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An Android-Based Rabbit Gastrointestinal Disease Diagnosis Expert System With a Forward Chaining Method

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Abstract – Rabbits are animals prone to diseases, mainly affected by digestive system conditions. According to the author's experience, the interviews with rabbit breeders and veterinarians were located in Tangerang, if disorders in the digestive system do not receive proper treatment and will quickly result in death for the rabbit. Rabbit owners sometimes don't know what to do. Obstacles often encountered are limited time, costs, and the number of veterinarians who are still small so that they cannot handle the rabbit immediately. Based on the above problems, it is necessary to design an expert system application with an Android base. The purpose of creating a system is to diagnose diseases in the digestion of rabbits, accompanied by a solution. The method used is to use the forward chaining method to design a digestive disease diagnosis system. This study resulted in the design of an application based on android to diagnose diseases in the digestion of rabbits**.**
Keywords – Android, App, Forward Chaining, Rabbit Disease, Expert System.

I. INTRODUCTION

Pets are animals that we regularly keep in our homes and are sometimes thought of as everyday companions or even as having a very significant impact on their owners' lives. Because of their affinity for humans, rabbits are one of the most popular pets. Rabbits are not immune to the risk of disease, either, and untreated illness can be harmful [1]. Rabbits require special care to prevent illness, much as other domestic animals. This illness is to blame for the rabbit's demise, particularly if it has intestinal issues. based on the author's experience and conversations with vets and rabbit breeders. If indigestion is not adequately and promptly managed, it may result in the rabbit's death.

In Indonesia, rabbits are a simple animal to breed. There is excellent potential for meat production and procreation. Rabbits have a gestation period of about 30 days and can give birth 6–8 times a year. Up to 8 kits can be produced each time you give birth. The high death rate and declining output quality of mature rabbits, however, limit this potential. Some of the deaths happened when the rabbit was an adult, but the majority happened when it was still a baby bunny and hadn't been weaned. Sometimes the paired mother will not give birth either; however, upon investigation, it is discovered that the mate was unsuccessful or was unable to conceive. This issue is brought on by breeders' lack of awareness regarding diseases that affect rabbits and the likelihood of successful pregnancy after mating. Counselling on the traits of sick rabbits, the symptoms they feel, and how to handle them is one possible option. Farmers are instructed in the handling and injection of sick rabbits. The second method is to teach rabbits how to marry until they are successful at it and to look for pregnant rabbits 12 to 14 days after mating. Therefore, breeders are not required to wait 30 days before breeding again [2].

A sick rabbit's most typical presentation to the doctor is gastrointestinal stasis syndrome. The causes of this syndrome are frequently multifaceted, and an improper diet increases the risk of the condition in the rabbit. This disorder's complications can result in gastrointestinal obstruction, a potentially fatal illness that calls for urgent medicinal and occasionally surgical treatment. Rabbits may also have diarrheal symptoms [3].

In the other hand, the proximal colon is the primary location for the separation of the diet's digestible and indigestible components in the rabbit's complicated gastrointestinal physiology. The clinical significance of this system lies in the requirement of a regular diet rich in long particle length (> 0.5 mm) indigestible fiber to sustain the motility of the colon and cecum. The majority of common digestive issues in rabbits kept in captivity are caused by unsuitable meals (low fiber, excessive protein, high carbohydrate) and infrequently giving the rabbit treats to which it is not used. If captive rabbits are fed a diet that consists mostly of fibrous material, such as grass, hay, and fibrous weeds, many of these issues can be avoided [4].

In the book Goldmine of Ornamental Rabbits by [5] the authors discuss various illnesses that affect rabbits frequently, such as bloat, scabies, and diarrhea. The state of the cage's cleanliness and the quality of the food are two things that can cause rabbits to contract diseases more frequently, according to [6]. It's crucial to understand the numerous diseases that affect rabbits and how to feed them properly and healthily [7]. Additionally, it is uncommon for rabbit breeders and breeders who lack the time to consult a veterinarian directly. If a sick rabbit is not treated right away, the illness will get worse and may even kill the animal. Such things may be harmful to rabbit breeders and keepers [8].

