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Expert System Application on Citrus Plant Disease Using *Seesaw* Method Approach

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ABSTRACT
This research is based on the reality that farmers' citrus plants are experiencing some disturbanceand late growth which the cause is not from citrus plant pest. The researcher uses an approach called SEESAWmethod and development method. The researcher collects information from farmers thenstudies the existingliterature and later develops them into system and method that can be implemented in application software. Java is used in system design to implement this new concept. Data collected into this system consist of citrus plant disease data, symptom data, data of disease control and other supporting data. The knowledge basis used is collected from citrus experts and citrus farmers. One of the results of this research is a ready-to-use application. This application can be used by farmers to have early detectionand identification on citrus plantdiseasein Rejang Lebong district.
Keyword: *application, Disease Detection, SEESAW method*

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I. INTRODUCTION

1.1. Background

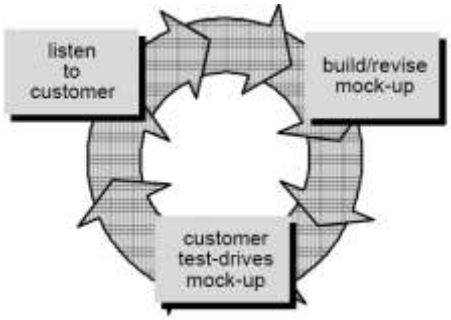
Citrus is one of main commodities grown by farmers in Bengkulu, especially in Lebong district as their supporting income. Citrus is also fruit commodity which has economic and health value (it contains vitamin C & vitamin A). Citrus can be consumed directly as raw fruit or as juice which is useful for health. The content of vitamin C varies from varieties between 27 - 49 mg/100 g of fruit meat. Riper citrus is usually lesser in vitamin C content, but it is sweeter. Thereare many citrus varieties, each variety has different characteristics. The crop yields dependon the quality of produced fruit. Recently, the crop yields have decreased due to plant diseases. From the recent study it is found that thedisease is not from plant pest that commonly found in the past. This causes difficulty for early detection and eventually brings effect to fruit quality and crop yields.

The use of information technology is increasing nowadays, especially in the field of computer science. One example is the use of computer as human assisting system which is supported by application. . This research will show that the advance in computer science today can also be applied in farming;it is to diagnose citrus plant disease in the form of application. Citrus plant disease detecting application is urgently needed by citrus farmers; this application can be used to transfer knowledge of an expert into a ready-to-use system. This system is built by implementing a technique and the success of the system is determined by the performance of the technique or method. Thus, the researcher entitles this research Expert System Application on CitrusPlant Disease Using SEESAW Method Approach.

The objectives of thisresearch are: (1) To help citrus farmers in Lebong district to conduct early detection of plant disease (2) To help farmers to get information and data about citrus plant disease more easily (3) One of techniques or methodsimplemented in this research is SEESAW method. This method combines Forward Chaining method with Backwardchaining method (4) To design and build Expert System Application on Citrus plant disease that can be operated on multi operating system commonly used today.

1.2. Supporting Theory and Concept

In building the Expert System Application, prototyping model (Whiten & Betley, 2004) is used. This method is taken in order that the resulting application works properly. Besides, the main reason of taking this method is that there is repetition of data collection after evaluation or test that is less proper. For example, if in a given test the prototype result still can not fulfill the objective, data collection will be done again to fulfill the objective. Thus, this method is very suitable to use in building this application. Prototype model can be seen in picture 1.



Picture 1. Prototyping model (Whiten & Betley, 2004)

Stages in prototyping model can be explained as follow:

a. Information collection is aimed to collect data and information needed in the resulting application.
b. Building/revising prototype stage is done to elaboratethe result of information collection and revise the result of the resulting prototype.
c. After theabovestages, the next step is to test the resulting prototype; it tests the outcome of the resulting prototype. This is done to avoid unexpected error.
d. This process will be repeated if the existing result is not satisfying yet. If the result is already satisfying this process will stop at the stage of prototype test.

Djunaedi (1986) said that literature review isused to see and to answer the problem that is going to be studied. The researcher finds at least three recent researches which have correlation with this research (1) Expert System of Sweet Orange Pest and Disease in Karo District (Theopilus and Tati, 2013) in which its implementation using Knowledge in Data Store. (2) Expert System to Diagnose Disease on Citrus and Its Solution (Dianni and Eka, 2016) in which its implementation using Probability Calculation. (3) Development of Expert System of Garut Tangerine Disease Diagnosis (Dini and Yusuf, 2015) in which its implementation using Backward Chaining.

