Expert System for Diagnosing Eye Diseases in Teenagers Using the Forward Chaining Method

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ABSTRACT

Introduction: Eye disease, especially in adolescents, has various symptoms. Currently, most adolescents pay little attention to the condition of the eyes. The assumption circulating in society is that the disease will heal on its own without the need for medical treatment. As a result, many adolescents experience delays in treatment. **Method**: This method is used because forward chaining uses a search value or reasoning that starts from facts to get conclusions from these facts to assume the degree of confidence of an expert. The data in this study are data on symptoms and eye types in adolescents aged 12-15 years obtained through interviews with experts at the Smec Palu eye clinic. This study uses 3 tests namely Alpha testing, beta testing, and accuracy testing. **Results and Discussion**: System testing is done through alpha testing, beta testing, and accuracy testing. Alpha testing shows that the system components function as expected. Beta testing uses a questionnaire that produces a percentage of 86% for System Quality, 86% for Information Quality, and 88% for User Satisfaction. Accuracy testing shows that the system has 100% accuracy because all test data matches the results of expert analysis. This shows that the system has very good accuracy. **Conclusion**: Expert system testing to diagnose eye diseases in adolescents aged 12-15 years with the forward chaining method shows positive results. Alpha testing ensures that all features function properly, while beta testing gives a score of 86% for System and Information Quality, and 88% for User Satisfaction. Accuracy testing showed 100% results. This system is effective for diagnosing eye diseases based on symptoms.

1. Introduction

The eye is an important part which is one of the five human senses, the eye is useful for knowing and detecting what can be seen by humans, if there is a disturbance in the eye then the function of the eye cannot run properly. Visual impairment is a condition where there is a sharp decrease in vision or a decrease in the field of visibility that can result in blindness [1].

Eye disease is a disease with an increasing number of patients every year in Indonesia. The prevalence of blindness in Indonesia is around 1.2% of the total population [2]. Eye diseases, especially in adolescents, have various symptoms, currently, most adolescents pay less attention

to the condition of the eyes, this is exacerbated by the assumption circulating in the community that the disease will heal by itself without the need for a doctor's treatment, as a result of this many adolescents experience delays in treatment. One of the symptoms of eye disease is red and itchy eyes, red and itchy eye symptoms are the easiest symptoms to occur but it is difficult to know directly the type of disease.

SMEC Palu Eye Clinic is one of the quality health service centers that focuses on eye health services. Every day many people visit to do routine eye examinations, not proportional to the number of doctors and nurses available, this makes the service less efficient. Therefore, an expert system is needed as an alternative to help doctors reduce these problems, and with this computerized technology, it is hoped that it can save time in conducting eye checks.

An expert system is a computer application program that attempts to mimic the reasoning process of an expert in solving specific problems. The expert system created is an expert system that can diagnose eye diseases in adolescents aged 12-15 years based on the symptoms experienced, so using this system can find facts in solving problems. This system diagnoses eye diseases based on the symptoms experienced. Symptoms of eye diseases that exist in the system. With criteria based on the identification of diseases experienced by patients. This diagnosis system is built using *forward chaining*. *Forward chaining* is forward tracking that starts from a set of facts by looking for rules that match existing conjectures or hypotheses.

2. Reserch Method

The method used for system development in this study is the waterfall development model. In this method, software where describes a systematic and sequential approach to software development, starting with the specification of user requirements [3]. The stages of developing a waterfall model development system start from *Requirements Analysis, System and Software Design, Implementation and Unit Testing, Operation and maintenance),* The following stages of the waterfall model system development can be seen in Figure 1 below.

