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Expert System in Diagnosing Pet Disease

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Abstract: The existing system of the Klinik Haiwan & Surgeri (MHI) are not appropriate because of the pet owner need to fill the registration form every time their pet get a treatment. MHI also use unappropriated method to give the consultation about the pet treatment and medicine intake method by the phone call. The purpose of MyPet are to help the owner to diagnosis the pet disease by selecting the symptoms in the phone. This system developed to change the method of consultation session to appropriate one and the user will get the benefits from this expert system that uses the rule base inference engine in diagnosis their pet disease. The result that obtains from system analysis and design using object-oriented approach, Use Case diagram, Class diagram, To-be model flowchart have been developed. Lastly, system prototype has been developed to make sure that the system fulfills the all the requirements.

Keywords: Expert System, Diagnosis, Pet Disease, Rule Based Inference

1.   Introduction

"MyPet," is a expert system for diagnosing pet diseases that developed for "Klinik Haiwan & Surgeri MHI" (MHI). MyPet is a system that focusing on diagnosis pet disease that called as expert system (ES). Most definitions of an expert system (ES) include some reference to the ability of the system to perform at a level close to human expect performance. Typically, the performance of an ES has been validated by running a number of test cases through the system and comparing the result from the system against either known results or expert opinion [1]. There are additional definitions, such as the ability to acquire and retain knowledge; mental ability; the ability to adapt swiftly and successfully to a new situation; and so on. ES technology is increasingly being used to assist individuals in reaching decisions and solving difficulties by replying or entering certain symptoms or information.

In addition, diagnosis is the process of determining the nature of a disease or ailment and differentiating it from other potential diseases. The term "diagnosis" comes from the Greek word gnosis, which means "knowing" [2]. To perform the diagnosis process, the rule-based inference has been implemented in this system. The rule base contains rules, the conditions of which must be matched to elements in working memory. The inference engine determines which of the rules in the rule base have all their conditions matched to objects in the working memory, and then decides which rule to apply.

The application of a rule will usually cause elements in working memory to be added, removed or altered. The rule is an 'if-then' construct, where the 'if' part contains conditions that must be met in order for rule to be considered for use. If the rule gets used, the actions in the 'then' part are performed [10].

2.   Related Work

2.1   Mobile Application

In the modern era, mobile is being need gadget that can connecting with other people in bigger distant. Mobile application become growing sector because there is a global positive impact of mobile application. This is because mobile applications are running on a small hand hold mobile device which is moveable, easy to use and accessible from anywhere and any place. Meanwhile, so many people are using mobile application to contact friends, browse internet, file content management, document creating and handling, entertainment etc. [3].

This application is building as the mobile application because it is portable device that user can access the system easily, and MyPet is not suitable for web based system because MHI requested a system that user do not to write information every time the patient get a treatment at their clinic. This approach are very suitable as requested by MHI because the user only need to login and register once user enter the system.

From the review has made by Simon at el., Benefits of Mobile Apps in Pain Management conclude that "Apps for pain management may be beneficial for patients, particularly in an out-clinic setting. Studies have shown that pain apps are workable and well-liked by patients and health care professionals. There is no doubt that in the near future, mobile technologies will develop further. Medicine could profit from this development as our results indicate, but there is a need for more scientific inputs. It is desirable to know which elements of apps or additional devices or tools may improve usability and help patients in pain management." [9]

2.2   Rule Based Inference

In this application, rule-based inference is chosen to be implement in this application development because it is used to store and manipulate knowledge to interpret information in a useful way. MyPet also used the rule-based inference which are consist of three components: a long-term memory (in the form of rule base), a working memory, and an inference engine.

The rule base contains rules or ruleset, the conditions of which must be matched to elements in working memory. The inference engine determines which of the rules in the rule base have all their conditions matched to objects in the working memory, and then decides which rule to apply. The application of a rule will usually cause elements in working memory to be added, removed or altered. The rule is an 'if-then' construct, where the 'if' part contains conditions that must be met in order for rule to be considered for use. If the rule gets used, the actions in the 'then' part are performed [10].

Rule-based data mining algorithms have a number of desirable properties. Rule sets are relatively easy for people to understand, and rule learning systems outperform decision tree learners on many problems. Rule sets have a natural and familiar first order version, namely Prolog predicates, and techniques for learning propositional rule sets can often be extended to the first-order case [11].

