

ONLINE PAPAYA DISEASE DIAGNOSTIC SYSTEM (OPDDS)

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ABSTRACT

Nowadays, expert system is one of the artificial intelligent techniques which have been widely used in system development. Online Papaya Disease Diagnostic System (OPDDS) is a web-based expert system that helps to identify diseases of *Carica Papaya* (Papaya) and suggest the appropriate treatments or preventions. The goal of Online Papaya Disease Diagnostic System (OPDDS) is to mimic the roles played by a papaya expertise to provide virtual consultancy, and it act like a virtual papaya expertise. A linear model of expert system development methodology and rule-based expert system technique has been used in the development of this project. With this system, it will contribute towards a well-managed system that will helped many people and management to overcome the existing problems. The system can act as a powerful tool with extensive potential in agriculture especially in situations where agricultural specialist assistance is not readily available when the farmer needs it. The expert system is intended to help the farmers, researchers and students and provides an efficient and goal-oriented approach for solving common problems of papaya.

Keywords: *rule-based expert system, symptoms, disease, linear model of expert system development methodology.*

ABSTRAK

Sejak kebelakangan ini, sistem pakar merupakan salah satu teknik kepintaran buatan yang digunakan secara meluas dalam pembangunan sistem pada masa kini. Sistem Diagnosis Penyakit Betik Secara Talian merupakan satu system pakar berasaskan jaringan untuk membantu mengenalpasti penyakit pada *Carica Papaya* (betik) serta mencadangkan rawatan atau pencegahan yang bersesuaian. Matlamat system ini adalah untuk bertindak sebagai pakar dalam bidang berkaitan betik dan menyediakan khidmat perundingan maya. Metodologi model selari dan sistem kepintaran berasaskan teknik peraturan telah digunakan dalam proses pembangunan sistem ini. Dengan adanya system ini, ia akan menyumbang ke arah pembangunan system yang lebih teratur yang akan membantu pengguna dan pihak pengurusan untuk mengatasi masalah sedia ada. Sistem ini bertindak sebagai medium dengan potensi yang luas dalam pertanian, terutama apabila pakar dalam pertanian tiada apabila para petani memerlukannya. Sistem pakar bertujuan untuk membantu petani, penyelidik dan pelajar dan menyediakan pendekatan yang berorientasikan tujuan dalam menyelesaikan masalah perkaitan dengan tanaman betik.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Malaysian Agrifood Corporation (MAFC) is a private sector that taking part under the Taman Kekal Pertanian Lanchang project, where papaya has been their product. Papaya diseases usually cause by bacterial diseases, fungal diseases, parasitic, viruses and some other miscellaneous diseases.

The environmental conditions make the papaya diseases arise from day to day. Unfortunately, agriculture experts are not always available when the non-experts need their advice to diagnose the diseases. The non-experts will then facing the difficulties in order to diagnose the disease and apply the appropriate control. Papaya diseases are diagnosed based on the symptoms on papaya crop itself.

Thus, Online Papaya Disease Diagnostic System (OPDDS) is developed to ease non-experts to identify papaya diseases and controlling the diseases. This system is an expert system which uses knowledge from expert in order to solve problems regarding to the papaya disease. Therefore, this system is like an agriculture consultant as it will advises non-experts regarding to the identified diseases and explain its treatments or preventions. In this area of domain, the experts are those who are expert in this particular field, such as agriculture consultant and so on. Non-experts are the other people who did not have any experts or knowledge in this field. The experts knowledge will be used as the main facts in this system in order to recognize the crop's disease.

Through this expert system, data or rules is needed to solve the problems by function call. Experts system is a system that interprets the knowledge from books and manual and make ease for human as it can save time and a lot of energy because of the tremendous amount of knowledge make it difficult for human to read and interprets all of them in a short period of time. In the other words, experts system is a system that uses human expertise and human knowledge to solve problems. It acts as a system that represent the transformation of human knowledge into different perspective of representation, through data or rules and facts.

The goal of Online Papaya Disease Diagnostic System (OPDDS) is to mimic the roles played by a papaya expertise to provide virtual consultancy, and it act like a virtual papaya expertise. Its domain is ristricted to the area of papaya disease and provide the recommendation for its particular disease.