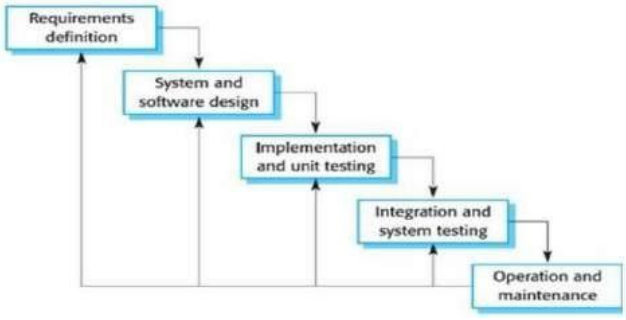

Fig. 1. Waterfall method

System Usage. An explanation of the stages of the *waterfall* model is as follows:

2.1 Requirements Analysis and Definition

The requirements analysis stage in this research begins by looking for information or data needed to be applied to an expert system for diagnosing eye diseases using the *forward chaining* method through interviews with experts (experts) who in this study are an ophthalmologist. The information and data are in the form of types of eye diseases along with their respective symptoms and initial treatments or solutions as well as collecting information and other supporting data. The information and data are analyzed and processed into the expert system to be built.

2.2 System and software design

At this stage, the author makes a system design that begins by connecting the information or data that has been obtained in the previous stage, namely regarding the relationship of symptoms that lead to each type of eye disease and how to handle the initial or solution of the diagnosis results. Then the system design stage regarding the method used, namely by using the *forward chaining* method as a method for existing facts to be correct with a confidence value for the symptoms chosen by the patient. Furthermore, designing the *interface of* an expert system for diagnosing eye diseases in adolescents aged 12-15 years using the *forward chaining* method as needed.

2.3 Implementation and Unit Testing

At this stage, the system and software design in the previous stage are implemented by writing programming codes into a series of programs or program units. Implementation and testing of program units begins with building a database that contains some information and data. Then write programming codes based on the system design that has been made in the previous stage while checking if there are errors or errors in the coding process.

2.4 Integration and system testing

At this stage, all units developed at the implementation stage are integrated into the system as a whole. After the integration process, the entire system is tested to check whether or not the application of the system to diagnose eye diseases using the *forward chaining* method is correct.

2.5 *Operation* and maintenance

At this stage, the implementation of a system that has successfully passed the integration and system testing stages can be implemented and at this stage can perform system maintenance.

2.6 Data Analysis

The data analysis method used by the author in this study is as follows:

A. Data Flow Diagram (DFD)

Data Flow Diagram is a method used to describe a data flow, data origin, and data destination or input and output on the system to be created.

B. Entity Relationship Diagram (ERD)

Entity Relationship Diagram is a method used to design a database by describing the relationships between visible entities or objects and their attributes.

3. Results and Discussion

3.1. System Analysis

1) Context diagram

A context diagram is a data flow diagram with an outline of system operations. The context diagram describes the system's relationship with outside entities, which describes the system globally. The Context Diagram can be seen in Figure 2 below:

Fig. 2. Context Diagram

The description of Figure 2 can be seen in the following points:

a. Admin

Admin in this expert system has a function to manage disease data, manage symptom data, manage rules, and manage diagnoses.

b. User

Users in this expert system are tasked with selecting symptom data from the disorders needed by the system to provide diagnostic results along with treatment suggestions.

2) *Data Flow Diagram* (DFD)

According to [4] *Data Flow Diagram* (DFD) is also called a Data Flow Diagram (DAD). DFD is a logical model of data or processes made to describe where the data comes from, where the data is going out of the system, where the data is stored, what processes produce the data, and the interaction between the stored data, and the processes imposed on the data.

a. Login

The process of processing user data in order to access the system. The login process can only be done by the admin.

b. Manage Master Data

This process is a process for managing disease data, symptoms, and rule and diagnosis data.

Managing master data means adding, changing, or deleting data.

c. Diagnosis

This process is a process to diagnose the type of disorder suffered after the user selects the symptoms felt. This process is a process to detect the type of disorder suffered after the user selects the symptoms felt.