Fromthose three researches the researcher elaborates the topic being studied based on new findings of which one of them is that pest is not part of disease. The researcher also develops method that is called SEESAW so that in the implementation of knowledge basis the used expert is more dynamic. The resulting application from this research can be operated on multi operating system so that it is possible to be run on all kind of smart phones, tabs and all computer devices existing today.

a. Expert System

According to Nugroho (2008) Expert System is a system with computer basis which uses knowledge, fact, and reasoning technique in solving problem which usually can only be solved by an expert in the field. While Durkin (1994) states that expert system is a system which tries to adopt human knowledge into computer so that computer can solve problem like what expert does. Knowledge used in expert system consists of rules or information from experience of behavior of an element of problem cluster (Kusrini, 2006).

b.Knowledge Acquisition

Knowledge acquisition is a process of identification, interview, collecting and filtering basic knowledgeinvolving systemdeveloper and one or some expert systems in a particular field. Stages of knowledge acquisition process that are used to build expert system are: First, process of knowledge acquisition of expert system is determined by comprehension of expert system toward the field that is being studied, definition of expert system, knowledge organization, arrangement, validity and keeping of basic knowledge. Second, knowledge acquisitionprocess of expert system consists of some stages: identification, conceptuality, formalization, implementation and testing. Third, knowledge acquisition process also consists of stages of implementation hypothesis based on expertise, knowledge modeling and validation (Ismadi & Hartati, 2008).

c.Knowledge Representation

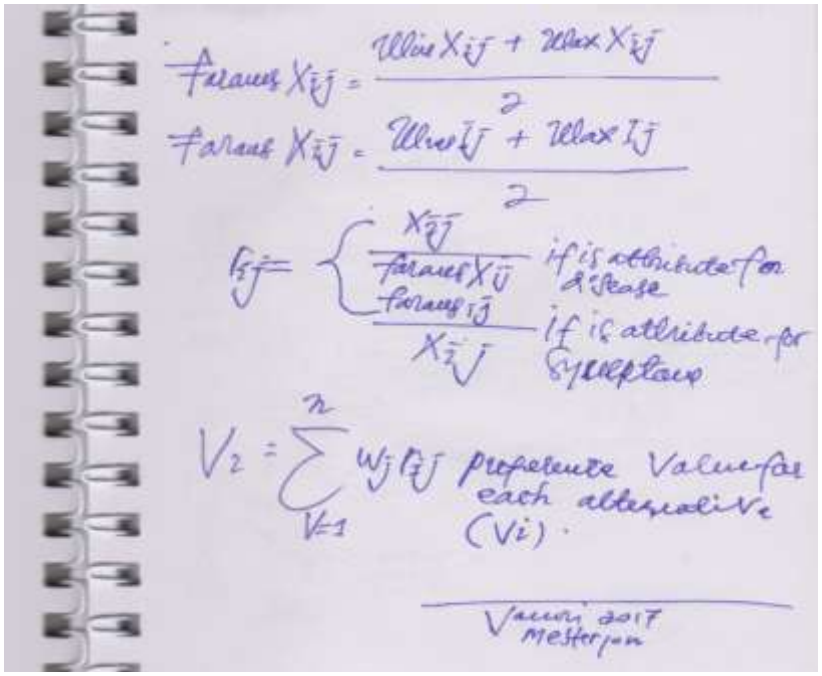
In order that knowledge can be used in a system, knowledge \must be represented in a format that later compiled into a knowledge basis. Knowledge basis is a part which conveys knowledge objects and relation between objects. Knowledge representation is a method used to code knowledge in an expert system with knowledge basis. This is aimed to capture important traits of problem and to enable the information to be accessesed by problem solving procedure. Inference machine which is expert system component that manipulates and directs knowledge from knowledge basis is also needed in drawingconclusion (Kusrini, 2006). The main task of inference machine is to test fact and rule and to add new fact if possible and to determine command based on the result of reasoning.