OPDDS is a prototype web based and can be used at any places which have internet application and network communication field. OPDDS can make ease for user where they can use this system that acts as an expertise instead of making an appointment and queing in a long queue just to see the expertise. So, this system will be more efficient and time consuming as well.

1.2 Problem Statement

There are several problem statements arise that lead to the development of this project. The human expert on this field is limited, and might not be able to handle every problem that arises. Human experts are those who are experts and familiar in this field, which experts about papaya disease. Nevertheless, the number of human experts in every single place is not enough compared to the number of workers and also the diseases itself. Some more, human diseases may retire one day. It will lead to bigger problem if the knowledge not yet be transferred to other people. Then, the others will not be able to recognize each type of disease.

The non-experts might be not familiar to some kind of disease, and might only know only several things of the diseases. So, they are unable to identify all various types of papaya diseases by themselves. Some more, there will always be the new diseases from time to time. If no action or late action will be taken, this problem will cause the effect that can be very damaging.

For the non-experts who try to get the related information regarding to the diseases, they have to see the experts on this particular field. They need to go to the agriculture department or ask the experienced person to collect the information. This will cause a lot of trouble. Experts may not have sufficient time to handle all of the requests regarding to the disease. If there is any new disease found, it will also be a burden for experts to inform the non-experts about the disease and its appropriate control.

In order to overcome this problem, Online Papaya Disease Diagnostic System(OPDDS) will help them. This system will provide them enough information about the disease and also provided some set of questions that they need to answer. The particular type of disease and its appropriate set of control will be highlighted after user do this system.

In this thesis, problems are investigated according to these questions:

- i. What is the best solution to replace the human expert in determining the papaya disease?
- ii. What is the best technique to diagnose the papaya disease?
- iii. How this expert system will be implemented to save time and energy?

1.3 Objective

In this system development, the objectives are:

- (i) To develop a web-based prototype for papaya disease diagnosis system.
- (ii) To apply the rule based expert system technique in classifying the disease of papaya.

1.4 Scope

The project is developed and used the resources or data by the helps from the MAFC unit, and also from the available sources from the websites. It used the Macromedia Dreamweaver and Peripheral Hypertext Processor (PHP) programming tool as code generation to develop in a web based format and MySQL tool as the database management.

The scope of the system development are:

- (i) The system is developed for Taman Pertanian Moden Lanchang, Pahang.
- (ii) The system will cover several types of papaya diseases such as bacterial diseases, fungal diseases, parasitic and viruses.
- (iii) The users of this system are the non-experts including farmer and workers at Taman Pertanian Moden itself and Department of Agriculture in Pahang.
- (iv) This system is web-based application by using rule based methodology, and being used using internet access.
- (v) The system is developed for diagnose common diseases of papaya.
- (vi) The system will provide the recommendation and the cure for the disease.

1.5 Thesis organization

This thesis consists of six (6) chapters. Chapter 1: Introduction- This chapter is the introduction about the project that will be develop. It consist the introduction, problem statement, objective, scope, and thesis organization. Chapter 2: Literature Review- This chapter will explain the case study of the project. There are 2 general structure of this study, the technique that has been use and the former system that are already created. Chapter 3: Methodology- This chapter will discuss more close on the overall work flow in the development of the project. It will justify the technique along with the equipment and the software. Chapter 4 - Conclusion - This chapter is the last parts of this thesis that will be summarizing the project that will be develop.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter describes about several studies related to the domain of interest. The purpose of this chapter is to increase knowledge and understanding in project background. The first section is study on papaya and common papaya's diseases. The second section is study on artificial intelligence concept and expert system which including features of expert system, expert system programming language, type of expert system and its application.