3) Use Case Diagram

Tohari in [5] *use case diagram* is a series or description of a group of interrelated or forming a system in an organized manner that is carried out or supervised by an actor.

a. Admin

- Login

At this stage, the admin accesses the system by entering a username and password.

- Processing Symptom Data

At this stage the admin manages the symptom data, namely inputting data, changing, and deleting.

- Processing Diagnosis Data

At this stage the admin manages disease data, namely inputting data, changing, and deleting.

- Manage Rule Data

At this stage, the admin creates rules for each symptom by linking the corresponding symptom to the disorder.

- Manage Disease Data

At this stage the admin manages eye disease data, namely inputting data, changing, and deleting.

b. User

- Consultation

At this stage the user performs the diagnosis process by selecting the symptoms that are available, then it will be processed and will display the results of eye disease diagnosis.

4) Activity Diagram

Activity Diagram describes the workflow or activity of a system or menu in the software. An overview of the Activity Diagram in the following figures 5 and 6:

3.2. System Implementation

1) Hardware and Software Implementation

Implementation of devices used to create an expert system for diagnosing eye diseases in adolescents aged 12-15 years using the forward chaining method with minimum specifications of intel core i5 processor, 4 GB RAM, monitor with a resolution of 1366x768 pixels, and Windows 11 64 bit operating system.

For a software implementation, the programming language used is PHP, the media used as a text editor to build the system is sublime text / Visual Studio code, and XAMPP is a MySQL database server linked with the programming language.

2) Database Implementation

The database server used is MySQL. The tables used in making this system, among others:

a. Tb_user

This user table is used to store registered user data that can be used to enter the system in the login process.

Table. 1. Tb_user

Field	Type	Length/ Values	
Indexid	int	11	*AUTO_INCREMENT*
Name		50	
username	varchar	50	
password		255	

b. Tb_symptoms

The symptom table is used to store symptom codes and names as shown in table 2.

Table. 2. Tb_symptoms

Field	Type	Length.	Index
id	int	11	*AUTO_INCREMENT*
symptom_co	varchar	10	-
symptoms	varchar	100	-

c. Tb-disease

The disease table is used to store disease code names and treatments as shown in table 3.

Table. 3. Tb_disease

Field	Type	Length.	Index
id	int	11	*AUTO_INCREMENT*
disease code	varchar	10	-
Disease name	varchar	100	-
Description	text	-	-
handling	text	-	-

a. Tb_diagnosis

The diagnosis table is used to store user data when consulting. The table can be seen in Table 4.

Table. 4. Tb_diagnosa

Field	Type	Length/ Values	Index
Id_diagnosa	int	11	*AUTO_INCREMENT*
nik	varchar	20	-
Name	varchar	100	-
Age	int	10	-
Gender	varchar	20	-
Distric	varchar	50	-
Village	varchar	50	-
Address	Text	-	-
Syimptoms	varchar	100	-
Name-disease	text	100	-
Description	Text	-	-
Handeling	varchar	-	-
Date	date	-	-
Time	time	-	-

d. Tb_rules

The rule table is used to store data from each symptom experienced in patients using the forward chaining method seen in Table 5.

Table. 5. Tb_rules

Field	Type	Length. Values	Index
Id_rule	int	11	*AUTO_INCREMENT*
code_rule	varchar	10	-
disease_name	varchar	100	-
symptom_nam	int	-	-

3) Input and output implementation

In an expert system for eye diseases in adolescents aged 12-15 years using the forward chaining method, there are several input and output forms, including the following.

a. Home form

The home form is the initial page when the system is run. This form presents information about eye diseases in adolescents aged 12-15 years. The home form can be seen in Figure 3 as follows.

