PADDY DISEASE IDENTIFICATION AND VECTOR CONTROL SYSTEM (PADICS)

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ABSTRACT

Agriculture is important resources in providing food and drink to human society. Paddy is a main sector in national agricultural development. Paddy production in Asian is widely effected by paddy diseases and also attacked by a number of insect pests. The identifications of disease are the difficult task. If the diseases identified timely, the control measures can be applied effectively. The objectives to develop the system are: (1) To apply the rule based an expert system technique for paddy production that covers paddy disease and the best pesticide based on paddy disease and (2) To develop a web-based prototype for paddy disease diagnosis. The system aims to provide a guide to identify the paddy disease and also recommended of disease control related to the disease. The system has been tested and result given by the system has been validated with domain expert. Technique that used in the system is rule-base expert system because the production rules have the uniform IF-Then structure that make the system is easier to develop and the methodology is Rapid Application Development (RAD).

Key words: *Agriculture, Expert System, Paddy, Disease, Pesticide*

ABSTRAK

Pertanian adalah sumber penting dalam penyediaan makanan dan minuman untuk manusia. Padi merupakan sektor pertanian yang amat penting di Negara kita. Pengeluaran padi di Asia amat meluas namun seringkali dipengaruhi oleh penyakit padi dan juga diserang oleh serangga perosak. Untuk mengenalpasti penyakit amatlah sukar oleh golongan petani. Namun, jika kita dapat mengenalpasti lebih awal, pelbagai kawalan akan dapat dilaksanakan dengan segera. Sistem Mengenalpasti Penyakit dan Kawalan Vektor Pokok Padi dibangunkan bertujuan untuk membantu para petani mengenalpasti penyakit padi dan serangga perosak serta membantu golongan ini untuk membuat keputusan berkenaan kawalan yang bersesuaian dengan penyakit pokok padi mereka. Objektif pembangunan sistem ini adalah untuk membangunkan Sistem Mengenalpasti Penyakit dan Kawalan Vektor Pokok Padi bagi membantu petani membuat keputusan berkenaan kawalan yang bersesuaian dengan penyakit pokok padi. Selain itu, sistem ini menggunakan teknik 'rule-based expert system' kerana penggunaan struktur IF-THEN ini akan memudahkan proses pembangunan. Bahasa yang digunakan untuk membangunkan sistem ini adalah bahasa pengaturcaraan PHP kerana kebolehanya untuk menyokong pengunaan MySQL sebagai pangkalan data. Manakala, kaedah yang digunakan dalam membangunkan Sistem Mengenalpasti Penyakit dan Kawalan Vektor Pokok Padi adalah 'Rapid Application Development'(RAD).

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LIST OF ABBREVIATIONS

PADIC	-	Paddy Disease Identification and Vector Control System
ESTA	-	Expert System for Text Animation
KROL	-	Knowledge Representation Object Oriented Language
KADS	-	Knowledge Analysis and Design Structuring
RAD	-	Rapid Application Development
GUI	-	Graphical User Interface
GT	-	Generic Task

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Agricultural production is a complex problem that involves many parameters and requires very complicated optimization and modeling steps. The overall production management problems involve, among other aspects, land preparation, water and fertilizers requirements, pest control, and variety selection. The crop production management problem also includes the lack of enough experts to support the agricultural growers, and the heavy dependence upon the experiences of these experts. This makes the choice of the expert system approach for the solution of this problem a suitable one (Edrees, et al., 2000).

Paddy Disease Identification and Vector Control System (PADICS) has been developed in consideration towards agricultural domain. This expert system gives the best disease control suggestion for farmers in Malaysia to improve Paddy productivity. The system contains two main parts namely as paddy disease and disease control part. The Paddy disease part is developed to diagnoses the problems that occurs during Paddy growing season and gives suggestion about how to control those problems. The disease control gives the suggestion on the best pesticides for the problems that occurs.

This system is in the collaboration work with *Pahang Agricultural Department.* The knowledge engineering methodology is used in the system development where the information and knowledge on Paddy diseases and pesticides are acquired from group of experts in *Pahang Agricultural Department.* The expert knowledge is gathered and represented in the form of production rules and frames.

1.2 Problem Statements

Around 300 paddy farmers in two areas around Simpang Empat, Kangar are afraid that their field has been the victim of a white worm disease, since more than a month ago. Nearly 60 hectares of paddy in the village was attacked by a disease not only affects the production of rice, but also fear the impact on the income of farmers this season. Pleted and the worm attacks the war not only resulted in a white rice plants died, but new trees will not grow when exposed to the two diseases (www.bharian.com.my, 2010).

From the problem statement, PADICS is proposed to solve the problem by investigating on these two questions:

i. What kinds of paddy diseases?

ii. What are the best disease controls to cure the paddy disease?

So, these are some way to help the farmers to know about the paddy diseases at once could help them in the appropriate use of pesticides.

1.3 Objectives

The objectives of this project are:

i. To apply the rule based an expert system technique for paddy production that covers paddy disease and the best pesticide based on paddy disease

ii. To develop a web-based prototype for paddy disease diagnosis.

