Utilization and Management of Technology in Making Decisions to Assist Owners in First Aid for Dogs

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Article Info	Abstract
	Dogs are one of the pets that have a close relationship with humans, due to various factors including following the word, easy to be a human playmate, and even being docile to live with humans. However, in dog keeping, disease-related problems for dogs are harmful, not only to them but also to their owners. Difficult situations in obtaining treatment also often occur, where due to the distance of the veterinary clinic, the limited number of animal specialist clinics and the owner's desire to carry out the treatment on his own. Therefore, advanced technology needs to be introduced in diagnosing and giving recommendations to dog owners for first aid in providing fast and appropriate treatment to dogs. Therefore, here an expert mobile system-based application is introduced, that uses a decision tree classification method and a forward chaining algorithm. The application was tested for user acceptance using a Likert scale that yielded 94.4% for the ease of understanding the application, 92% for the ease of use of the application, 88% for the accuracy of providing information about symptoms and diseases, 93.6% for the attractiveness of the application display and 92.8% for the benefits for application users.

I. INTRODUCTION

Dogs are one of the pets that have the closest relationship with humans because dogs can be trained, play with, and even to live with. However, as time goes by, several problems in dog care may arise, one of which is the emergence of a disease that results in death [1].

This research is important to carry out because, in the current condition, many people prefer independent diagnosis and treatment rather than direct treatment from a doctor [2]. Apart from that, another problem in treating diseases in dogs is the long distance and the limited number of veterinary clinics, especially in rural areas [1].

With the development of technology, these problems can be solved by combining technology with science, where through an expert system-based mobile application [2]. An expert system technology assist the dog owners to diagnose diseases and provide first aid recommendations so that disease management is faster and more precise [3]. The classification method used is a decision tree. Decision trees are used to divide large data sets into smaller record sets by applying a series of decision rules. Apart from that, this expert system also uses a forward chaining algorithm which is a method based on facts or data to conclude. This algorithm is suitable for use on mobile. It is used because it does not require heavy computational processes [4]. Through this expert system-based mobile application, it is hoped to help identify diseases in dogs and provide information about first aid that can be done effectively. This study aims to produce an expert system application that can help dog owners to identify diseases in dogs and provide information about first aid that can be done.

II. RESEARCH METHODOLOGY

The research method carried out by researchers has several stages, namely primary data collection, architectural design, decision tree design, user interface design, implementation, and software testing.
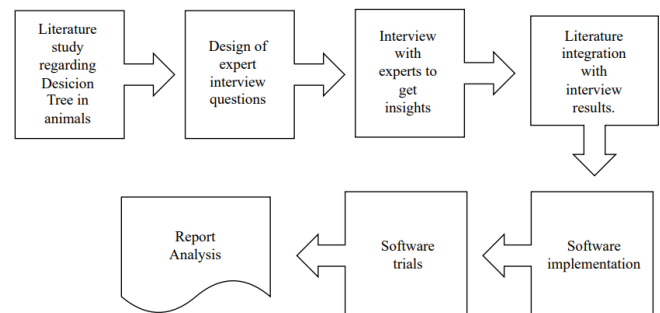

Figure 1. Research Methodology Steps

The researcher collected primary data through interviews. At the interview stage, the researcher conducted a question-and-answer session with a competent expert in his field (expert) to obtain accurate information.

A. Question Formulation

The questions were formulated by the researcher after conducting a question-and-answer session with experts. Some of the questions formulated by the researcher are as follows:

1. Has the dog lost its appetite?
2. Are there worms in the dog's feces or vomit?
3. Does the dog have a fever?
4. Does the dog have seizures?
5. Is the dog pale?
6. Does the dog have a cold?
7. Do dogs like it in the dark?
8. Is the dog's mucosa yellow?
9. Are there spots on the dog's skin?
10. Does the dog have diarrhea?
11. Does the dog have a wet cough?
12. Does the dog have bloody urine?
13. Is the dog's feces orange?
14. Does the dog have bloody diarrhea?

The formulation of this question is used as a decision-making step using a decision tree with the forward chaining method.