d.Diagnosis

Diagnosis is an examining process on an itemorresearch process on type of disease or destruction based on its symptom. Diagnosis is identification of diseasetraits or condition which differ a disease from other disease that the early step can be done through physical check, laboratory test, etc (Saputra and Robinson, 2012)

e.SEESAW

SEESAW is a combination between Forward chaining and backward method. This is the basis of knowledge which is used by the researcher to build application based on expert system. With SEESAW approach the researcher can apply and develop the two methods in order to produce rule that can read fact in different condition. In Forward chaining fact matching starts from the left (IF first). In other word, reasoning starts from fact to test hypothesis. According to Kusumadewi and Sri (2003) Backward chaining method is contrast to Forward chaining; it starts from a hypothesis (an object) and asks for information to ensure or to ignore. Forward chaining is often called bottom-up reasoning because reasoning starts at lower level fact toward conclusion at higher level based on fact. Bottom-up reasoning in an expert system is considered equal to bottom-up conventional programming (Hasibuan, 2007). Fact is basic unity of paradigm based on knowledge because it can not be separated into meaningful smallest unit. Backward chaining is a chain crossed from a hypothesis turns back to fact that supports the hypothesis. Other way to depict Backward Chaining is in term of objective that can be provided by providing its sub-objective. Backwards chaining can also be defined as reasoning starts from the highest level building a hypothesis down to the lowest level fact which supports hypothesis. It is called top-bottom reasoning (Arhami, 2012). The formalization formula of SEESAW can be seen below:



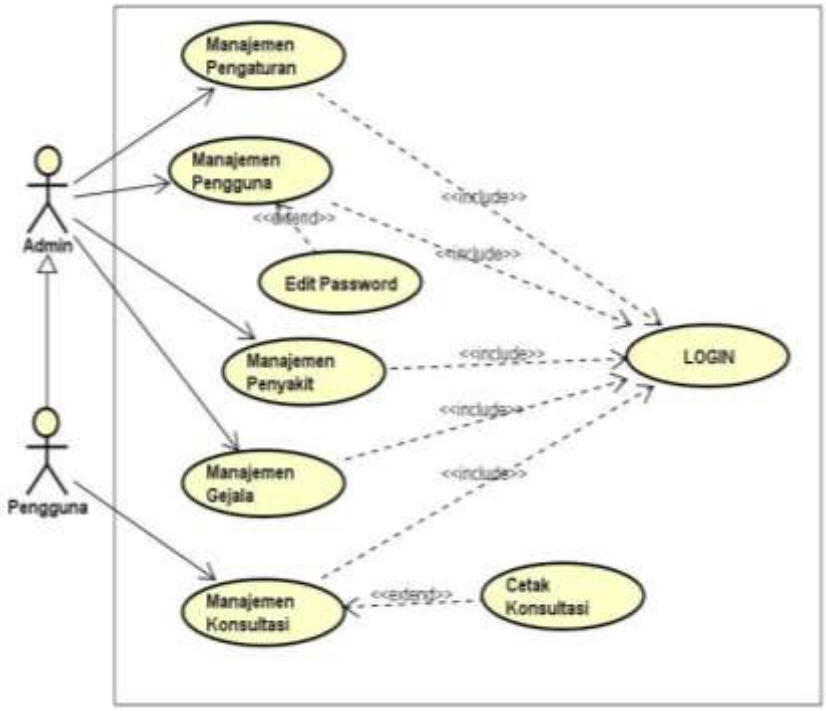
1.3. Research Method

This research uses development method. According to Pressman (2010) Development method is a change from old diagnosis system of citrus plant disease to the new one. Formerly, identification of disease type by Balai Benih Induk Holtikultura (Plant Seed Center) done manually and uses simple way by making record in ledger.The new diagnosis systemdeveloped by the researcher is aimed to help citrus farmers and Balai Benih Induk Holtikultura to make diagnosis of citrus plant diseasetype more easily.

