

Application Expert System of Forward Chaining and The Rule Based Reasoning For Simulation Diagnose Pest and Disease Red Onion and Chili Plant

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Abstract—One of obstacles to do cultivation on red onion and chili plant is overcome pest and disease. Pest and disease attack can decrease productivity and even causes harvest fail that influence toward one of income sources the country. Therefore the diagnose on pest and disease must be done fastly and accurately. Expert system is offered as the second choice after expert on consultation. Using *Expert System Development Life Cycle (ESDLC)* method, the application of expert system of forward chaining and the rule based reasoning simulation diagnose pest and plant disease giving solution based on the symptoms completed by definitions and pest disease pictures that made for accelerating diagnose. Based on the evaluation on performance system verification step, the application expert system of pest and disease simulation diagnose red onion and chili plant using forward chaining and rule based reasoning also could be a learning system to farmer about pest and disease red onion and chili plant.

Keywords : expert system, forward chaining, rule based reasoning, ESDLC, pest and disease red onion and chili plant.

I. INTRODUCTION

Onions and peppers is a kind of horticultural crops are widely cultivated in Indonesia, but when viewed from the results is still not satisfactory. This is caused by various factors, among them the cultivation techniques, environmental conditions and pest and disease problems. Of the three factors that until now the problem is pests and diseases (Wibowo, 1999)

Limitations of an expert is sometimes an obstacle to farmers who will conduct consultations to resolve a problem to get the best solution. In this case an application simulation expert diagnosis of plant pests and diseases of onion and peppers are made to be used as a means for consultation, a means of learning in an agency or the Department of Agriculture Agricultural Laboratory and can be used as a tool for an expert in diagnosing and socializing types of pests and disease are two types of horticultural crops. With the application of expert system is also a Farmers can easily help farmers who are experiencing problems of pests and plant diseases of onion and chili pepper along with the best solution, which must be taken

without relying entirely on an expert and can share information or knowledge among fellow farmers based on the system.

Forward chaining inference techniques are applied, because the data and facts in conducting the research process has been obtained and the data and facts can be made a system that will provide a conclusion or solution based on a set of data and facts. By using inference techniques are also opportunities to get a more specific conclusion can be easily obtained (Baur & Pigford, 1990). By using the method of rule-based approach that has a pattern of if-then on the basis of knowledge in diagnosing in this expert system application, you're also an expert in performance can solve the problem sequentially. With the same method of approach to the rules that have been generated can be reviewed by experts to be repaired or modified in order to obtain better results. In addition, this method is also used where necessary explanation of the steps in getting an achievement of a solution (Ignizio, 1991) or a step towards the achievement of a diagnosing result against pests and plant diseases of onion and peppers.

Application of expert systems for simulation of and diagnosis of disease pests of horticultural crops including onions and chili using chaining forward inference and rule-based approach can provide a solution to the conclusions of a pest and diseases that have diagnosed based on symptoms that have been equipped with the description of plants that attacked by pests and plant diseases and their images. If expert system application is also equipped with a profile of pests, disease profile, the profile of horticultural crops, the profile of red onion, chili profiles, a glossary of terms and instructions for using the application

II. BASED THEORIES

A. Expert System

Some definitions of expert systems is :