Table 1: Training Set for Diagnosing Pet Disease

PetID	Symptom	Disease	Treatment
1	Diarrheal Tiredness	Campylobacter	Self
2	Vomit Red eyes Tiredness Swollen lymph nodes	Cat Scratch Disease	Clinic
3	Diarrheal Greasy Stools Dehydrated	Giardiasis	Clinic

Table 1 shows an example of dataset in diagnosis pet disease. This dataset is used for a medical diagnosis, and it contains information for pet disease with their symptoms. The type of symptoms for each disease is used to make decision whether the patient need treatment at the clinic or self-treatment. The class type of each instance is either clinic or self, representing whether the patient need treatment at the clinic or not.

2.3   Comparison between Existing System

The proposed system is Expert System for diagnosing pet disease remotely. According to research conducted on three existing systems, certain functions that are similar with the proposed system and some functions are not provided. Furthermore, each system has their disadvantage, which is the functions needed is not required in the systems. Therefore, all benefits and disadvantages will act as a guidance in developing the proposed system in order to build a better system. Table 2 shows the comparison between existing system in term of functions or modules

Table 2: Comparison between existing system

System/Module	Leander Veterinary Clinic [13]	VetPain [14]	Vet-Anatomy [15]	MyPet
Registration and Login	Available	Available	Available	Available
Health Progress	Not Available	Not Available	Not Available	Available
Pet Disease Status	Not Available	Not Available	Not Available	Available
Consultation	Available	Not Available	Not Available	Available
Report	Available	Not Available	Available	Available

3.   Methodology

Iterative model is used for the development of MyPet, expert system in diagnosing pet disease. Figure 1 shows the phase of the iterative model from the beginning until the end of this project. The phases are planning and requirement phase, analysis and design phase, implementation phase, testing phase, deployment and evaluation phase.
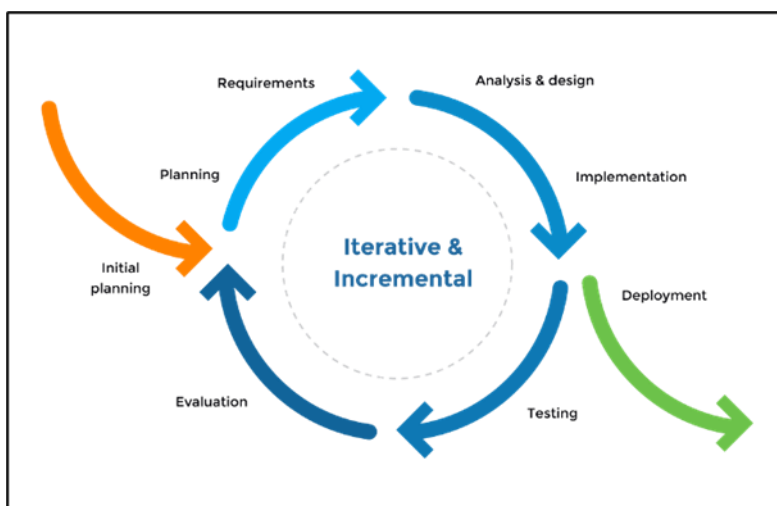
Figure 1: Iterative and Incremental Model Diagram

The explanation of research methodology phases is explained as follows. Table 3 summarize the main phase and activities carry out during each phase. The tasks will carry out based on the phase.

Table 3: Project Workflow

Phase	Activity	Deliverables
Planning	• Identification of the system for development • Feasibility assessment • Creation of project plan	• Project proposal • Gantt Chart
Analysis and Design	• Gathering business requirement • Creating process diagram • Performing a detailed analysis • Design the user interface	• System Requirement • Use case Diagrams • Class Diagram • System Design (Flowchart) • Requirement Traceability Matrix (RTM)
Implementation	• Develop the system based on project charter	• Program Code
Testing	• Test the developed system to find potential bugs or issues	• Test Cases • System Overall Testing Result
Evaluation	• Validates the requirements	• Complete system

3.1   Planning

In this phase, the specific goals of this project need to be identified. The title has been agreed to proceed was MyPet, expert system in diagnosing pet disease. User requirements are collected, and analyst tests whether or not the requirements can be fulfilled. The research papers and journals of previous works and the existing system are used to obtain all the information. The objective of this system are identified, and all the requirements are gathered to fulfill the requirement of the to-be system. Figure 5 shows the To-Be model flowchart of the proposed system.