2.2 Agriculture in Taman Pertanian Lanchang

Agriculture refers to the production that relies essentially on the growth and nurturing of plants and animals, especially for food, usually with land as an important input for farming (www-personal.umich.edu). Agriculture has played an important role in the development of modern Malaysia that continues make a significant contribution to the national economy. Type of papaya that has been planted in Taman Pertanian Lanchang is *Carica frangi* and has been marketed using the name as Piola Papaya,

which is tastier than any other papaya in Malaysia. Taman Pertanian Lanchang also provides the places of the papaya grading and packaging. Here, almost 80 tan metrics papaya will be grade and package per day and it only take 8 hours per day for the work to be done. (<http://www.utusan.com.my>)

Since the papaya agriculture here is very famous and successful, Lanchang itself has been called as the National Papaya Valley (Lembah Betik Negara). The papaya not only being sell in Malaysia, but also exported globally to United Kingdom, Singapore, Hong Kong, West Asia, Europe and China. More than 40% of the papaya here will be exported, and the rest is for local markets. This papaya takes 30 months for a single cycle, and will produce the fruit after 9 months and after 21 months, it can be harvested. (<http://www.utusan.com.my>)

2.2.1 Papaya background and diseases

Papaya is a fast growing tree-like herb that reaches 3 to 10 meters tall. It is usually without branched during its initial growth. The whole plant contains a rich sap or white latex from which the substance called Papain is extracted. The leaves are arranges spirally, greenish or purplish green, measuring 25-27 c, in diameter. The fruits weigh 200 – 300 grams. The flesh is yellow to re-orange when ripe. The diseases of papaya can be diagnosed based on three steps which are listed as below (Rex A, 2005):

- i. **On the Spot Inspection or Observation**
 - Observe the portion of a crop that has been affected which follow by inspect the visible changes on the appearance or growth of a crop. The visible changes occur at different portions of a tree.

- ii. **Identify Papaya's Disease**
 - A papaya's disease is identified by experience or search on other resources based on the observed symptoms at the papaya tree.
 -

- iii. **Recommendation**

- Treatments and preventions are recommended when the type of diseases and causes are identified.

Papaya has many kinds of pest and disease. It can be identify by their type and also can be cure. The common pest diseases of papaya are shown in the Table 2.0.

Table 2.0 - Pest and disease management

i. Oriental fruit fly	They deposit their eggs on mature fruits. Harvest fruits at the mature green stage and dispose properly over ripe & infested fruits to avoid spread of pest.
ii. Army and Cut-worm	The larvae feed on young and mature leaves of the host plants, making large holes on the leaves. Control – Decis, spray the leaves and stems after emergence.
iii. Grubs (Japanese Beetle)	The old larvae feed on the roots. As control, use Decis, drench the soil at the base of the stem or apply organic fertilizer with herbal pesticide property.
iv. Scale insects	Round, oval pear shaped flattened scales of various colors on trunks or fruits. As control, spray Malathion or Lime sulfur.
v. Red spider mites	Tiny 8 legged yellow, dark green or reddish spider on the underside of foliage. Mites prefer to feed on very young plant tissues. They can transmit viral disease. As prevention, heavily infested parts (branches and leaves) should be pruned and buried or burned. Spray with herbal insecticide or Lime sulfur.
vi. Mites and aphids	Suck plant sap and may transmit virus diseases. To control, remove alternate host, ants and allow natural predators and enemies in the plantation. Spraying herbal insecticide

	and lime sulfur underneath the leaves will greatly help clean the plant of these pest.
vii. Thrurops	Tiny, elongated, winged dark brown or black adults – white or yellow when young. Control by spraying Malathion, Decis or Lime sulfur.
viii. White flies	Minute winged insects. control by spray Malathion and Lime sulfur. Herbal pesticide will also drive away the insect pest.
ix. Nematodes	An cause damage to papaya roots. Planting marigold or spreading organic fertilizer will greatly help suppress nematode infestation.
x. Damping-off	Infect both the seedlings and the mature plants. Cultivating the soil will reduce this fungal disease. Allow sunlight to penetrate the soil surface to dry-off the fungus.
xi. Anthracnose	Infects the fruits during ripening. They appear as circular spots on the fruit. Spraying herbal fungicides at weekly interval before harvest is an effective control. Spray Dithane, Mancozeb or Zineb or Lime sulfur to control.
xii. Papaya ring-spot virus	Initially appears as oil streaks on stem and petioles and as it progresses, mottling of leaves become evident. Severely infected plants do not flower or they die young. To control, plant is isolated, removed and burned. Use tolerant varieties.
xiii. Ants	Small to large, yellow, red brown or black winged or wingless ants. Regular hand weeding and cultivation at the base of the plant to disturb foraging ants and nests is a good control.
xiv. Mealybugs	Flatten oval insects (1-4 mm long). They can transmit a viral disease known as leaf drop and