Fig. 3. Home Form

b. Consultation form

On this page, the user can consult the system by entering Nik, teen name, age, gender sub-district, village, and address. After that, users can choose symptoms or conditions experienced by adolescents aged 12-15 years. The consultation form can be seen in Figure 4 as follows

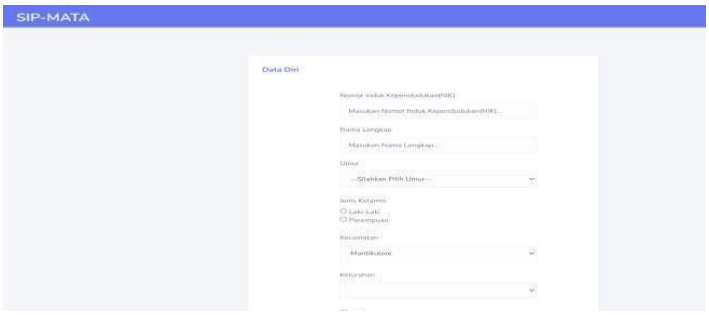

Fig. 4. Form Consultation

c. Login form

The login form is a page that can only be accessed by admins by entering a username and password. The login form can be seen in Figure 5 as follows:

Fig. 5. Login form

d. Disease diagnosis form

This form is a page that displays information data that can be accessed by the admin by entering personal data and entering symptoms that are experienced and will display information about the disease experienced and how to handle it. The eye disease data form can be seen in Figure 6 as follows:

Fig. 6. Disease diagnosis form

e. Symptom form

This form is a page that displays information data related to the symptoms of *eye disease*. On this page, the admin can add, change, and delete symptom data. The symptom form can be seen in Figure 7 as follows.

f. Eye Disease Data Form

Fig. 7. Symptom formThis form is a page that displays related information data from eye diseases. types of eye diseases as well as descriptions and treatments of eye diseases in 12-15 year old teenagers On this page, admins can add, change, and delete eye disease data. The eye disease data form can be seen in Figure 8 as follows:

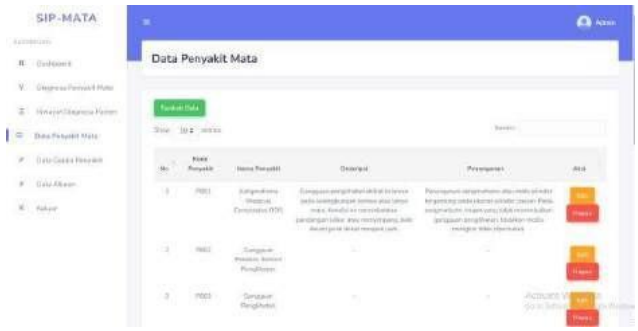

Fig. 8. Eye Disease Data Form

g. Rule Data Form

This form is a page that displays information related to the rules of the forward chaining process, which can be seen in Figure 9 as follows.

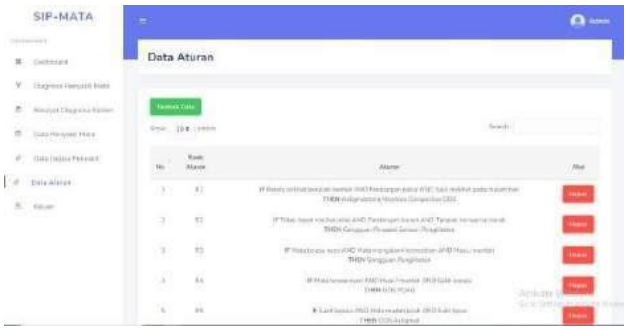

Fig. 9. Rule data form

h. Diagnosis History Form

This form is a page that displays related information data from the Diagnosis History. On this page, the admin can see the diagnosis results that have been inputted and delete the diagnosis history data can be seen in Figure 10 as follows:

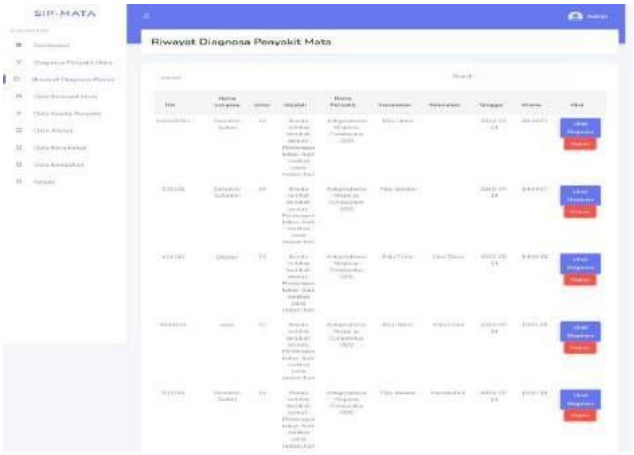

Fig. 10. Diagnosis History Form

3.1. System Testing

After the system has been completed, testing will be carried out on the system. Where testing will be carried out using Alpha Testing, knowing whether the functions contained in the system are running well or not [6] and Beta Testing to use questionnaires to patients or related parties and accuracy testing for the accuracy of expert systems [7]. which has been made in eye diseases in adolescents.

1) Alpha testing

The results of alpha testing on expert systems for diagnosing eye diseases in adolescents aged 12-15 years, namely testing system functions achieved and running well.

2) Beta Testing

Beta testing uses the distribution of questionnaires to patients or related parties in which there are several questions. Beta testing is carried out objectively where it is tested directly to the end user by making a questionnaire regarding user satisfaction in using the system.

3) Accuracy Testing

Accuracy testing is done to find out how accurate the expert system that has been made for eye diseases in adolescents is. The data tested is data. The results of system detection will be matched with data from expert analysis and will be summed up the system is classified as very good in system accuracy [8].

From these results, researchers used 5 diagrams, namely context diagrams, data flow diagrams (DFD), use case diagrams, activity diagrams, and entity relationship diagrams (ERD). The diagram is to describe the flow of the system and the basic design of the system created by the researcher.

Sample data of eye diseases in adolescents aged 12-15 years at the eye clinic smec hammer, as much as 19 disease data and 44 symptom data. In this study, the system was built using the forward chaining method to obtain the results of the rules of the types of eye diseases in adolescents aged 12- 15 years.

The system tests carried out are alpha testing, beta testing, and accuracy testing for system accuracy. In alpha testing that researchers do goes well, the components in the system run according to the expectations of researchers. From beta testing using the distribution of questionnaires from the results of the questionnaires that have been carried out, a percentage value of 86% for System Quality, 86% for Information Quality, and 88% for User Satisfaction from the results of the questionnaire conducted and for accuracy testing to determine the accuracy of the expert system that has been created, and the data tested is data The results of the system diagnosis will be matched with data from expert analysis accuracy value = correct data/test data x 100% then = 19 / 19 x 100% results 100% for accuracy, the system is classified as very good in system accuracy.

4. Conclusion

Based on testing and analyzing the expert system for diagnosing eye diseases in adolescents aged 12-15 years using the forward chaining method, the following conclusions can be drawn: Based on testing and analysis of expert systems for detecting eye diseases in adolescents using the forward chaining method, it can be concluded that the expert system created is able to diagnose eye diseases in adolescents aged 12-15 years by implementing the forward chaining method so that it can facilitate the community in diagnosing eye diseases experienced by adolescents by filling in the symptoms experienced. The design of an expert system for eye diseases in adolescents based on the results of testing using the alpha testing method using Blackbox testing, it can be seen that all functional and features on each menu can run well. In the design of an expert system for eye diseases in adolescents based on the results of testing using the beta testing method using questionnaires by giving questions to users, a value is obtained by calculating using a Likert scale with each parameter of System Quality of 86%, Information Quality of 86% and User Quality of 88%. In testing the accuracy of eye disease expert systems in adolescents using the Forward Chaining method using 19 disease data and 44 symptoms, a value of 100% was obtained for Accuracy.

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