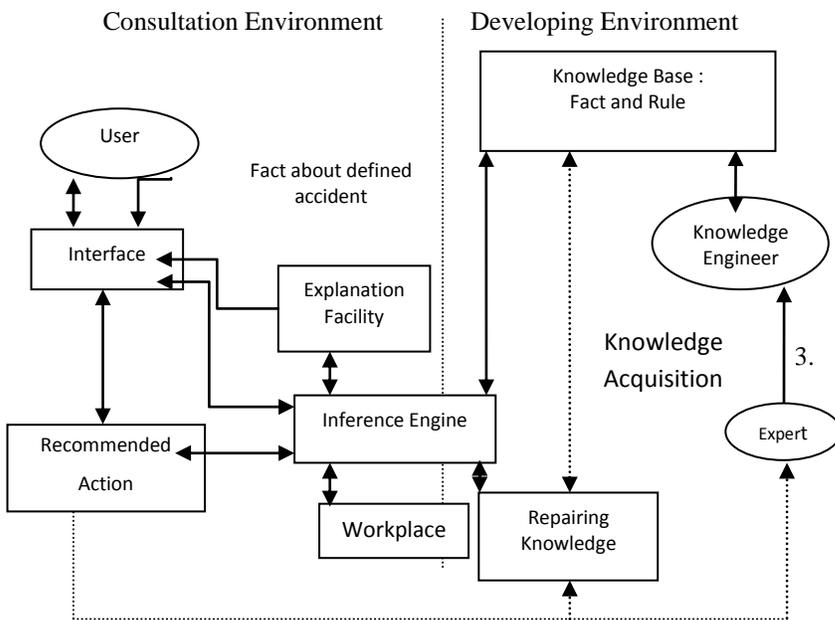
- a. According to Durkin, the expert system is a computer program designed to model the problem-solving skills by an expert
- b. According Ignizio, an expert system is a model and procedures relating, in a particular domain, where the

level of expertise that can be compared with the expertise of a specialist

- c. According Giarrantano and Riley, an expert system is a computer system that could match or mimic the ability of an expert
- d. According to Turban, an expert system is a software package of decision making or problem solving that can achieve performance levels comparable or even better with a human expert in some specialized fields, and usually narrow problem area

A good expert system designed to solve a particular problem by mimicking the work of the experts (Kusuma Dewi, 2003).

Expert system is composed by two main parts, namely the development environment and environmental consulting (Turban, 2001). Expert system development environment used to incorporate expert knowledge into an expert system environment, while environmental consultancy used by users who are not experts in order to obtain expert knowledge. The components of the expert system can be described as follows:



1. **User Interface**
Is a mechanism used by the expert system users to communicate. According to McLeod (1995), this section of the dialogue occurs between the program and expert system that allows users to receive instructions and information from the user, also provide information to the user.
2. **Knowledge Base**
Knowledge base is a knowledge base that contains facts, ideas, theories, procedures and relationships with one another or the information organized and analyzed

(knowledge in the education or experience of an expert) who entered into the computer.

There are two forms of approach to knowledge base that is very commonly used:

- a. **Rule Base Reasoning**
Knowledge presented in a form of facts and rules. The form of this representation consists of the premise and conclusion. This form is used because it has a number of expert knowledge on a specific issue and experts can resolve these issues systematically and sequentially. Rule-based representations that have a pattern if the condition / premise, then action / conclusion to a table of experts will provide benefits in various aspects, including ease in modifying both the data changes, the addition of data or deletion of data. In this case if can be represented as an attack symptoms in horticulture and then form solutions are achieved, in addition, this form is also used where necessary explanation of the steps the achievement of a solution.

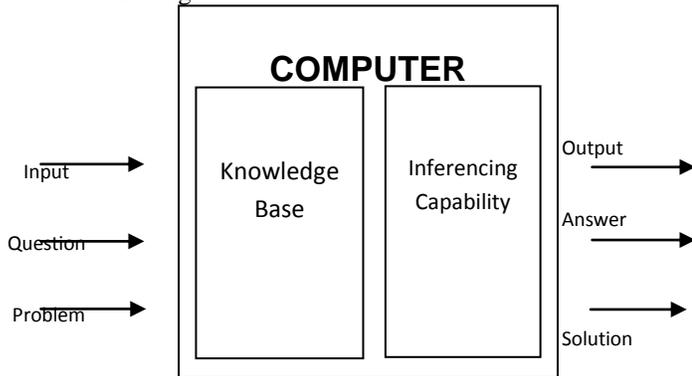
To a certain condition which *if* premise *then* conclusion, and its premise is more than one then it can be connected with the operator *and* or *or*. While at the conclusion may be a single sentence several sentences connected by *and*, it is possible to be developed with *else*.