There are instances when rabbit owners are unsure of what to do when their pet is ill. When owners have to take their animals to the doctor, they occasionally run into issues

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like the distance to the nearest clinic, the lack of a veterinarian who treats rabbits, or a lack of free time. These inquiries can be used to formulate an issue that calls for an expert system to help the general public, particularly rabbit owners, learn about digestive disorders in rabbits as well as their symptoms and how to treat them.

The success of growers or hobbyists in caring for their rabbits can be determined by their health; rabbits kept as pets must continue to be healthy in order for the quality and production of rabbits to be sustained. Cleaning the cage, providing clean, boiling water, offering vitamin-rich diet, and other measures will help to improve rabbit health. Speaking of health, it relates to disease issues that can affect rabbits. Disease issues can lower quality and production in rabbit culture, thus rabbit cultivators and hobbyists must have knowledge of the symptoms, diseases, and how to handle disease in rabbits. It is required to develop an expert system as a means of managing diseases in rabbits because the knowledge of current rabbit specialists in the field does not allow for the provision of full information about rabbit diseases [5].

Both internal and external factors might have an impact on a breeder's success. When growing rabbits, maintenance management and marketing must be taken into account. Housing, nutrition, and pest and disease control systems are all included in maintenance management [9].

The Android operating system has benefits over other smartphone operating systems that make it simpler for developers to produce applications and their features to their specifications [10]. The user can become irritated by the simplicity and usability of Android-based applications without ever opening a webpage. Because the expert system can automatically be connected when the program is opened [11].

A computer program known as an expert system belongs to the field of computer science known as AI (Artificial Intelligence). Artificial intelligence is concerned with how knowledge is used to come to a conclusion that will be represented in a machine, and it aims to make things intelligent in terms of understanding through computer programs that are demonstrated by a concept and method of symbolic inference or reasoning made by computers. Knowledge-based or expert systems are artificial intelligence programs that produce knowledge of a particular subject and can solve problems within a certain domain at an expert level. A knowledge-based system that mimics the deductive reasoning of an authority figure in a given subject is known as an expert system [12]. The objective of this work is to develop a forward chaining expert system application that can identify digestive disorders in rabbits.

II. RESEARCH METHODOLOGY

The research method used in this study is the Forward Chaining method. Referring to the opinions of Russel and Norving in [13] , the Forward Chaining Method is a search method or forward tracking technique that begins with existing information and incorporation rules to produce a conclusion or goal.

The forward chaining algorithm is logically described as a repetition application of the ponens mode (a set of inference rules and valid arguments); this method uses the inference engine by taking one of two reasons (thinking). Forward chaining begins to work with the available data and uses inference rules to get the other data until the target or conclusion is reached [14].

Inference machines that use forward chaining look for inference rules until they find one of the correct antecedents (theoretical postulates or IF - THEN clauses). When such rules are discovered, the decision-making machine can make inferences, or consequences (THEN clauses), which generate additional information from the data provided. The machine will repeat this process until the target is found [15]. The stages in this study start from data collection, system design, and implementation.

This article uses several data collection methods: literature study, documentation, observation, and interviews. It is a data collection technique by reading and comparing literature on the internet in articles, journals, and books [16]. Next comes the documentation. Data collection with documentation techniques is carried out by observing, researching, and mastering systems that have been seen or previously formed related to research objects to obtain valuable data. The interview itself is a data collection technique using question and answer sessions with experts to obtain the necessary information and data [17]. At this stage, the author observes and questions and answers through visiting a veterinary clinic and rabbit farm in order to get accurate results and later become the author's solution data in this expert system planning

The design of the algorithm in the expert system was created to make it easier to read the programs that have been created. Knowledge is divided into two main parts of its process: facts and conclusions. Then classify the facts into more specific facts and form rules with certain conclusions. Users provide input in the form of facts, namely user data and visible symptoms. Then enter the data into the rule, where the system will confirm whether the rule is correct. If it is not appropriate, the user will fill in other data. However, if appropriate, the rules or facts will be stored in a file in the database, and the file will go through a process by which the user can carry out the identification process [11].