II. RESEARCH RESULT

2.1. *Use Case Diagram*

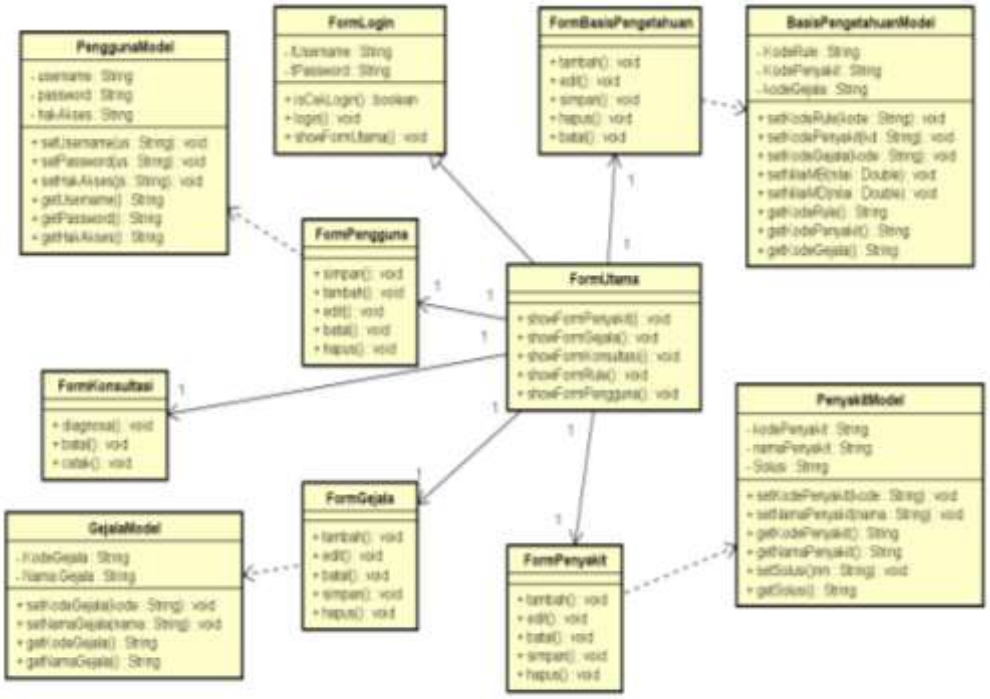
According to Whiten and Betley (2004) *Use Case* is a model communicating what is needed from user perspective. Based on fact analysis and review, the researcher conducts need specification design or requirements of use case diagram of the built system in which admin user can do control management when admin user has done proper setting. Admin user can do disease management, symptom management and user management. After inputting needed data for diagnosis or consultation the users of this system can have consultation based on data inputted by admin and print the consultation result. Use case diagram can be seen in picture 2.



Picture 2. Design of Use Case Diagram

2.2. Class Diagram

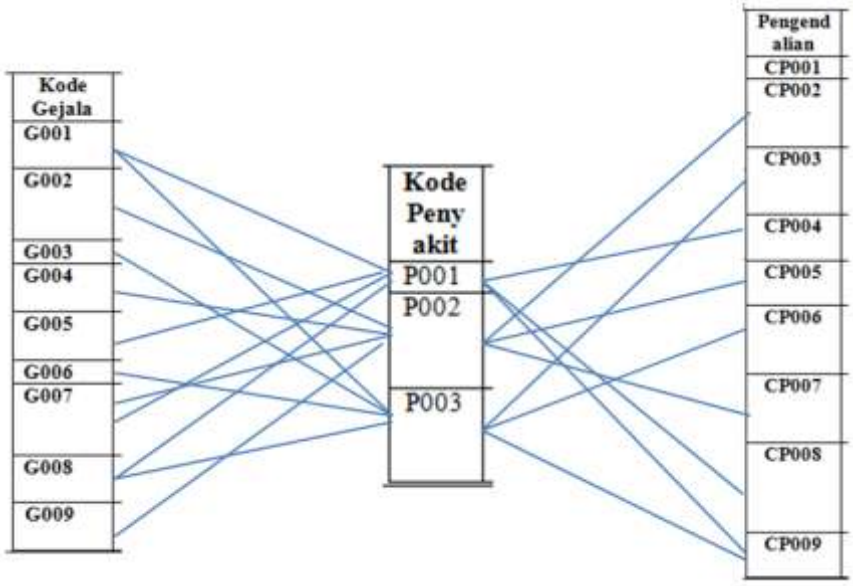
Class diagram is a diagram that shows existing classes of a system and their relation logically (Pender, 2002). Thus, class diagram is backbone or basic strength from almost each method that is object oriented including UML. The researcher designs class diagram that is depicted in form of boxes consisting three parts: name of class, attribute and operation. Picture of class diagram can be seen in picture 5 below:



Picture 5. Design of Class diagram

2.3. Semantic Network of SEESAW

Thissemantic network shows lines which havecorrelation between symptom, disease and pest control.Basedon research result it is found nine (9) items which can be grouped into symptom, three (3) items which can be grouped into disease and nine (9) items which can be grouped into control. Picture of Semantic Network can be seen in picture 6 below:



