Journal of Technlogy and System Information, Volume: 1, Nomor , 2024, Hal : 29-42

The Implementation of Android-Based Expert System Using Forward Chaining Method for Diagnosing Cat Diseases

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DOI: https://10.47134/jtsi.v1i1.2144
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Published: 19 January 2024

Abstract: The use of mobile devices is increasingly popular due to their user-friendly nature and portability. Expert systems are a component of artificial intelligence that can solve problems typically encountered by experts in determining diagnoses based on specific symptoms. Cats are captivating animals with adorable behaviors, which is why many people choose to have them as pets. As cat owners, it is important for humans to have knowledge about various diseases that can affect cats, as well as preventive measures and treatments to avoid negative impacts on the surrounding environment. The objective of this research is to develop an Android-based expert system application using the forward chaining method to diagnose cat diseases. The development of this system utilizes Android Studio software and employs blackbox testing for evaluation. Based on the research findings, it can be concluded that the implementation of the Android-based expert system application using the forward chaining method functions well, based on the questionnaire completed by 10 cat owners with 5 provided questions. The average result from the user satisfaction questions that have been presented is 88%. The system validation also yielded a result of 80% from 5 tests conducted with users. This application can also help alleviate the workload of veterinarians and cat owners in diagnosing cat diseases, although it cannot replace the role of a veterinarian.

Keywords: Android, Expert System, Forward Chaining, Android Studio, Blackbox.

INTRODUCTION

The use of mobile devices has become increasingly widespread due to their user-friendly nature and portability. The development of mobile applications has also seen significant advancements, providing numerous benefits, including the ability to diagnose diseases. Previously, disease diagnosis was manually performed by experts, but now it can be replaced by the role of a technology called an expert system (Sukma & Petrus, 2020).

Expert systems are a part of artificial intelligence that can solve problems commonly faced by an expert in determining diagnoses based on specific symptoms(Adjam & Altarans, 2020). This system will be incorporated in a computer that contains facts, knowledge, and reasoning methods to find solutions that usually can only be done by an expert. Many advantages offered by this expert system technology can help overcome and handle the era of technological progress(Prayogo & Amin, 2021). This expert system will utilize the forward chaining method in conducting information search progressively and combine several rules to produce logical conclusions and diagnoses(Nawangnugraeni, 2021).

Forward chaining is an easy-to-apply method when there is a collection of facts, including symptoms, diseases, and rules, to be used in this system(Sugiarto, 2022). This method can also be referred to as advanced search that identifies some facts based on existing rules or guidelines, and then makes hypotheses or diagnoses according to the collected facts(Ariandi & Kurnia, 2019). The system will also use mobile hardware to make it easier to use.

Currently, there are two types of mobile devices that can be distinguished, namely iOS-based mobile devices and Android-based mobile devices(Mahaputra et al., 2019). There are fewer iOS-based mobile device users compared to Android, because Android has a more affordable price for the people of Indonesia. Android was chosen as the platform in this study because of its easy use and almost owned by most Indonesians. In addition, the Android platform was chosen because it has various features that are not available in other platforms, such as touch screen, voice input without using a headset or other enhancements(Pranata et al., 2019).

Cats are attractive animals and have adorable mannerisms, which is why many people choose to keep cats (MohamadNurkamal Fauzan, 2020). As a cat owner, it is important for humans to have knowledge about various diseases that can attack cats and preventive and handling measures so as not to have a negative impact on the surrounding environment(Dwiramadhan et al., 2022). In many cases, humans often feel confused and panicked when their cats experience certain symptoms. The difficulty of finding a veterinarian in an emergency often forces cat owners to take cats to veterinary hospitals or veterinary clinics(Sukma & Petrus, 2020).

Based on the above description, the author is interested in creating and developing a system titled "The application of an android-based expert system using the forward chaining method to diagnose cat diseases".This system aims to facilitate cat owners in diagnosing cat diseases early and providing appropriate solutions for their treatment.

METHOD

The method to be used in this system is the forward chaining method. Forward chaining is a method that uses if-then logic. If represents the facts or symptoms that occur, and then represents the outcome of the existing facts or conclusions according to the rules (Syaputra & Setiadi, 2020). Forward chaining is the method that will be implemented in the system, while for the research flow, it starts with the data collection stage, followed by data processing, then system design, implementation into the system, and finally system testing. This method can be seen in Figure 1.