3.2   Analysis and Design

System analysis encompasses the full development and flow of the system involved in assessing a system's functioning [4]. Therefore, this section will describe the proposed system's design and analysis. Using this object-based programming approach, system analysis will be created initially in the analysis and design phase before being translated using specific diagrams such as Use Case Diagrams, Sequence Diagrams, Class Diagrams, and Activity Diagrams. Figures 2 and 3 shows the Use Case Diagram and Class Diagram of the proposed system.
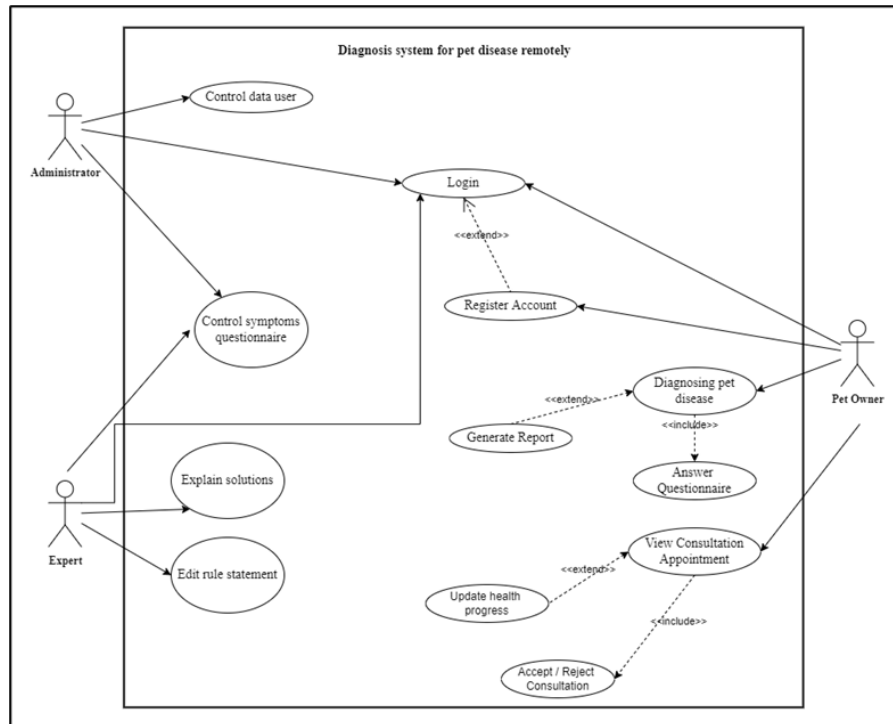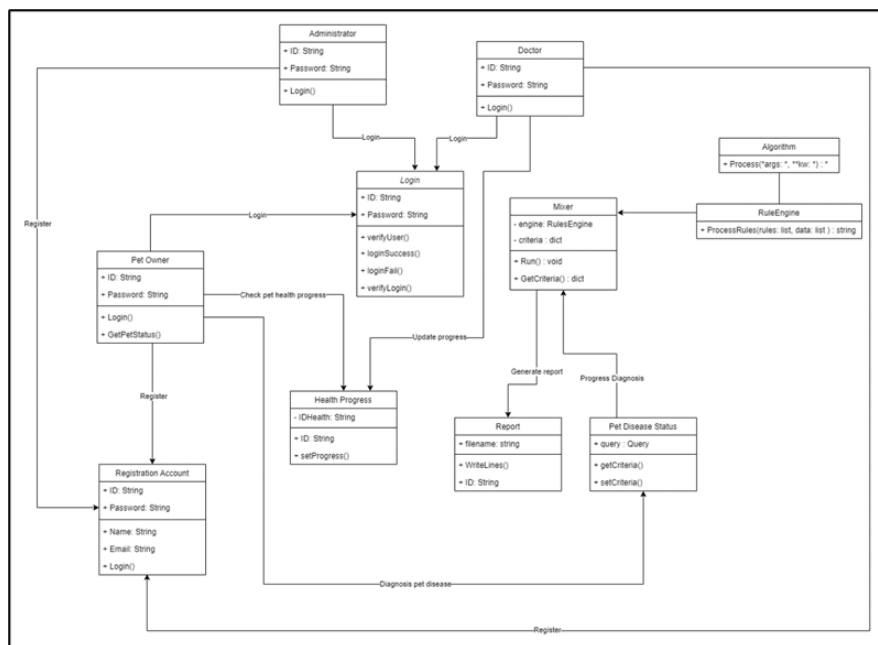