Picture 6. ***Semantic Network***

2.4. Cycle of SEESAW Diagram

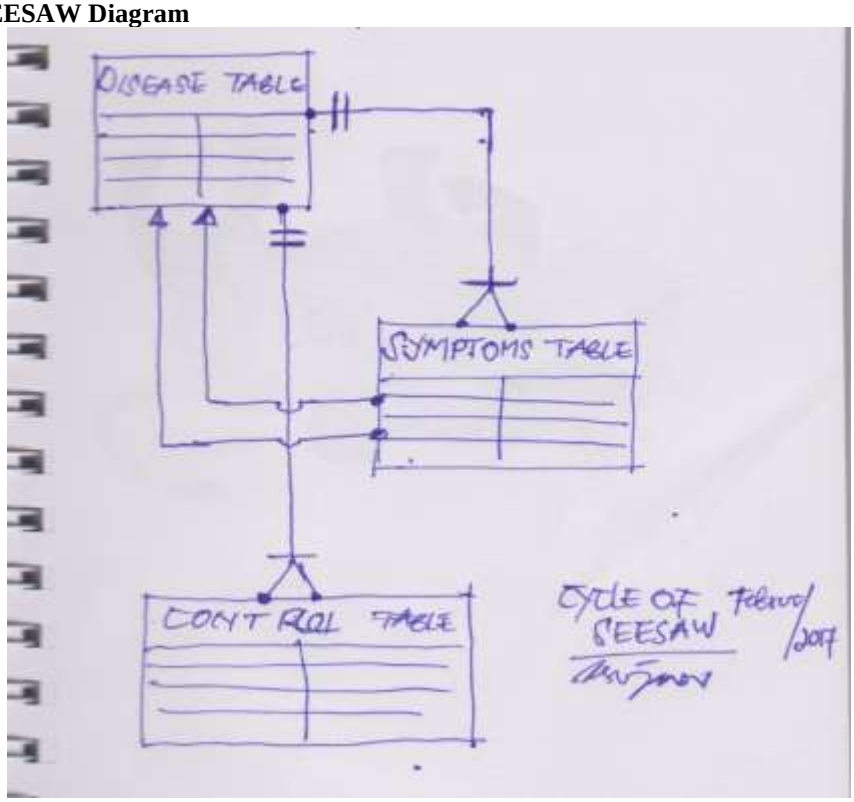


Table 1. Cycle of SEESAW System

2.5. The Resulting Application

With this application citrus farmers can have interactive and direct consultation without an expert. This application is equipped with knowledge basis of experts so that this system enables farmers to have direct consultation to detect disease that possibly attacksthecitrus plant early. Picture of consultation form can be seen in picture 7 bellow:

Picture7. *Consultation Form*

2.6. Application Test Result

Application test is done using Black Book System method. Black Book System is method of software test which tests application functionality which contras to internal or work structure. (Roger and Pressman, 2002). The result can be seen in table 2 below:

Table 2. System Test Result

No	***Testing scenario***	***Expected result***	***conclusion***
1	2	3	4
5	In the entry of symptom form, click button without filing in symptom code and symptom, directly click *save* button	System will reject to save data and show message "Data Tidak Boleh Kosong" (Data can be left empty)	As expected
6	In the entry of symptom form, click button then fill in symptom code and directly click *save* button	System will save data and show message "Data Berhasil Disimpan" (Data successfully saved)	As expected
7	In the entry of symptom form, click*edit* button and change the symptom then click *save* button	System will save data which has already been changed and show message "Data Berhasil Dirubah"(Data successfully changed)	As expected
8	In the entry of symptom form, choose data which is needed to be tabled then click *delete* button	Appears message "Apakah anda ingin menghapus data ini? (Do you want to delete this data?)Yes/No" click*Yes* and data will be deleted and message "Data berhasil dihapus"(Data is successfully deleted) appears, click *No* and data will not be deleted	As expected

III. CONCLUSION

The conclusions of this research are: (1)The resulting application from this research has generally been used by citrus farmers in Rejang Lebong district, Bengkulu Province. (2) This application can be operated on windows operating system, android and other platform so that it can be run in smart phones and portable computers.(3) The SEESAW method used to build knowledge basis of this application still needs improvement because there are some parts of its logical parts that can not be run. (4) The researcher also faces difficulty in designing *rule expert system* because SEESAW method used by the researcher needs deeper study.

LITERATURE REVIEW

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