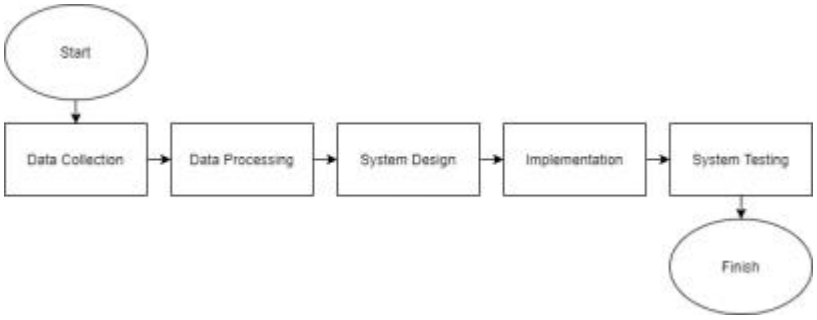

Figure 1. Research Flow

1. Data collection

In this stage, data will be collected, including disease data, symptoms, and rules, from journals, books, articles, and expert sources.

2. Data processing

In this stage, the data will be processed into a table or another format to facilitate reading or understanding based on the available data.

3. System design

In this stage, an overview of how the system will be operated by the users, from entering the system to exiting it, will be created. This stage will utilize two design methods, namely flowcharts and use cases. A flowchart consists of steps or diagrams to facilitate logical usage of the system (Syamsiah, 2019). The flowchart illustrates that users start from the home page, where they can choose various pages available on the home page. If users select the diagnosis menu, they will input symptoms, which will be analyzed according to the existing rules. Then, the system will diagnose the disease based on the experienced symptoms and the available rules. After exploring each page, users can exit the system when finished. This flowchart can be seen in Figure 2.

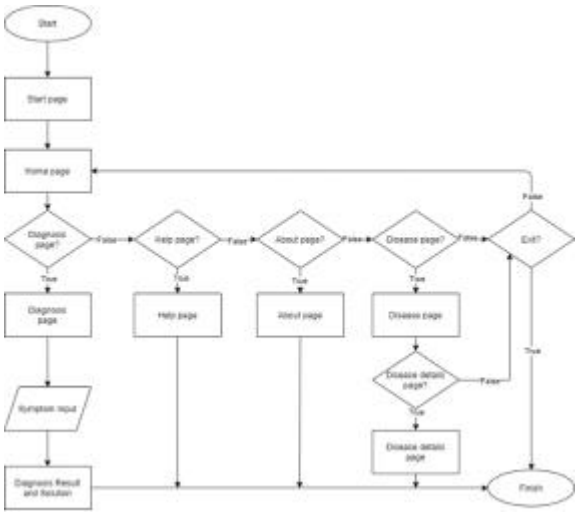

Figure 2. Flowchart

A use case is a diagram of a set of activities performed by users within a system (Sari et al., 2023). This use case explains that users can access the home page, diagnosis, list of diseases, help, and about. Users can also enter symptoms to obtain a diagnosis result. Users can also view details of the diseases. This use case can be seen in Figure 3.

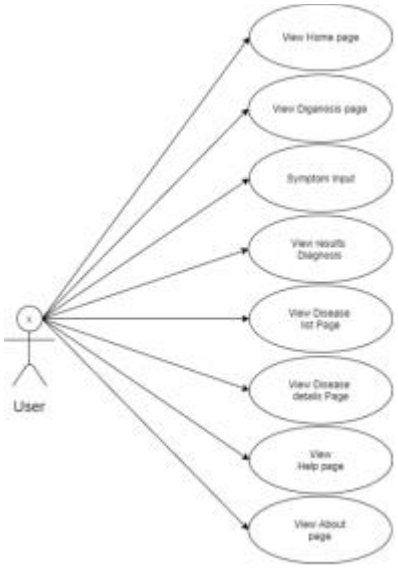

Figure 3. Usecase

4. Implementation

In this stage, the system is developed using the Java programming language and the Android Studio software to facilitate the creation of the Android-based system.

5. System testing

In this stage, system testing is conducted using the blackbox testing method to identify any errors or flaws in the system. User testing is performed to determine the effectiveness of the application, and validation testing is conducted to assess the accuracy of the application.

RESULT ANDDISCUSSION

A. Analysis

1. User requirements analysis

In the development and use of a mobile-based expert system application, several devices are required for users, such as an Android smartphone and an internet connection to download the application initially.

2. System requirements analysis

The following are some system requirements analysis for the mobile-based expert system for diagnosing cat diseases:

a. The disease diagnosis menu will be displayed, which contains a list of disease symptoms.
b. The diagnosis results of diseases and the steps for handling them will be displayed.