In the identification process, conclusions will be drawn about diseases caused by symptoms entered by the user or diseases that cannot be found because the disease does not comply with the rules. The results obtained at the end of the plan are in the form of preventive and treatment solutions according to the type of disease.

The use of forward chaining in the expert system so that later users can choose facts in advance about gastrointestinal diseases suffered by rabbit owners. Next, a conclusion will be formed against the previously selected points. In the identification process, decisions will be drawn about infections caused by symptoms entered by the user or illnesses that cannot be found because the condition does not comply with the rules. The results obtained at the end of the plan are in the form of preventive and treatment solutions according to the type of disease.

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The forward chaining method can provide much information from only a small data set. The advantage of this method is that it will work well when the problem starts from collecting/unifying information and then looking for what conclusions can be drawn from the report.

The following figure 1 is the design step of the algorithm in the author's expert system to make it effortless to read the program that has been made. If there is a failure in the knowledge base, the decision will be back in the appearing symptoms step. Here below the detailed algorithm arrangement,

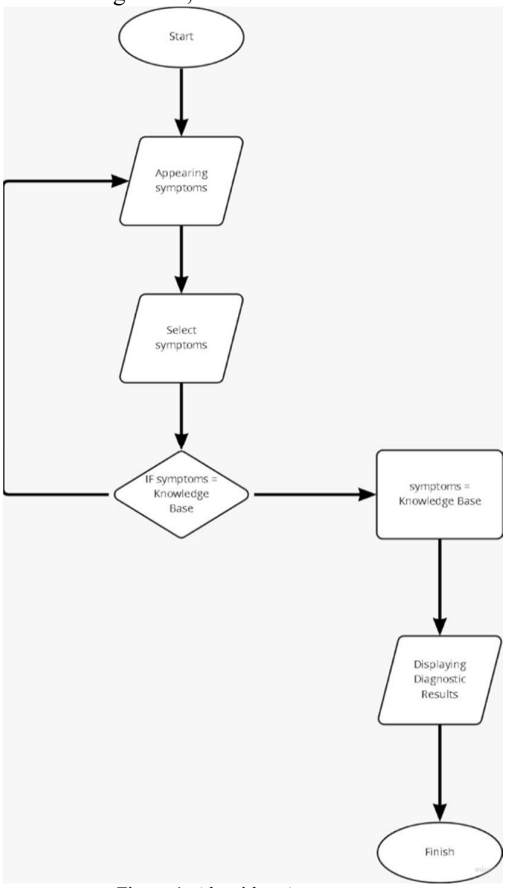

Figure 1. Algorithm Arrangement

III. RESULTS AND DISCUSSION

As for making a simple expert system with an android foundation for diagnosing disorders of the rabbit digestive system, the expert system designed incorporates symptom and disease data, which is a crucial object. The author has created the expert table below to make it easier to process knowledge base data input.

Table 1. Rabbit Digestive Disease Data

No	Disease Code	Name of Disease
1	P01	Bloating
2	P02	Coccidiosis
3	P03	Enteritis
4	P04	Hairball

Table 2. Rabbit Digestive Disease Symptoms Data

NO	Symptoms Code	Symptoms of Disease
1	G01	Sluggish
2	G02	Faint
3	G03	Bloated Stomach
4	G04	Diarrhoea
5	G05	Anorexia
6	G06	Abdominal Distension
7	G07	Watery Stool
8	G08	Slimy Stool
9	G09	Bloody Stool
10	G10	Depression
11	G11	Lose Weight

Table 3. Data Types of Rabbit Digestive Disease Solution

No	Solution Code	How to Overcome
1	S01	Medicine: Bamboo Shoots K, Acepromazine, Permethyl Vitamin: B Complex, Probiotik, Sun-drop Lifestyle: Reduce food/drink consumption and give dry feed such as timothy grass **If you feel the condition is severe, immediately consult a veterinarian**
2	S02	Medicine: Sulfaquinoxaline, Nitrofurans Lifestyle: Separate rabbits from others, place rabbits in a clean and comfortable place, and provide nutritious food and drinks
3	S03	Medicine: Bamboo Shoots K, neomycin or chloramphenicol antibiotics Lifestyle: Reduce the consumption of food or drink and provide dry feed such as timothy grass
4	S04	Medicine: Hairball paw gel **It is recommended to check with the veterinarian** Lifestyle: Be diligent in combing the rabbit's fur so that the hair that falls out is not swallowed and do grooming regularly

