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Expert system for disease diagnosis in cocoa plant using android-based forward chaining method

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Abstract. Cocoa is one of the plantation crops that has high economic value besides it can also provide a large contribution so that it can increase the source of foreign exchange in Indonesia. This expert system is made for Android device users. In 2010 Indonesia succeeded in occupying the number three position after Ghana and Ivory Coast as the largest cocoa producer in the world. But the amount of cocoa production in West Sumatra has decreased due to a lack of knowledge of farmers in caring for and cultivating it. This is the background of this research, where this expert system uses the Forward Chaining method as a symptom search method that has been included as a tracking algorithm for each rule that has been set. So that it can produce an expert system for diagnosing cocoa plants that are right for farmers. When conducting a consultation, the user can answer Yes or No from the question given by the system. User answers are then processed based on rules and calculated using the forward chaining method. Testing is done to see if the system can run well as expected.

1. Introduction

Cocoa (*Theobroma cacao* L.) is one of the plantation commodities that is suitable for smallholder plantations, because this plant can flower and bear fruit throughout the year, so it can be a source of daily or weekly income for cocoa farmers. Cocoa has demand for production both domestically and abroad. This demand is getting stronger with the development of the agro-industry sector. In addition, cocoa is also in great demand by various chocolate product processing companies in improving their processed products so they can compete in the business world.

Various types of pests and diseases that attack cocoa plants can cause losses especially for cocoa farmers. Identification of pests and diseases of cocoa plants must be done quickly and accurately, because these pests and diseases can quickly spread and attack cocoa plants in all plantation areas. If farmers have more knowledge about pest and disease attacks, then the attack can be immediately overcome. Conversely, if farmers lack knowledge about the attack, farmers tend to need the help of more expert people to overcome this problem. In fact, many cocoa farmers currently need the help of experts to overcome the problem of cocoa plantations, one of which is to identify the types of pests and diseases and provide appropriate ways of dealing with them, so that losses do not have an impact on productivity. In addition, if there are new pests and diseases, an expert must be able to find a solution to overcome the attack and immediately provide socialization to farmers or farmer groups regarding these pests and diseases. But the number of experts and their distribution is limited, so that this problem cannot be solved maximally.



The forward chaining method is used in the development of this system because this method has been widely used by researchers conducting research in the field of expert systems and producing a fairly accurate identification system. The forward chaining method is a method that uses a set of action-condition rules, starting with combining information that has been collected with certain rules (conditions), which will later produce a conclusion (action).

Android is a mobile operating system that adopts the Linux operating system, but has been modified. Android was taken over by Google in 2005 from Android, Inc. as part of a strategy to fill the mobile operating system market. Google takes over all the results of Android's work including the team that developed Android. (2015, Sibagariang S).

The expert system of identifying cocoa pests and diseases with the forward chaining method is developed based on android or mobile that can be freely accessed by cocoa farmers or other users and is expected to help cocoa farmers in identifying and providing solutions to cacao pests and diseases so as to minimize losses which will be caused.

1.1 Problem Formulation

Based on the background described above, it can be concluded that the formulation of the problem in the study is:

1. How do you develop an android-based application that can be used to identify cocoa pests and diseases based on the symptoms given?
2. How to create an expert system for diagnosing Android-based cocoa pests and diseases?
3. How to provide a solution to overcome pests and diseases that attack cocoa plants?

1.2 Hypothesis

The author can present a hypothesis as follows:

1. By diagnosing the disease using the application as a tool, it can make it easier for farmers to diagnose cocoa plant diseases. So that farmers can make the right decisions in their diagnosis.
2. By using this expert system, temporary diagnostic results will be obtained that are more relevant and in accordance with predetermined criteria. So that the results of the diagnosis can be taken into consideration in decision making by farmers.
3. It is hoped that this expert system will help users get knowledge about diseases in cocoa plants.