Figure 2: Use Case Diagram

Figure 3: Class Diagram

System architecture is considered a fundamental element in the development of large and complex electrical systems. This is because a good architecture assures that the system fulfils and will fulfil after future upgrades all required quality demands. IEEE also defines software architecture as the fundamental organization of a system embodied in its components, their relationships to each other and to the environment, and the principles guiding its design and evolution.
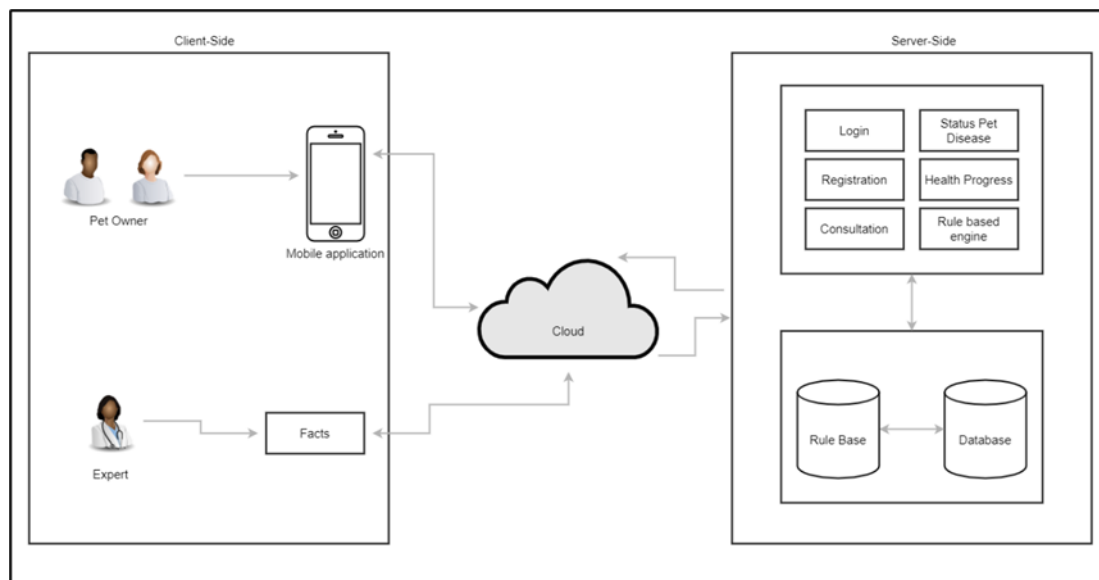
Figure 4: System Architecture Diagram

A functional requirement specifies "a function that a system (...) must be able to perform", "what the product must do", "what the system should do". The second thread emphasizes behavior: functional requirements "describe the behavioral aspects of a system"; behavioral requirements are "those requirements that specify the inputs (stimuli) to the system, the outputs (responses) from the system, and behavioral relationships between them; also called functional or operational requirements."[5].

Table 4: Functional requirement for the proposed system

No.	Modules	Functionalities
1.	Registration and Login	• System shall allow users to register for their account • System shall alert users when the required information field is empty. • System shall show error when the user enters already existing email when register. • System shall allow users to log in to the system using email and password. • System shall allow users to input valid email and password when logging in. • System shall alert users when there is invalid or incorrect input. • System shall redirect users to the next page once the login is successful.
2.	Health progress	• System shall allow the users to see the health progress of the pet. • System shall allow the doctors to update the pet health progress after every consultation appointment.
3.	Pet Disease Status	• System shall allow user clicks pet name to display the steps of diagnosing pet disease.

No.	Modules	Functionalities
		• System shall allow the users select the symptoms that pet have and click submit button. • System shall display the name of the disease based on symptoms selected
4.	Consultation	• System shall allow users to set the consultation appointment • System shall display the calendar for user select the date. • System shall allow user click button to submit the appointment.
5.	Report	• The system will auto generate report if the user diagnosis pet disease.

