1. *H*ardware *R*equirements

The details of the software requirements used to build this expert system are as follows:

Software Requirements	**Instruction**
Windows 10	Operating system
Visual Studio Code	Text editor
Google Chrome	Using to *website* access
XAMPP	*web server*
MySQL	Using to make *database*
Microsoft Visio	Using to system design
Adobe Photoshop	Using to display design

Table 2. Software Requirements

Knowledge Acquisition Phase

At this phase the author collects data about skin diseases, then represents the knowledge. The following is disease data and symptoms of skin diseases caused by viruses.

No	**Code**	**Disease**	**Treatment Guide**
1	P001	Herpes Simplex	Herpes simplex treatment is divided into 3 categories, namely prophylaxis (prevention), non-specific treatment, specific treatment. Prophylactic measures include avoiding factors that trigger an attack, using vaccines, psychotherapy and avoiding factors that spread. Non-specific treatment, for example giving analgesics at a rather strong dose during a primary attack, Co-trimoxazole at an oral dose 2 times 2 tablets a day is useful for preventing secondary infections, antiseptic drying agents such as Povidone Iodine, warm and cold salt solutions as compresses, as well as psychotherapy. Specific treatment by administering antiviral drugs such as Idoxuridine 5% in DMSO and Acyclovir both topically, orally and IV, Interferon and Lysine orally, as well as Isoprinosine.
2	P002	Herpes Zoster	Neuralgia (pain) can be reduced by administering analgesics. Calamine compresses and lotions can reduce discomfort and dry out vesicular lesions (fluid-filled lumps). Oral administration of triamcinolone 48 mg/day will reduce the duration of post-herpetic neuralgia, especially in the elderly, and is given at the beginning of the eruption. Viral antiviral drugs such as acyclovir can be given.
3	P003	Varicella	There is no specific therapy for varicella. If you have a fever, you can give acetosal or another antipyretic. Local therapy can be given with calamine lotion, and oral anti-histamines can reduce itching. If a secondary infection occurs by bacteria, antibiotics can be given.

4	P004	Variola	There is no specific treatment for variola. Good care and avoiding secondary infections are important actions for sufferers. Antibiotics are used to prevent secondary infections by bacteria. It is also necessary to pay attention to the intake of food, fluids and electrolytes in sufferers
5	P005	Molluscum Contagiosum	Because it is **self-limited** (heals by itself) and the lesion heals without any scarring (scar tissue that forms after injury) in lesions that do not experience secondary infection, there is no need for treatment. Removing the lesion with a curette or liquid nitrogen can be done easily and effectively even though it is not very painful.
6	P006	Verruca	Treatment for verruca is non-specific. Usually aimed at destroying the lesion and is often accompanied by pain. Therefore, this action must be carried out carefully.

Table 3. Disease Data

No	Code	Symptom Type
1	G001	There are fluid-filled blisters around the mouth or around the genitals that feel itchy and have a tingling sensation, which then turn into scabs.
2	G002	There are small reddish spots, they feel painful and hot, then turn into blisters and then become crusts (scabs).
3	G003	There are small red spots, feel itchy, then turn into small lumps filled with fluid.
4	G004	Fever
5	G005	Headache
6	G006	The body feels tired and weak
7	G007	Pain in the body
8	G008	Throws up
9	G009	Experiencing cough and sore throat
10	G010	There are small, soft, pink lumps (papules) that grow on the skin and cause itching, usually in clusters but can also be scattered and can occur anywhere throughout the body.
11	G011	There are papillomas (non-cancerous lumps that are benign or commonly called warts) on the limbs.