3. Diseases and symptoms analysis

a. Disease representation

Here is a table representing the available disease codes and types, with codes starting with P:

Table 1. Disease Representation

Disease Code	Disease Name
P01	Worm Infestation
P02	Hives
P03	Tick Infestation
P04	Liver Disorder
P05	Rhinotracheitis Virus
P06	Calicivirus
P07	Panleukopenia Virus

b. Representation of Symptoms

Here is a coded representation and the symptoms suffered with the code prefix G:

Table 2. Symptom representation

Symptom Code	Symptom Name
G01	Vomiting
G02	Loss of appetite
G03	Lethargy
G04	Frequent defecation
G05	Diarrhea
G06	Weight loss
G07	Itching around the anus
G08	Watery eyes
G09	Eye discharge
G10	Fever
G11	Dull fur
G12	Symmetrical and round skin lesions
G13	Hair loss leading to baldness
G14	Lesions on the neck, throat, and head area
G15	Symmetrical and round skin lesions
G16	Jaundice or yellowing of the ears
G17	Change in eye color
G18	Yellowish gums
G19	Dehydration
G20	Flu
G21	Sneezing
G22	Shortness of breath
G23	Mouth sores
G24	Excessive salivation

G25	Ear infection
G26	Sudden paralysis
G27	Coughing

c. Representation of Knowledge Symptoms

Here is a representation of knowledge types by matching diseases and symptoms suffered using checkmarks (√) in each column:

Table 3. Knowledge symptom representation

Symptom Code	Disease Code						
	P01	P02	P03	P04	P05	P06	P07
G01	√			√			√
G02	√			√	√	√	√
G03	√				√	√	√
G04	√						
G05	√			√			
G06	√						
G07	√						
G08	√						
G09	√						
G08					√	√	
G11		√	√	√			
G12		√					
G13			√				
G14			√				
G15			√				
G16				√			
G17				√			
G18				√			
G19				√	√		√
G20					√		
G21					√	√	
G22					√		
G23						√	
G24						√	
G25						√	
G26						√	
G27					√	√	

d. Rule Representation

Here is a representation of the rules that will identify the disease according to the existing symptoms:

Table 4. Rule representation

Rule code	Rule
R01	IF G01 OR G02 OR G03 OR G04 OR G05 OR G06 OR G07 OR G08 OR G09 THEN P01
R02	IF G11 OR G12 THEN P02
R03	IF G11 OR G13 OR G14 OR G15 THEN P03
R04	IF G01 OR G02 OR G05 OR G11 OR G16 OR G17 OR G18 OR G19 THEN P04
R05	IF G02 OR G03 OR G10 OR G19 OR G20 OR G21 OR G22 OR G27 THEN P05
R06	IF G02 OR G03 OR G10 OR G21 OR G23 OR G24 OR G25 OR G26 OR G27 THEN P06
R07	IF G01 OR G02 OR G03 OR G19 OR THEN P07

B.Implementation

1. Start page

On this page will display an initial explanation of the application rammed with credits and images indicating that this application is intended for cat pet owners. This page can be seen in figure 4.

Figure 4. Start page

2. Home page

On the home page there are several buttons that when pressed will go to the page according to the button pressed. This page can be seen in figure 5.

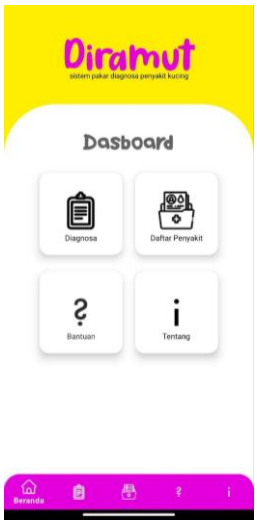

Figure 5. Home page

3. Diagnosis page

On this page will display some symptoms of the disease. Symptoms of this disease must be checked to be able to diagnose the disease, and there is a diagnosis button below and the results and solutions will be given below yourself. This page can be seen in figures 6 and 7.

Figure 6. Symptom diagnostics page *Figure 7. Result diagnostics page*

4. Disease list page

On this page will display some lists of diseases in this application. If the list of diseases is clicked, it will go to the details of the disease. This page can be seen in figures 8 and 9.