The term 'non-functional requirement' has been in use for more than 20 years, there is still no consensus in the requirements engineering community what non-functional requirements are and how we should elicit, document, and validate them [5]. Non-functional requirement is defined as requirements which are not specifically concerned with the functionality of a system [6].

Table 5: Non-functional requirement of the proposed system

No.	Requirements	Descriptions
1.	Performance	• System shall be able to be use anytime. • System shall respond to the user within 2 seconds.
2.	Operational	• System shall be able to be used on the android mobile operation system. • System shall be easy to use even for the first-time users.
3.	Security	• All users must login to the system to have access to it. • Users can only log in with the correct user id and password.

Understanding user requirements is an integral part of information systems design and is critical to the success of interactive systems. It is now widely understood that successful systems and products begin with an understanding of the needs and requirements of the users [7].

Table 6: User requirements for the proposed system

No.	User requirements
1.	User shall be able to input the required information during the registration process.
2.	Users shall be able to log in using the correct information they provide during the registration process.
3.	User shall be able to see able the report.
4.	Users shall be able to select symptoms in the pet disease status module.
5.	User shall be able to view profile information.
6.	User shall be able to set the consultation appointment.
7.	Administrator shall be able to log into the system.
8.	Administrator shall be able to see the consultation appointment

3.3   Testing

After the development phase, it continues to testing phase. Testing is carried out to know the outcome of application. Testing is made to know the actual result and the expected result. Testing is more than just error detection. Testing is done under controlled conditions. [12]

- Verification: To verify if system behaves as specified. It is the checking and testing of items, which includes software, for conformance and consistency of software by evaluating the results against pre-defined requirements.
- Validation: In this we check the system correctness which is the process of checking that what has been specified by user and what the user actually wanted.

The result will be declared whether the application is successful or failed. The testing result are getting from the test on each module and their functionalities. Table 7, 8, 9 shows the modules testing summary. This module passed all the requirements and features work nicely.

Table 7: Registration and Login module testing summary

Test Case	Test Condition	Expected Result	Test Result
STD_TEST_100	SRS_REQ_100	Registration and Login Module	Success / Failed
STD_TEST_101	SRS_REQ_101	User click button register to register account.	Success
STD_TEST_102	SRS_REQ_102	User enters all the information required.	Success
STD_TEST_103	SRS_REQ_103	User clicks the back button to login system for the first time.	Success
STD_TEST_104	SRS_REQ_104	User enters the correct ID and password to login the system.	Success
STD_TEST_105	SRS_REQ_105	System will display error message if user enter wrong ID or password.	Success

Table 8: Pet disease status module testing summary

Test Case	Test Condition	Expected Result	Test Result
STD_TEST_300	SRS_REQ_300	Pet Disease Status Module	Success / Failed
STD_TEST_301	SRS_REQ_301	User clicks pet name to display the steps of diagnosing pet disease.	Success
STD_TEST_302	SRS_REQ_302	User will answer the symptoms that pet have and click submit button.	Success
STD_TEST_303	SRS_REQ_303	System will display the name of the disease based on symptoms selected in the step 2.	Success

Table 9: Consultation module testing summary

Test Case	Test Condition	Expected Result	Test Result
STD_TEST_400	SRS_REQ_400	Consultation Module	Success / Failed
STD_TEST_401	SRS_REQ_401	User can set the consultation appointment.	Success
STD_TEST_402	SRS_REQ_402	System will display calendar for user selected for the consultation date.	Success
STD_TEST_403	SRS_REQ_403	User will be able to select date in the calendar.	Success
STD_TEST_404	SRS_REQ_404	User click done button to submit the appointment and finish the steps.	Success

The testing that has been made on MyPet are meeting the requirements and objectives on the project charter. Table 10 shows the record of the testing result.

Table 10: Whole system test result

| Test Case	Number Of Test Case Passed	Success (%)
STD_TEST_100	5/5	100.00
STD_TEST_300	3/3	100.00
STD_TEST_400	4/4	100.00

5. Conclusion

For conclusion this application has their own advantages and disadvantage. The advantages are the system developed as mobile applications where the user can access anytime and anywhere. Secondly, the function of diagnosing pet disease can help user to check the disease and knowledge about the treatment. Otherwise, the disadvantages of this system are the report of the system does not display well. There is need some deployment of that system and forget password button are not provided. The user will has difficulties to recover their password.