1.3 Scope of Research

The scope of the problem used as the object of research needs to be constrained, namely:

1. provide solutions to overcome pests and diseases that attack cocoa plants.
2. This expert system is developed using the forward chaining method, which is identifying cocoa pests and diseases based on the symptoms given by the system.
3. This expert system was developed for the Android platform.

1.4 Objectives and Benefits of Research

The purpose of this study is to develop an expert system application that can identify pests and diseases that attack cocoa plants based on the symptoms provided and provide solutions to overcome pests and diseases that attack cocoa by distributing human knowledge into the system.

The benefits of the research that the authors did:

1. Make it easier for cocoa farmers to know the types of pests and diseases of cocoa plants and find out about their solutions.
2. Make it easier for cocoa farmers to know how to control pests and diseases that attack their cocoa plants.
3. Helping cocoa farmers to reduce the loss caused by the delay in handling cocoa pests and diseases.

2. Literature Review

2.1 Cocoa Plants

Cocoa (*Theobroma cacao* L.) is one of the plantation commodities that is suitable for smallholder plantations, because this plant can flower and bear fruit throughout the year, so it can be a source of daily or weekly income for cocoa farmers. Cocoa has demand for production both domestically and abroad.

2.2 Cocoa Disease

Here are the diseases that often attack Cocoa plants:

- a. Fruit rot (*Phytophthora palmivora*)
Cocoa fruits that are attacked by this disease will have blackish brown spots from the tip to the base of the fruit.
- b. Upas Mushroom (*Upasia salmonicolor*)
This fungal disease attacks the stem and branches of the cocoa plant.
- c. Cacao Stem Cancer
This disease is caused by an infection of the fungus *Phytophthora palmivora* which attacks the stem and branches of the cocoa plant.
- d. Vascular Disease (Vascular Streak Dieback)
The disease in cocoa plants is caused by an infection of the fungus *Oncobasidium theobromae*. This disease attacks plants in the nursery phase to production.

3. Methodology

The author forms the research framework as follows:

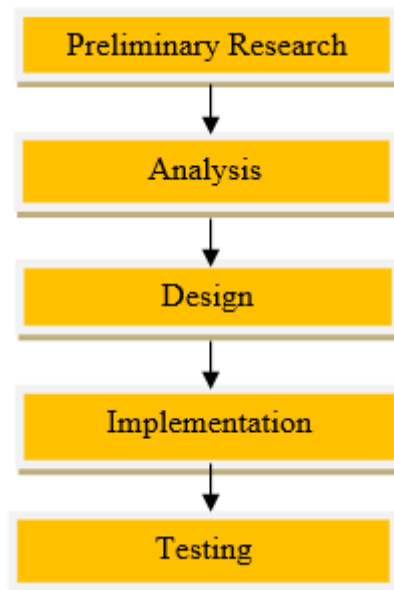


Figure 1. Research Framework

4. Results and Discussion

4.1 Implementation and Testing

Program view, which is a sub-chapter that explains about the commencement process until the program is finished executing, the points in this sub-chapter will explain how a form is executed and what functions are contained in the form.

a. Display of the Main Menu

Is the initial display of the main menu that displays this main menu there are several menus that can be accessed by the user. Display main menu can be seen in the following picture:



Figure 2. Display of the Main Menu

b. Display Menu Consultation

The consultation page contains consultation instructions and one button to start the consultation. Display consultation can be seen in the following picture:

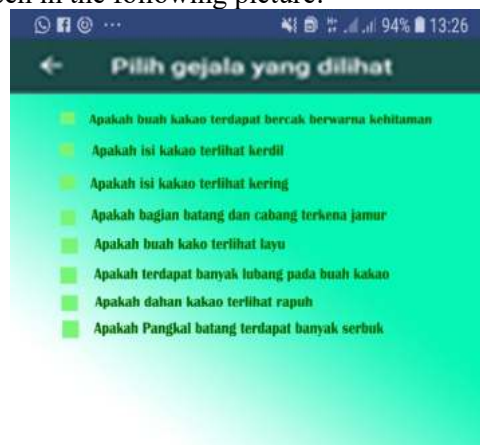


Figure 3. Display Consultation Menu

c. Display of Symptom Selection

The Symptom Selection Display contains symptoms of pests and diseases experienced by banana plants and was chosen to carry out the diagnosis. Display of symptom selection can be seen in the following picture:



Figure 4. Display of Symptom Selection

d. Display of Consultation Results

The results page of the consultation contains information on the similarity of each cocoa plant disease. Display of consultation results can be seen in the following picture:



Figure 5. Display of Consultation Results

e. Upas Mushroom (Upasia salmonicolor)

Display of Banana Leaf Suction Ladybug Process contains detailed disease information, case symptoms, case calculations and solutions. Display of Upas Mushroom can be seen in the following picture:



Figure 6. Upas Mushroom (Upasia salmonicolor)

f. Display Menu Disease

Disease Menu Display can be seen in the following picture:

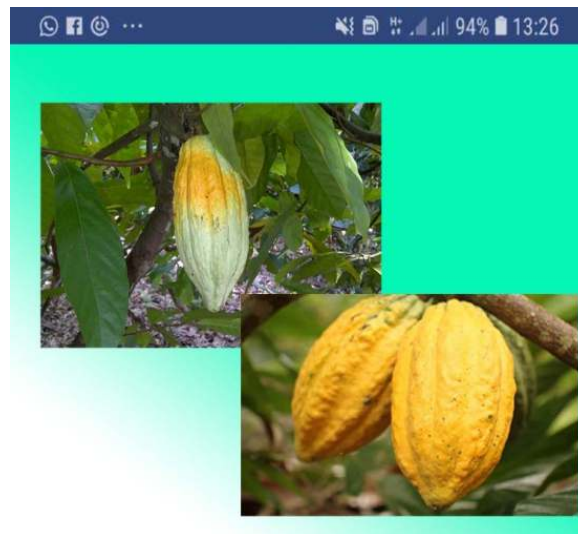


Figure 7. Disease Menu Display

5. Conclusions

Based on the research that has been done can be concluded several things as follows. 1. Application has been developed "Expert System for Identifying Pests and Cocoa Diseases" that can help farmers, entrepreneurs, or academics related to cocoa in identifying problems with cocoa pests and diseases. This system can provide confidence values from the identification of pests and diseases based on facts and knowledge provided.

Based on the Equivalence Partitioning test conducted, it can be concluded that expert system applications are made compatible with several versions of Android, namely: Android Kitkat, Lollipop, Marshmallow, and Nougat. This application also displays interfaces according to several smartphone screen sizes tested. External testing by filling out questionnaires distributed to 67 respondents, namely 4 people from the first group of respondents consisting of experts on pests and diseases, 41 people from the second group of respondents consisting of farmers and students of the Faculty of Agriculture and 22 people from the third group of respondents consisting of 121 students majoring in Computer Science got an average percentage score of 82.98% (very good). Based on this assessment, "Cocoa Disease Identification System" can be categorized as a 'Very Good' system.

From the study above, the authors expect further research, because there are some shortcomings in the application and there are still many that have not been discussed because of the limited time and limitations of the author in compiling this scientific work.

5.1 Suggestion

The suggestions given from this study so that applications can be developed better are as follows.

1. Addition and renewal of data if new pests and diseases have been found in cocoa plants along with solutions or solutions to the problem of controlling pests and diseases.
2. Complete picture of symptoms of attack and improvement of User design Interface (UI) so that users can be more helpful in using and understanding the application.
3. Simplifying the language in the description and solution of pests and diseases to make it easier to understand.
4. Designing and rule making still need to be developed in the direction of climate or weather factors that have a strong influence and also the influence of plant age or fruit age on several types of pest attacks.
5. External testing in the form of filling out questionnaires by cocoa farmers is having problems because not all farmers use an Android smartphone

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