B. Decision Tree Design

A decision tree or also called a decision tree is the basis for supporting the running of an expert system application [2]. This decision tree aims to diagnose diseases experienced by dogs. The decision tree is compiled based on the formulation of questions made by researchers based on debriefing with experts.
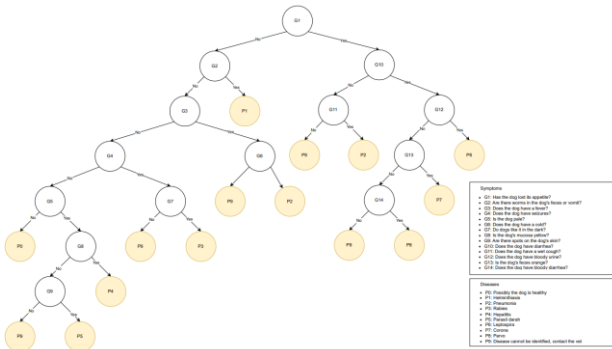

Figure 2. Decision Tree Design

The decision tree has 3 main components, namely attribute, value, and conclusion. The attribute contains questions about the symptoms that occur in dogs. Value contains "Yes" which means the symptoms are appropriate or "No" which means the symptoms are not appropriate. The last component is the conclusion which contains the results of the diagnosis of the disease according to the symptoms that arise. This decision tree is then implemented into an application called Dognosis to make it easier for users to make an independent diagnosis.

In the Dognosis application, the diagnosis process is carried out by asking the user several questions regarding the symptoms experienced by the dog. The first question asked was "Has the dog lost its appetite?" For each question, the user is required to choose one of two answer options, namely "Yes" or "No". The application of the forward chaining method causes the next question to depend on the answer to the previous question. Users will get the results of the diagnosis along with first aid methods after answering all the questions. The results of the diagnosis shown are by the conclusion on the decision tree.

C. Architecture Design

The architectural design is explained using activity diagrams. According to Tohari activity diagram is to model the workflow of business processes and the sequence of activities in a process. This diagram is very similar to a flowchart because it models the workflow of another activity or from activity to status [5].
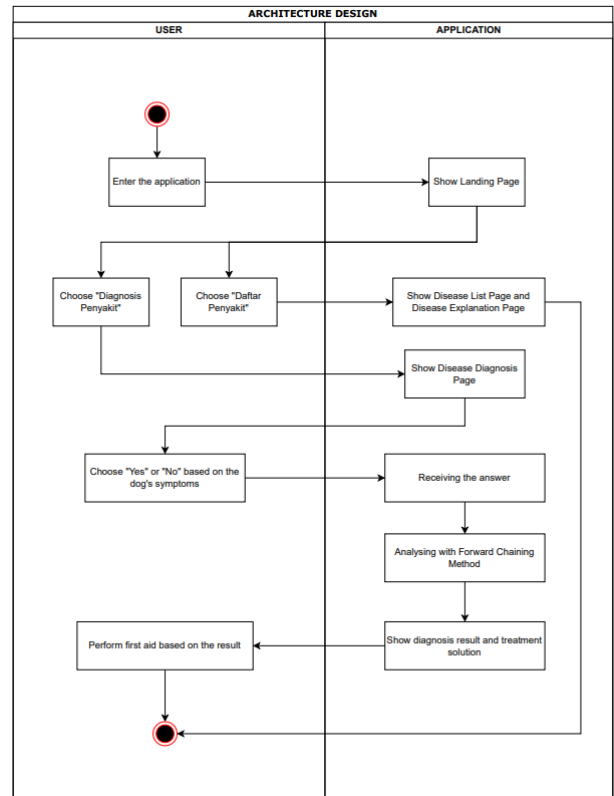

Figure 3. Architecture Design

D. User Interface Design

User interface design is a graphical interface design that displays how users interact with the system. In this study, 5 user interface designs were made, namely the main menu page, user manual page, diagnosis page, disease list page, and disease explanation page.

a. The main menu page provides 3 features that can be accessed, namely disease diagnosis, list of diseases, and assistance. This main menu page is also the landing page of the application.

Figure 4. Main Menu

b. The Diagnosis page is the main feature of this app. The diagnosis page applies the forward chaining and decision tree methods as a basis for decision-making. The user will be asked to answer each question by selecting "Yes" or "No" until a conclusion of dog disease and first treatment is obtained.

Figure 4. Diagnosis Page

c. The disease list page contains several common diseases that dogs often experience. Explanation of the list of diseases accompanied by descriptions, triggers, prevention, and treatment.
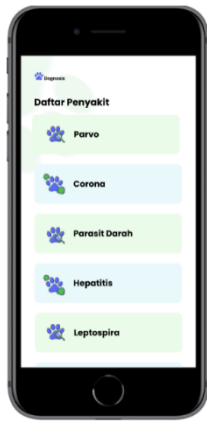

Figure 5. Disease List Page

d. The help page contains a guide for using the application.

Figure 6. Help Page

e. The disease explanation page contains a description, triggers, prevention, and treatment of the disease.