The uses of the existing system in MHI that using the WhatsApp and phone call as a method to give consultation session is not appropriate. The owner of MHI, Dr.Muhammad Hariz Ibrahim said during the interview session that MHI need another initiative to deliver the consultation and the clinic also need to save all the data of their patient. Dr. Hariz also suggested some ideas to be added in the system to improve their service at MHI.

Acknowledgment

Appendix A
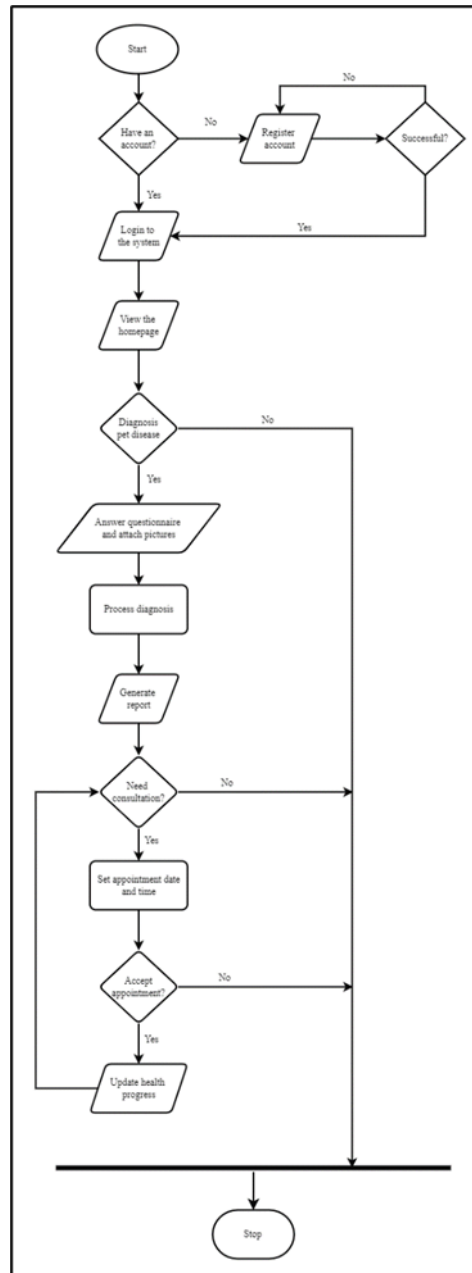
Figure 5: To-be Flowchart Diagram

Table 11 shows the requirement traceability matrix (RTM) that Requirement traceability matrix is a table that captures the complete user and system requirement for the system. It helps to trace from requirement till testing in order to verify that the requirement is fulfilled [8]. In MyPet development methodology, requirement traceability matrix is used to capture the linkage of user stories between the user and the system. Thus, the proposed system must be surpassed with the requirements traceability matrix.

Table 11: Requirement Traceability Matrix (RTM)

Requirement	Software Requirement Specification	Description
Registration And Login SRS_REQ_100	SRS_REQ_101	User click button register to register account.
	SRS_REQ_102	User enters all the information required.
	SRS_REQ_103	User clicks the back button to login system for the first time.
	SRS_REQ_104	User enters the correct ID and password to login the system.
	SRS_REQ_105	System will display error message if user enter wrong ID or password.
Health Progress SRS_REQ_200	SRS_REQ_201	User can click health progress to check the progress pet health.
	SRS_REQ_202	The system will update the progress bar after every treatment appointment.
Pet Disease Status SRS_REQ_300	SRS_REQ_301	User clicks pet name to display the steps of diagnosing pet disease.
	SRS_REQ_302	User will answer the symptoms that pet have and click submit button.
	SRS_REQ_303	System will display the name of the disease based on symptoms selected in the step 2.
Consultation SRS_REQ_400	SRS_REQ_401	User can set the consultation appointment.
	SRS_REQ_402	System will display calendar for user selected for the consultation date.
	SRS_REQ_403	User will be able to select date in the calendar.
	SRS_REQ_404	User click done button to submit the appointment and finish the steps.
Report SRS_REQ_500	SRS_REQ_501	The system will auto generate report if the user diagnosis pet disease.

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