- b. **Case Based Reasoning**
In movement-based approach, knowledge base will contain the solutions that have been achieved before, and then going down a solution to the current situation (facts).

3. **Knowledge Acquisition**
Acquisition of knowledge is the accumulation, transfer and transformation of expertise in the settlement of problems of knowledge sources into a computer program. In view of human knowledge are sometimes unstructured and difficult to be clearly expressed, the activities of an expert knowledge acquisition usually requires expert called as an expert computer system that experts in the field of expert systems (Bultman, Kuipers & Van Harmelen, 2000).

4. **Inference Engine**
Inference Engine is a computer program that provides a methodology for reasoning about the information in the knowledge base and in the work space to formulate conclusions.
In the process, the inference engine using reasoning strategies and control strategies.
The strategy consists of strategic reasoning certain and uncertain strategy. Reasoning strategy would have done if all the data required to draw a conclusion available, while the uncertain reasoning strategies performed in

the opposite situation. And to control the direction serves as a guide in conducting the process of reasoning.



Inference Engine : Durkin, 1994

There are two tracking techniques in the inference engine that is tracking forward or trace-driven approach that is developed on the data, this approach begins tracking the input information that further describes a conclusion. And tracking to back or back alphabetical and approach driven by the goal. In this approach, the tracking starts from the next goal sought a rule that has a goal to make a conclusion.

5. Workplace

Working memory is used to store the conditions / circumstances experienced by the user and also hypotheses and decisions while.

6. Explaining Facility

Facility explanation can give the information to users about the course of reasoning that generated a decision.

7. Knowledge Maintenance

Experts have the ability to analyze and improve its performance and ability to learn from its performance.

Forward Chaining

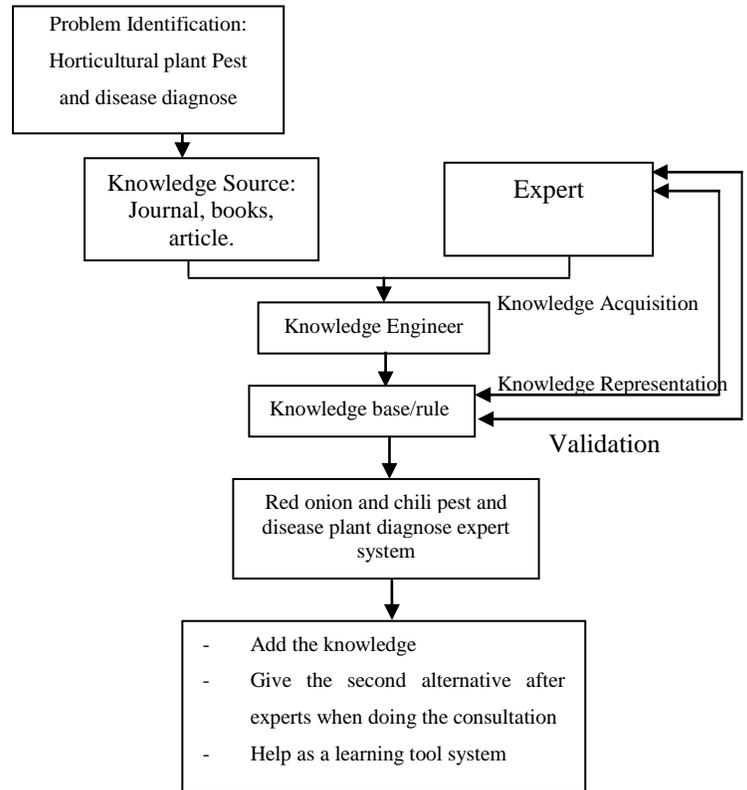
Forward Chaining it is a reasoning that starts from the facts to get a conclusion from that fact (Giarranto Andriley, 2005). Forward chaining inference can be regarded as a strategy that stems from a number of known facts. Search is performed by using rules that premise fits the known facts is to acquire new facts and continue the process until the goal is achieved or until it no longer rules the premise is more compatible with the known facts and the facts obtained.