Table 1 shows that rabbit digestive diseases are inputted in the P01 to P04 code. Each code defined the name of the disease. In addition, as shown in table 2, the disease symptoms illustrate by G01-G11 codes. Finally, the disease solution presents in table 3 and using S01-S04 codes. It includes how to overcome the diseases, such as medicine will be taken and lifestyle changes.

Moreover, in making an adequate expert system the User Interface (UI) needs to be inputted some algorithm language using IF, AND, and THEN commands. Due to reflecting the knowledge, the rule method is used in the form of If-Then (IF-THEN). The rules consist of four types. Here below the detail of the rules:

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Rule 1

IF Sluggish
AND Faint
AND Bloated Stomach
THEN Rabbit diagnosed with bloating

Rule 2

IF Diarrhoea
AND Lost Appetite
AND Abdominal distension
THEN Rabbit diagnosed with coccidiosis

Rule 3

IF Diarrhoea
AND Watery Stool
AND Slimy Stool
AND Bloody Stool
Then Rabbit diagnosed with Enteritis

Rule 4

IF Anorexia
AND Diarrhea
AND Depression
AND Lose Weight
Then Rabbit diagnosed with Hairball Disease

The entire four rules to be inputted based in basic data as shown in tables 1,2 and 3. The four diseases data inputted as THEN command. The previous IF and AND function is used to determine disease symptoms. Each rule has a different solution from the expert system. The expert system must analyse the input and output rules.

The expert decision tree that the author has made is based on the Expert Table as shown in figure 2,

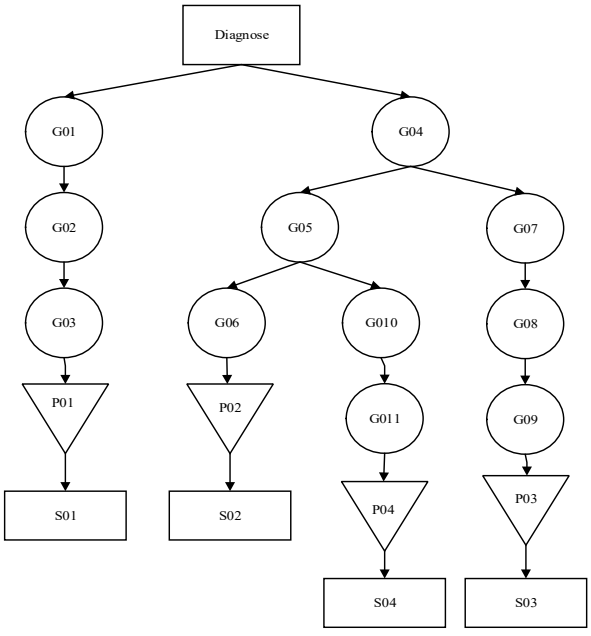

Figure 2. Root Decision Tree

The root decision tree based in figure 2 illustrates that the sequences are from G to P to S codes. It means that the rabbits have some symptoms and are diagnosed with a disease. After that, the expert system could give a decent solution to the rabbit.

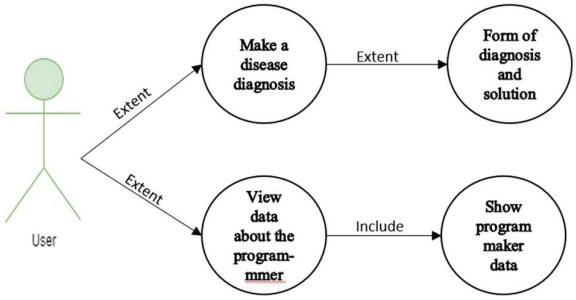

Figure 3. Use Case Diagram

Furthermore, as shown in figure 3 the case diagram explains the two steps which user can click within the expert system. The first way is to make a diagnosis of the disease and another step is function as a data viewer. The following table 4 is a description of the use case diagram of the user in the Rabbit Digestive Disease diagnosis system,