	will cause a reduced yield. Control by spraying Malathion or Lime sulfur. Control the presence of ants that spread mealy bugs and other minute insects. Spray herbal pesticide.
xv. Aphids	These are tiny lice-like insects with color ranging from pink yellow, brown to black. They can transmit a viral disease known as rosette. Control by spraying Decis the stem, leaves after emergence.
xvi. Phytophthora	Roots, fruit and stem rot. Seedling damping-off, root rot, trunk cankers and fruit rots. Prevention by removal of infected plants and fruits from the field and dispose properly by burying or burning. Control with Ridomil, Mancozeb or Lime sulfur.

Papaya is not only has the pest disease. It also has the viral disease. The common viral diseases of the papaya are shown in Table 2.1.

Table 2.1 – The Viral Disease of Papaya

Disease	Symptoms
i. Rosetting	Shortening of the internodes.
ii. Chlorosis	Weakening of the green color of the leaves.
iii. Yellowing	Chlorosis and dominance of yellow color of the leaves.
iv. Mosaic	Pale green, yellow or chlorotic areas sharply bordered by small vines of the leaves that are often angular in appearance.
v. Mottle	Discolored areas of various rounded shapes, often diffusely bordered.
vi. Leaf spots	Single or concentric rings of chlorotic or necrotic areas to large irregular patches of the leaves
vii. Vein clearing	Vein appearances of the leaves are translucent rather than

	chlorotic or yellow.
viii. Papaya leaf curl	Crinkling and curving of leaves with margins rolled down and inward.

To prevent all of these problems, some action should be taken. Some control should be taken towards insects that are virus carriers like aphids, white fly, leafhopper, mealy bug, thrips and mites or insects that produce viral disease (Rex A, 2005). Besides that, herbal insecticides should also be used for control of the virus carriers. The infected plants should be burn to destroy the virus sources and prevent it from spreading towards the others. The pesticides should also be used.

2.3 Studies on Artificial Intelligence

Artificial intelligence (AI) is the intelligence of machines and the branch of computer science which aims to create it. The AI's ultimately goal is to build machines that mimic human intelligence (Turban, 2005). This generally involves borrowing characteristics from human intelligence and applying them as algorithms in a computer friendly way.

There are several AI techniques which are expert system, fuzzy logic, neural network, genetic algorithm, chaos theory, rough sets, artificial life, and DNA Computing (Negnevitsky, 2005). AI techniques usually have features which are symbolic processing, heuristics, inferencing and machine learning. AI concepts have been applied to a group of areas such as expert system, natural language processing, speech understanding, robotics and sensory system, computer vision and scene recognition, intelligent computer – aided instruction, neural computing, game playing, language translation and intelligent agents.

Basically, there are 4 types of AI techniques which are:

- i. Rule based Expert System
- ii. Fuzzy Logic
- iii. Neural Network
- iv. Genetic Algorithm

2.3.1 Rule-based Expert System

Expert system are computer programs that are derived from a branch of computer science research called *Artificial Intelligence* (AI). AI's scientific goal is to understand intelligence by building computer programs that exhibit intelligent behavior. It is concerned with the concepts and methods of symbolic inference, or reasoning, by a computer, and how the knowledge used to make those inferences will be represented inside the machine. (<http://www.wtec.org>)

An expert system is an interactive computer-based decision tool that uses both facts and heuristics to solve difficult decision problems based on knowledge acquired from an expert. AI's scientific goal is to understand intelligence by building computer programs that exhibit intelligent behavior. It is concerned with the concepts and methods of symbolic inference, or reasoning, by a computer, and how the knowledge used to make those inferences will be represented inside the machine (Robert S. Englemore).

Often, the term expert systems is reserved for programs whose knowledge base contains the knowledge used by human experts, in contrast to knowledge gathered from textbooks or non-experts. The area of human intellectual endeavor to be captured in an expert system is called the task domain. Task refers to some goal-oriented, problem-solving activity. Domain refers to the area within which the task is being performed. Typical tasks are diagnosis, planning, scheduling, configuration and design.

Basic component of expert system tools are knowledge base, reasoning engine, knowledge acquisition subsystem, explanation subsystem and user interface. This is represented in Figure 2.0.