Table 4. Symptoms Data

From disease data and symptoms of skin diseases, a decision table can be prepared as follows:

Kode	P001	P002	P003	P004	P005	P006
G001	✓					
G002		✓				
G003			✓	✓		
G004	✓	✓	✓	✓		
G005	✓	✓	✓	✓		
G006	✓	✓	✓	✓		
G007			✓	✓		
G008			✓	✓		
G009			✓			
G010					✓	

G011						✓

Table 5. Decision

From table 5, production rules can be created as in the following table

No	Rule	Production Rules
1	*Rule 1*	*IF* There are fluid-filled blisters around the mouth or around the genitals, they feel itchy and there is a sensation, for example *paresthesia*, then they will turn into scabs *AND* Fever *AND* Headache *AND* The body feels tired and weak *THEN* Herpes Simplex
2	*Rule 2*	*IF* There are small red spots, feel painful and hot, then turn into blisters and then become crusts (scabs) *AND* Fever *AND* Headache *AND* The body feels tired and weak *THEN* Shingles
3	*Rule 3*	*IF* There are small reddish spots, feel itchy, then turn into small lumps filled with fluid *AND* Fever *AND* Headache *AND* The body feels tired and weak *AND* Pain in the body *AND* Vomiting *AND* Cough and sore throat *THEN* Varicella
4	*Rule 4*	*IF* There are small reddish spots, feel itchy, then turn into small lumps filled with fluid *AND* Fever *AND* Headache *AND* The body feels tired and weak *AND* Pain in the body *AND* Vomiting *THEN* Variola
5	*Rule 5*	*IF* There are small, soft pink lumps (papules) that grow on the skin and cause itching, usually in clusters but can also be scattered and can occur anywhere throughout the body *THEN* Molluscum Contagiosum
6	*Rule 6*	*IF* There are papilloma (non-cancerous lumps that are benign or commonly called warts) on the limbs *THEN* Verruca

Table 6. Production Rules

Design Phase

At this phase the author designs the system that will be created. The author's first step is to design a system using UML (*Unified Modelling Language*).

a. *Use Case Diagram*. A description of the interactions between the system, external systems, and users.

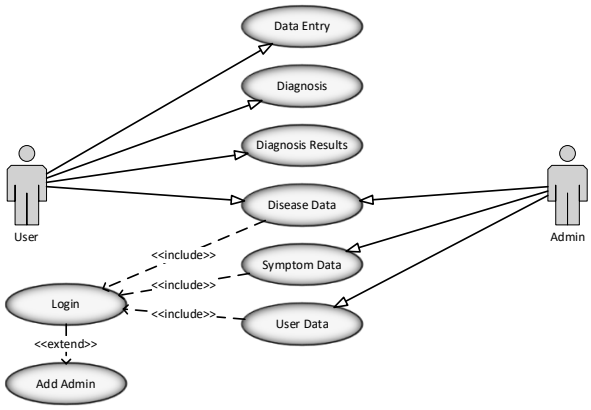

Figure 5. Use Case Diagram

b. *Activity Diagram*. The flow of activities that occur in a web-based skin disease diagnosis expert system.

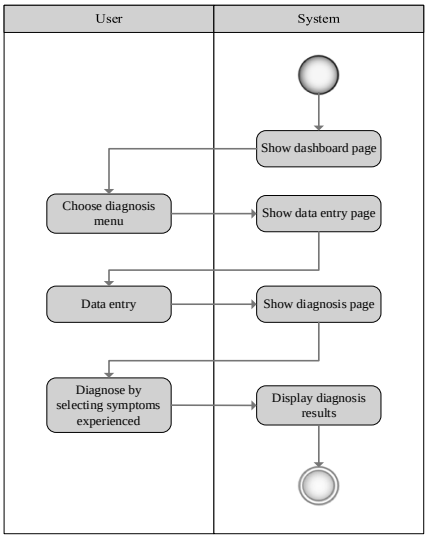

Figure 6. Activity Diagram – Diagnosis

c. *Sequence Diagram*. Describes how objects interact with each other through messages in a web-based skin disease diagnosis expert system.