Some types of systems that can use tracking techniques forward chaining :

- a. System is presented with one or more conditions.
- b. For each condition, the system looks for the *rules* in the *knowledge* base for *rules* corresponding to conditions in the *if*.

- c. Each *rule* can generate new conditions demanded at the conclusion of the *then* part, these new conditions can be added to other existing conditions.
- d. Any condition that is added to the system will be processed. If you encountered a condition, the system will return to step 2 and look for *rules* in the *knowledge* base. If no new conclusions, the session is terminated (Subakti, 2000).

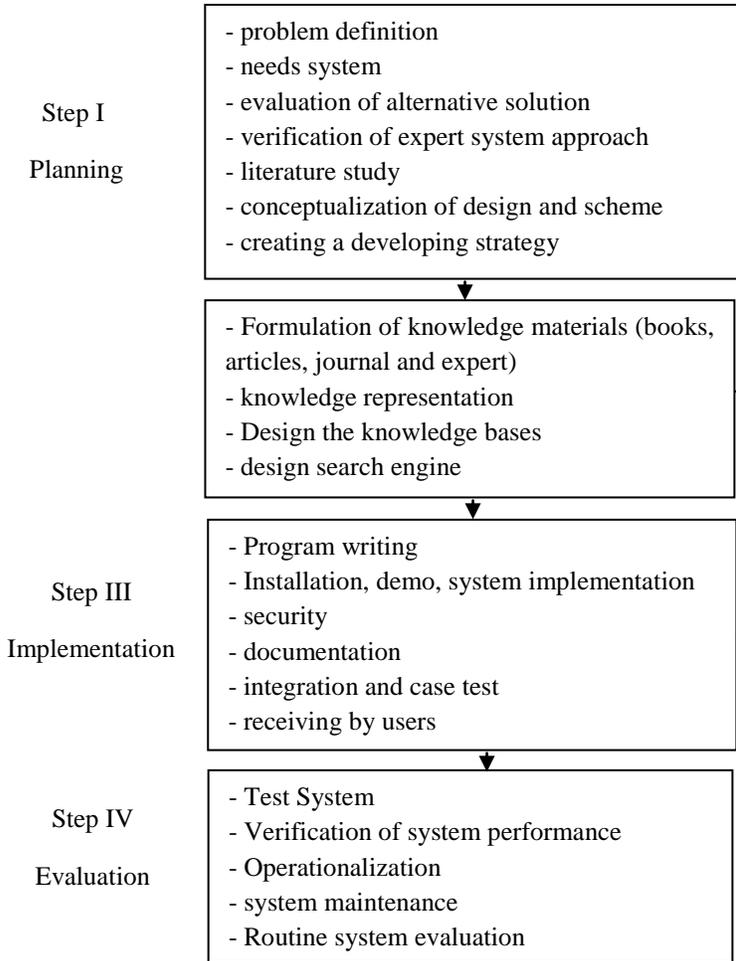
III. FRAME OF MIND



IV. RESEARCH METHOD

Research methods of expert system applications diagnosis pests and plant diseases of onion and chili was developed with Computer System Engineering Methods Based on the principles of Expert System Development Cycle or ESDLC.