Figure 7. Disease Explanation Page

III. LITERATURE REVIEW

A. Previous Study

This research was carried out inseparable from the results of previous studies that have been carried out as comparative and study material. The research results used as comparisons are studies that apply expert systems.

Table 1
Previous Study

No.	Previous Study
1.	**Researcher(s) Name/Year:** (Prawira & Tanamal, 2021) [3] **Research Title:** Expert System for Diagnosing Diseases in Koi Fish Using Forward Chaining Method Based on Android **Research Result:** Mobile apps-based applications that are made based on knowledge obtained from decision trees that have been validated and implemented in Thunkable using the Forward chaining method which functions to diagnose disease in Koi fish based on the results of interviews and observations made with experts. This application has been analyzed using a Likert scale and it can be concluded that the user's approval of the Koi Disease application is functioning properly.
2.	**Reseacher(s) Name/Year:** (Pangestu & Tanamal, 2020) [6] **Research Title:** Design and Build a Mobile-Based Expert System Application for Diagnosing Skin Diseases in Persian Cats **Research Result:** The mobile-based application is made based on the knowledge from decision trees that have been designed and implemented using the Thunkable apps builder by applying the Forward chaining method which is useful for making temporary diagnoses of skin diseases in Persian cats with the knowledge base of experts. According to the results of the user acceptance test through the questionnaire, they agreed that this application provides convenience and benefits.
3.	**Researcher(s) Name/Year:** (Ratih Fitri Aini, Mohamad Hadi, M. Misdram, 2016) [7] **Research Title:** Design of Expert System for Diagnosing Chicken Diseases with Forward Chaining Method **Research Result:**

An expert system that makes it easy to find and get countermeasures in dealing with symptoms that occur in chickens, especially in Leghorn chickens and the results of the analysis are almost similar with the experts.

4. **Researcher(s) Name/Year:**
(Sibagariang, 2015) [8]

Research Title:
Cattle Disease Diagnostic Expert System with Certainty Factor Method Based on Android

Research Result:
The completed expert system prototype covers various aspects of cattle disease and is designed to be easily operated by users who use the forward chaining method and certainty factor based on the knowledge from questions asked to farmers.

B. Expert System

An expert system is a system designed to be able to imitate the expertise of an expert in answering questions and solving a problem. The expert system will provide a solution to a problem obtained from dialogue with the user. With the help of an expert system, someone who is not an expert or an expert can answer questions, solve problems and make decisions like an expert [9].

C. Decision Tree

Decision trees are one of the most popular classification methods because they are easy to interpret by humans. A decision tree is a structure that can be used to divide large data sets into smaller record sets by applying a series of decision rules. The decision tree has tree nodes that represent the attributes that have been tested and each branch is a distribution of test results and leaf nodes (leaf) represent certain class groups. The top node level of a decision tree is the root node which is usually an attribute that has the greatest influence on a particular class. The basic concept of a decision tree is to convert data into a decision tree model, then convert the tree model into a rule and simplify the rule. The data in the decision tree is expressed in table form with attributes and records [10].

D. Forward Chaining

Forward-chaining algorithms are one of the two main methods of reasoning when using an inference engine and can logically be described as the iterative application of modus ponens (a set of inference rules and valid arguments). The opposite of forward-chaining is backward-chaining. Forward-chaining starts working with the available data and uses inference rules to obtain other data until a goal or conclusion is reached. An inference engine that uses forward-chaining searches the inference rules until it finds one of the correct antecedents (theoretic propositions or IF -THEN clauses). When these rules are found, the decision-making engine can make conclusions, or consequences (THEN clauses), which generate new additional information from the data provided. The machine will repeat this process until the target is found. Forward-chaining is an example of the general concept of data-driven thinking, that is, thinking in which the focus of attention begins with known data. Forward-chaining can be used in agents to generate conclusions from incoming perceptions, often without specific queries [11].

Forward chaining is a forward-tracking method that starts with existing data and combines rules that are used to create a conclusion or goal. It starts with a set of known facts and applies rules to generate new facts where the basis of the conclusion matches the known facts, and continues this process until it reaches a predetermined goal, or until there are no further facts from which its premise can be derived. that agree with known facts. It checks the facts against a predefined query or goal and shows that inference moves forward from the facts toward the goal [3].

E. Thunkable

Thunkable is a platform where anyone can create their mobile apps. With Thunkable, non-coders can design attractive apps, program powerful functionality by drag and drop and upload apps to the Google Play Store and Apple App Store. All applications built using Thunkable work for Android and iOS devices [6].