Table 4. Description of Use Case User Expert System for Diagnosis of Rabbit Digestive Disease

Use Case Name	Diagnostic Process
Requirement	
Goal	Users can access all the menus on the expert system for diagnosing rabbit digestive diseases
Pre-Conditions	Users know about the rabbit digestive disease diagnosis application
Post-Conditions	Users can find out the type of disease and the solution for handling it
Failed and Conditions	The user does not get the type of disease or solution to the problem in diagnosing rabbit digestive diseases
Primary Actors	User
Mainflow/Basic Path	1. Users answer questions in the form of digestive disease symptoms in rabbits 2. Users get information about the type of rabbit disease

In other hand, based in table 4 the expert system has an use case for user. There some steps from the case, requirement, goal, pre-conditions, post-conditions, failed and conditions, primary actors, also mainflow or basic path. All steps determine case for user utilisation. If there is any miss step or error, the expert system will be back to previous step.

The user interface is used to reflect the appearance of the application that will be used by the user.

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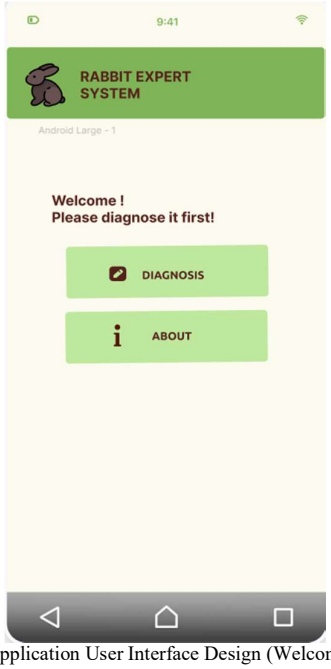

Figure 4. Application User Interface Design (Welcome Section)

Subsequently, the dashboard menu of the expert system program as shown in figure 4 consists of diagnose and about section. If the user clicks on the diagnosis, you'll be sent to figure 5, which comprises questions that will provide the diagnostic findings and answers for a solution, as shown in figure 6. Whenever the user clicks the about, It advances to the section containing information on the expert system creator.

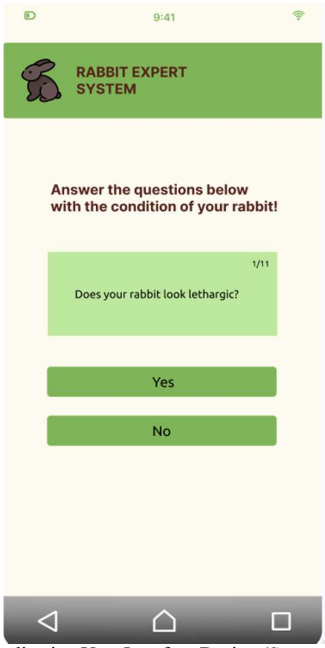

Figure 5. Application User Interface Design (Symptom Question Section)

In addition, based on the above picture as shown in figure 5, the expert system asked about the rabbit symptom condition. The user must give a correct answer because it affects the next step.

Figure 6. Application User Interface Design (Diagnose and Solution Section)

Finally, the final view of the expert system as shown in figure 6 the diagnose and solution of the rabbit. The diagnose is inputted from previous rule data based in table 3. The data from the inputted rules is vital to give an appropriate answer.

IV. CONCLUSION

In summary, the forward chaining method can identify gastrointestinal diseases of rabbits according to the existing symptoms. The created system can only identify gastrointestinal disorders in rabbits. The Forward Chaining method in the diagnostic process will provide questions by the tree flow, so it must answer each question until the discharge is completed to get the final result (solution). The implication of the existence of an information system created is that users can quickly consult anywhere and anytime just by using a cellphone. Further research is expected to be able to develop applications by adding disease symptoms and solutions so that more diseases are detected and can be appropriately treated.

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