ESDLC consists *planning, knowledge acquisition, coding, evaluating* (Turban & Aronson, 2001)



RESEARCH PROCESS

The process of making the application of expert system diagnosis pests and plant diseases of red onion and chili using *forward chaining* and rule-based approach are as follows:

- a. Determine the object of research to be applied in an expert system, namely horticulture crops comprised of red onion and chili
- b. Collecting and identifying data about the types of pests and plant diseases in the form of physical symptoms that plague crops, pests and plant diseases images are attacked by pests and diseases, pests and disease information as well as control or the best solution that must be taken
- c. Analyzing the problems of existing pests and diseases by tracing the symptoms, then do a search to ascertain whether the problem of pests and plant diseases can chili onions can be accommodated by an expert system by providing the best solution that must be adopted or not
- d. Selection of expert knowledge to be acquired to be interviewed and observed the task form of practical experience and understanding of pests and plant diseases of onion and peppers

e. Creating the design inputs and outputs. Enter the expert system in the form of symptoms caused by pests and diseases, while the output of the type of pests and diseases, pictures or images of pests and diseases of plants attacked by pests and diseases, pests and disease information, as well as the best solution to do to deal with plant attacked by pests and diseases

f. Expert system architecture
Technically, the architecture design of diagnostic expert systems pests and plant diseases of red onion and peppers are divided into 3 sections as follows:

1. Interfaces
This interface can be used to interact with users in expert system applications, the object is used to access the required information.
2. Parts of the application
Parts of the application of expert system contains knowledge and inference engine. All the symptoms of pests and plant diseases and their rules are stored in the knowledge base. To connect the interface and knowledge base, then the inference engine into the wheel. All entries in the form of the symptoms of disease and pests will be associated with this type of pests and diseases in accordance
3. Exodus
The output of this expert system is the type of pests and diseases, pests and disease information, images of pests and diseases and the best solution to be taken.

g. Needs of the user interface
User interface serves as a bridge or a communication medium that connects the user with a computer. In this case the application of expert system created as a user interface to provide facilities that contain the knowledge and expertise can be improved.

The software uses a visual display sub-menus and sub menus are user friendly so that it can provide facilities in consultation and in the charging base and their knowledge of the rules.

V. RESULT AND EXPLANATION

By using the Borland Delphi programming language and database Paradox application diagnosis expert system simulation horticultural crop pests and diseases that uses a *forward chaining* inference techniques and rules-based approach has been successfully created.

a. Menu Log In



b. Main Menu



c. Diagnose Menu



With reference to the research goals is to make application diagnosis expert system simulation horticulture pests and plant diseases that include onion and chili, then the necessary stages in the implementation and evaluation of the system according to the method used in the study of ESDLC (Expert System Development Life Cycle). These stages can also be used as a benchmark in assessing the success of this research.

A. System Implementation

1.1. Writing the Program

Making the program carried out in accordance with designing and design that have been made previously, the program also made so easily in doing the encoding of knowledge contained in the knowledge base by using a *rule base reasoning* and *forward chaining* as a inference techniques.

1.2. Installation, System Application and Training

Installing the program is done on one's practice / training along with a demonstration in front of two experts whose knowledge has been acquired and several people from one group of farmers in the district or Brebes, then proceed with the implementation of systems and training to one employee of Department of Agriculture Plant Food and Horticulture Brebes appointed as Administrator.

1.3. Computer Security

Security computer system must meet several aspects of the data to be protected from unauthorized use, so prevent insertion and deletion of data (data manipulation from outside the knowledge of the right), among which are (Ariyus, 2006):

- 1) *Confidentiality* : attempt to keep information from people who are not authorized to access.
- 2) *Privacy* : is more toward the nature of private data.
- 3) *Integrity* : the information must not be altered without permission from the owner of the information.
- 4) *Authentication* : Dealing with the method or way to declare that the information is really original and no one can change if you do not have the right to change
- 5) *Availability* : associated with the availability of data and information when needed
- 6) *Access control* : This aspect relates to how to setup access to information.

Security expert system applications that have been generated in this study have met some of these aspects, because the application has been equipped with a charging user id and password (which has been registered by the Administrator) prior to use, the application will also stop the charging process if the user id and password occur fail up to three times.