IV. FINDINGS AND DISCUSSION

The results in this study were measured using 2 tests, namely the accuracy test and the User Acceptance Test (UAT). An accuracy test was performed to measure the accuracy of the diagnosis made based on a decision tree with direct diagnosis from experts. This test is carried out by conducting a question and answer session again with experts regarding the symptoms and results of the diagnosis formulated using the forward chaining method in a decision tree. Accuracy test results will be displayed using a table containing symptoms and a comparison of the results of the application's diagnosis with experts directly.

Table 2
Accurate Test Result

No	Symptoms	Application Result	Expert Result	Conclusion
1.	Worms in dog's feces or vomit	Helminthiasis	Helminthiasis	Match
2.	Fever, Cold	Pneumonia	Pneumonia	Match
3.	Seizures, like dark places	Rabies	Rabies	Match
4.	Pale, Yellow Mucosa	Hepatitis	Hepatitis	Match
5.	Pale, Spots on the dog's skin	Parasit darah	Parasit darah	Match
6.	Lost appetite, Wet cough	Pneumonia	Pneumonia	Match
7.	Lost appetite, Diarrhea, Bloody urine	Leptospira	Leptospira	Match
8.	Lost appetite, Diarrhea, Orange feces	Corona	Corona	Match
9.	Lost appetite, Diarrhea, Bloody Diarrhea	Parvo	Parvo	Match

User Acceptance Test (UAT) is a test that aims to determine the level of user acceptance of an application. This test is carried out by allowing the user to directly use the application. After finishing using the application, users are asked to fill out a questionnaire containing 5 questions. Each question has its own scale as an assessment. The scale used is a Likert scale of 1 to 5 with 1 being strongly disagree and 5 being strongly agree. The results of this scale will be processed into percentages to measure the level of the User Acceptance Test (UAT). Respondents in this test totaled 25 people as a sample who met the criteria as dog owners/keepers.

Table 3
Questionnaire Score Result

No	Question	Scale					Total
		1	2	3	4	5	
1.	Is the Dognosis app easy to understand?				7	18	118
2.	Is the Dognosis app easy to use?				10	15	115
3.	Does the Dognosis application provide the right symptom/disease information?				15	10	110
4.	Does the Dognosis application have an attractive appearance?				8	17	117
5.	Does the Dognosis app useful to you?				9	16	116

The total is calculated using the number of selected scales multiplied by the scale value with a maximum value of 125. Then, it is converted to a percent so that the percentage of test results for each indicator can be seen in the following table.

Table 4
Assessment of Likert Scale Results

No	Question	Score	Conclusion
1.	Is the Dognosis app easy to understand?	94.4%	Strongly Agree
2.	Is the Dognosis app easy to use?	92%	Strongly Agree
3.	Does the Dognosis application provide the right symptom/disease information?	88%	Agree
4.	Does the Dognosis application have an attractive appearance?	93.6%	Strongly Agree
5.	Does the Dognosis app useful to you?	92.8%	Strongly Agree

Based on the two types of tests that have been carried out, namely the accuracy test and UAT, several conclusions can be drawn. It is concluded that the developed application has an accuracy rate of 100%, based on the suitability between the results of the application and the results of experts. Meanwhile, based on UAT, it was concluded that users strongly agree that this application is easy to understand and use. It was also found that users agree that this application provides the right symptom/disease information. Users also agree that this application has an attractive appearance. In addition, it was also found that users strongly agree that the application developed is very useful. Even though, this application has limitations because there are only 8 diseases that can be diagnosed and only developed for Android users.

V. CONCLUSION

From the research flow that has been traversed, an Android-based expert system application is produced that can assist dog owners in providing first aid to dogs. This is indicated by obtaining a value of 92.8% for the value of benefits for application users in the User Acceptance Test that has been carried out.

This application applies the Forward Chaining method because it requires checking on the rule-based that has been made. Making a decision tree based on the results of interviews with experts, namely veterinarians. The user interface of this expert system application was created using the Figma platform and this application was designed and built using the Thunkable platform.

This application has been tested for user acceptance using a Likert scale which yielded 94.4% for easy understanding of the application, 92% for ease of use of the application, 88% for the accuracy of providing information on symptoms and diseases, 93.6% for the attractiveness of the application display and 92.8% for benefits for application users. Based on the accuracy test of the suitability between the results of the application and the results of experts that have been done, this application has an accuracy of 100%.

VI. SUGGESTION

This expert system application has limitations, where merely 8 diseases can be diagnosed. To get the most out of it, users still need the help of a veterinarian to receive more accurate results. From the questionnaires that have been distributed, there are also suggestions for adding types of disease. Some other suggestions are about the appearance of the application itself. This is like the "Home" button that is too small and the use of colors can be improved because it is considered uncomfortable to look at for a long period.

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