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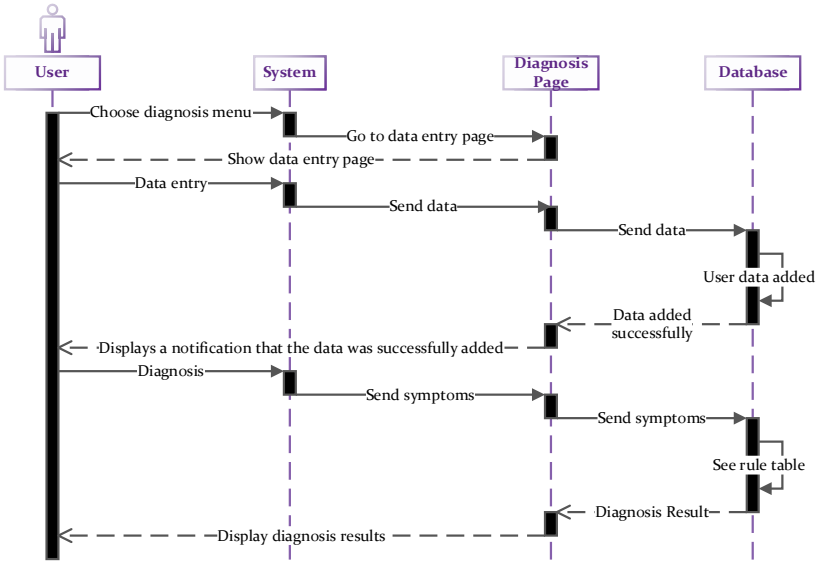

Figure 7. Sequence Diagram – Diagnosis Page

In the next phase, the author designs the appearance of the dashboard page, as can be seen in the following image:

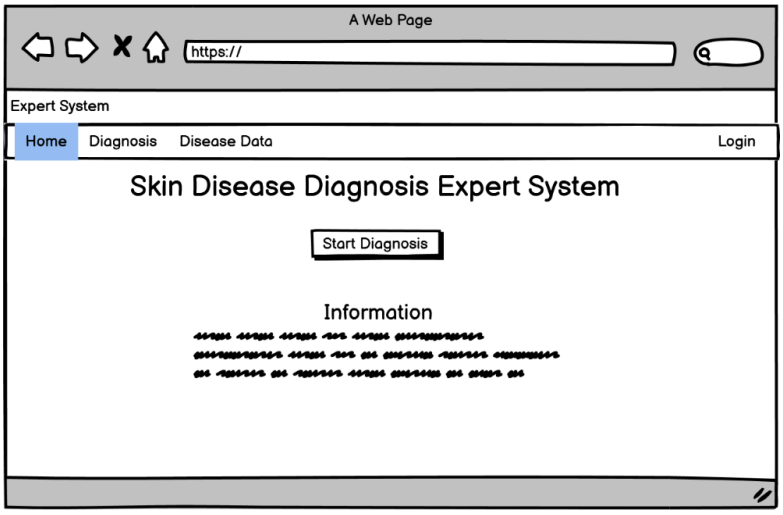

Figure 8. Display Design – Dashboard Page

Testing Phase

At this phase, the author tests whether the system that has been created meets the requirements using the black box testing method.

Documentation Phase

At this phase the author documents the product such as user documentation and system documentation. This documentation includes how the user operates the system, as shown in figure 8, there are 4 menus (*Home*, *Diagnosis*, *Disease Data* and *Login*) that users can choose according to their needs. Click the "*Start Diagnosis*" menu to run operation.

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On the diagnosis page, a choice of perceived symptoms is available (figure 3). Users will select the symptoms they are experiencing, then press the diagnosis button to see the diagnosis results. On the diagnosis results page, users can see the diagnosis results (figure 4).

Maintenance Phase

Maintenance is carried out to anticipate disruptions and system damage, so regular system maintenance is needed, so that disruption and damage can be minimized and repairs can be carried out immediately.

At this stage the expert system can also be developed if at any time there is additional disease data thanks to the development of knowledge, so it is hoped that this expert system can always keep up with the times.

Conclusion

Based on the results of the analysis on the web-based skin disease diagnosis expert system, the following conclusions can be drawn:

a. A web-based skin disease diagnosis expert system can provide diagnoses like those made by doctors (expert) and treatment methods to system users.
b. The benefit of this system is to make it easier for patients to diagnose skin diseases.
c. Research Novelty: A web-based expert system for diagnosing skin diseases, especially for diseases caused by viruses, was developed, which differentiates it from previous similar research.

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