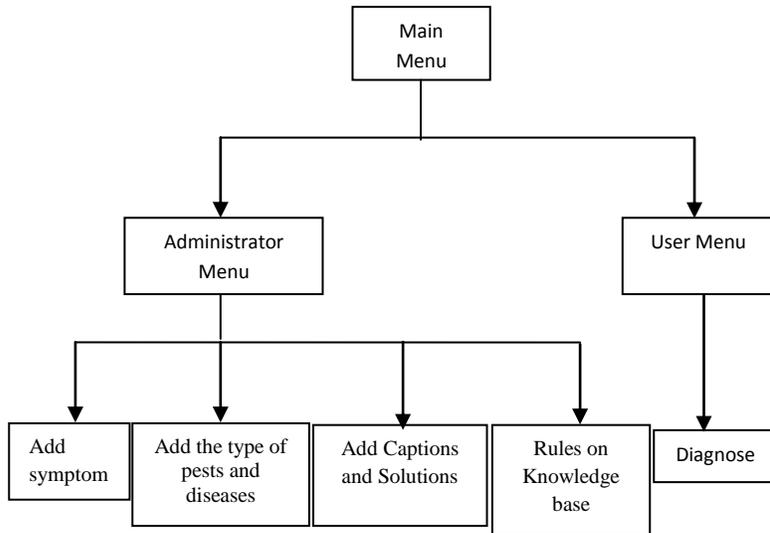
1.4. Documentation

Documentation is used to archive data on the application so that when there is damage to data and system backup file still available, documentation done with

- 1) Documentation of the system is to keep the original file system (which is not already installed) in another drive disc.
- 2) Documentation of the diagnosis is by printing hail diagnosis has been done

1.5. Integration

Integration testing is a technique to construct the structure of the program by conducting tests to uncover errors with respect to combining modules together. Integration is done by *top down* approach on the structure of the program. Modules are integrated by moving downwards through the hierarchy of control modules starting from the main menu, then sub-program to the main menu incorporated into the structure by means *depth-first*.



1.6. Case Evaluation

At the time of application of expert system diagnose horticultural crop pests and diseases run, then that appears first is the display log in. authorized users access to log in is the Administrator and Level User Level, by entering the User Name and Password. There are three tests in the test case that tests every menu in the application, testing the process of questioning and testing of modifications to the knowledge base.

B. Evaluation

2.1. Test System

System testing is a critical element of software quality assurance and represents the basic study of the specification, design and coding. In this research test system was done by testing black box to all functions within the application.

2.2. System Mechanism Verification

Verification of system performance is an aspect of expert system validation which states the extent to which the role of expert systems can be applied in solving problems. Verification of system performance was done by testing on diagnosing the results by comparing the results with expert diagnosis expert system application and evaluation system by distributing questionnaires to experts and users of expert system applications.

2.3. System Evaluation

The purpose of evaluation system is to determine the extent of the epidermis and the useful application of expert systems to ensure that the new system can deliver results as expected. For that test is conducted using a questionnaire consisting of 10 respondents are:

2 experts, six farmers from farmer groups BAHAGIA I Banjaratma Village, District Bulakamba Brebes and 2 public.

2.4. Operationalization and System Maintenance

Operationalization done in one place research which the Department of Agriculture Food Crops and Horticulture Brebes and then performed at the Laboratory of Pest and Disease Observation Pernalang as well as farmers' groups in various places by applying the expert system application on the computer hardware While the system maintenance is done by evaluation periodic of data on the application but due to time constraints it was not until the research on system maintenance.

CONCLUSION

1. Expert systems can be applied to agricultural areas, namely to diagnose plant pests and diseases of onion and peppers
2. Application of expert systems can diagnose plant pests and diseases of onion and chili based on simulation of symptoms that have been selected in advance using a forward chaining inference techniques and rules-based approach as an engineering approach to knowledge base
3. Application of expert systems can provide a description of pests and plant diseases of onion and chili includes images along with a solution that must be taken in controlling pests and diseases
4. Application of expert systems can be used as a second alternative after consulting the experts in diagnosing diseases of plants against pests and red onion and chili
5. Application of expert systems can increase knowledge about pests and plant diseases of onion and peppers.

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