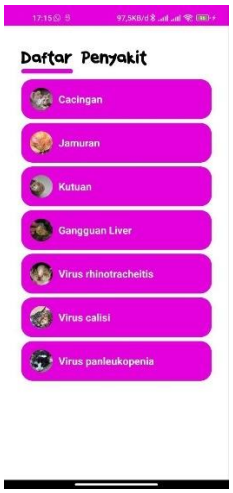

Figure 8. Disease list page *Figure 9. Disease details page*

5. Help pages

This page will show you some frequently asked questions if users are confused, or wondering how the app works, with a call button in case of emergency, which connects directly to an expert. This page also has a button on the location of the nearest clinic and a partner vet house clinic which when clicked will go to google maps according to location. This page can be seen in figures 10 and 11.

Figure 10. Help page *Figure 11. Detailed help page*

6. About page

On this page will display some of the people involved in making this application, with a small description for the biography of that person. This page can be seen in figures 12 and 13.

Figure 12. About page

Figure 13. Page about details

C.System test results

1. Black box testing results

The system testing was conducted using black box testing. Black box testing is a functionality-oriented testing method (Hidayat & Muttaqin, 2018). Blackbox testing is done to look for functions that are problematic and not in accordance with what is expected (Widiastiwi et al., 2020). The results of this system test are in table 5 which explains that the tests carried out using blackbox testing are in accordance with what the author wants, from the beginning of entering the system to testing one by one the buttons on this system run without any problems.

Table 5. Blackbox test result

Test Scenario	Expected Result	Testing Result	
		Success	Failure
Access initial menu	Display the initial menu	√	
Press dashboard button	Access and display the corresponding menu based on the pressed button	√	
Press bottom fragment button	Access and display the corresponding menu based on the pressed button	√	
Access diagnosis menu	Display the diagnosis menu	√	
Disease diagnosis	Display the disease and corresponding solutions based on the diagnosis	√	
Access disease list menu	Display the disease list menu	√	
View disease	View the disease	√	

Access help menu	Display the help menu	√
Press veterinary clinic location button	Open Google Maps with the nearest veterinary clinic	√
Press contact button	Connect with the expert doctor	√
Press question button	Display the answer to a given question	√
Access about menu	Display the about menu	√
Press individual button	Display the description of the respective individual	√

2. User testing results

This testing can be seen in Table 6, which explains that the testing was conducted by providing 5 questions to 10 cat owners to obtain their responses, and a factor of 50 is obtained as the divisor because it is the product of the number of questions and the number of cat owners who tested the application. Response "Totally agree" will be assigned 5 points, "agree" will be assigned 4 points, "somewhat agree" will be assigned 3 points, "disagree" will be assigned 2 points, and "strongly disagree" will be assigned 1 point. The results obtained from user testing for the first question were 92%, for the second question 86%, for the third question 90%, for the fourth question 82%, and for the fifth question 92%, average user satisfaction score for this application is 88%.

Table 6. User testing results

No	Question	User Response					Percentage
		Totally agree	Agree	Somewhat agree	Disagree	Strongly disagree	
1	Is this application usable?	6	4	0	0	0	92%
2	Is the appearance of this application easy to understand	3	7	0	0	0	86%
3	Is this application useful for you?	5	5	0	0	0	90%
4	Does this app show accurate results?	3	6	0	1	0	82%

5	Will you use this app when your cat looks sick?	6	4	0	0	0	92%

3. System Validation Results

The system validation results can be seen in Table 7. The purpose of system validation is to compare the system's diagnosis with that of a doctor and determine the accuracy of the system. This validation was obtained from 5 users who own cats and have them treated at a veterinary clinic. The results showed that 4 out of 5 diagnoses matched the system's diagnosis, while 1 out of 5 did not match the system's diagnosis due to limitations of the system itself. The overall validation result was 80%.

Table 7. System Validation Results

Dieses Name	Doctor Diagnosis	System Diagnosis
Hives	2	2
Liver Disorder	1	1
Calisi Virus	1	1
Other Disease	1	0
Total Diagnosis Result	5	4
Total Accuracy		4
Total Inaccuracy		1

CONCLUSION

Based on the above research, it can be concluded that the implementation of the Android-based expert system application using the forward chaining method functions well, as indicated by the questionnaire responses from 10 cat owners who completed the survey with 5 provided questions. The average user satisfaction rating obtained from the questions is 88%. The system validation results showed an accuracy of 80% based on 5 users who owned cats and had them treated at a veterinary clinic. This application can also help alleviate the workload of veterinarians and cat owners in diagnosing cat diseases, although it cannot replace the role of a veterinarian. The application provides solutions to cat owners based on their cat's diagnosed condition. The assistance provided in the system also facilitates direct communication between cat owners and the connected veterinarians through the application. With this system, cat owners can avoid immediate panic, provide proper care, and access information about common diseases experienced by cats.

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