1.4 Scope

The scopes of the project that have been identified are:

i. The system is developed for *Pahang Agricultural Department*

ii. The users of the system are farmers, *Pahang Agricultural Department* officers, system administrators and researchers.

iii. The information of the paddy will be gathered from *Pahang Agricultural Department.*

iv. The system is developed for diagnosis the paddy disease.

v. The system is developed for recommendation of disease control that will be provide in the system

1.5 Thesis Organization

This thesis consists of six chapters. Chapter one is explanation of introduction to system and research. This chapter will discuss about introduction, objectives, problem statements, and scope of the project.

Chapter two will discuss about the research for project that has been chosen. The researches divide into two that are for current system or case study and research for technique that will be used to develop current system.

For Chapter three will be discuss on approach and overall work load to develop this system. The content consists of the approach and framework for the project that used in this system.

Implementation of process that is involved during development of this system is explained in detail in Chapter four.

Son: The result that obtained from the implementation of the system is discussed thoroughly in Chapter five. The constraints of this project are also stated clearly in Chapter five.

2.2

Last chapter in this thesis is a conclusion which describe summary on the overall system.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss about knowledge and understanding in project background. In addition, it also explains the researches that had been related with the existing system. Some reviews of the techniques used are also discussed in this chapter.

2.2 Background

Agriculture is important resources in providing food and drink to human society. Paddy is the main staple food for most people in Asia, especially the people of ASEAN. The scientific name of paddy is Oryza sativa. Paddy is the food that produces rice which contains nutrients and adequate enforcement of the human body, because it contained material that easily transformed into energy.

According to Collin Clark Papanek, the nutrient required by every adult is 1821 calories. When the growth is accompanied by rice, the rice is needed every day of 0.88kg. Rice contains many nutrients needed by the body, such as: carbohydrates, protein, fat, crude fiber, ash and vitamins. In addition, rice also contains several mineral elements, including calsium, magnesium, sodium, etc. fuspor (http://pkukmweb.ukm.my).

Paddy sector is a main sector in national agricultural development. Average paddy production of the country at this time is 3:54 matric ton per hectare higher than Cambodia (2.05 tons matrix / ha), Thailand (2:57 matric tons / ha), Vietnam (4.80 tons matrix / ha), Indonesia (4.52tan matrix / ha) and the Philippines at 3:55 matric tons / ha). The objective of Paddy and Rice Industry Development is to improve rice production SSL from 72.37 percent in 2005 to 90.58 percent in 2010 (http://www.moa.gov.my). The data will show as below:

Table 2.1: Paddy production target (http://www.moa.gov.my)

SSL paddy production target by year		
Year	Paddy production (million mt)	SSL Target (%)
2005	2.400	72.37
2006	2.460	73.11
2007	2.610	76.28
2008	2.770	79.99
2009	2.990	85.08
2010	3.233	90.58

Paddy production in Asian is widely effected by paddy diseases like Rhizoctonia solani, Ustilaginoide virens, Zanthomonas oryzicola, Cercospora oryzae, Pyricularia oryzae, Helmintthos porium oryzae. The paddy plant is also attacked by a number of insect pests including Nephotettix Impiciticeps Ishihera, Scotinophara Coartata Thunbg, Leptocorisa acuta Thunbg, Nilaparvata Iugens Stal, S podoptera maurita Boisd, Cnaphalocrocis medinalis Boisd, Nymphula depuntalis Guenee (http://pkukmweb.ukm.my).

In any agricultural production system, accumulation and integration of related knowledge and information from many diverse sources play important role. Agriculture specialists and raw experiences are the common sources to provide information that the different stakeholders require for decision making to improve agricultural production. Agricultural specialists' assistance is not always available when the need arises for their help. In recent years, tools, technologies and applications of information technologies have emerged as efficient and effective measures for up gradation of the whole agricultural fields, ranging from scientific studies to farmers help. Integration of expert system as a powerful tool for the stakeholders of agricultural production has extensive potential (http://www.cscjournals.org).

2.1.1 Expert System in Agriculture

The expert system for diagnosis in general architecture domains is already being explored in several works. The applications of expert system are rapidly increasing. Such applications are very affective in situations when the domain expert is not readily available. In agriculture, applications of expert system are mainly found in the area of diseases diagnosis and pest controls. Many domain specific expert systems are being used at different levels. "AMRAPALIKA: An expert system for the diagnosis of pests, diseases and disorders in Indian mango" is an application of expert system in the agriculture domain. In this system, the expert system is developed with rule-based expert system, using ESTA (R. Prasad, et al., 2006). Another expert system "Dr. Wheat: A Web-based Expert System for Diagnosis of Diseases and Pests in Pakistani Wheat," is also an expert system. The system is for the purpose of pest and disease control of Pakistani wheat. They had developed the system with web-based expert system using e2gLite shell (F.S.Khan Khan, et al., 2008). "Web based Expert System for Diagnosis of Micro Nutrients Deficiencies in Crops" also describes application of expert system in agriculture particularly in the area of nutrient deficiencies in crops. The system is a web based system using the ServCLIPS tool (S.S.Patil, et al., 2009).

2.3 Studies on Existing System

There are an existing system related to this project that will help to understand about the expert system concept, selected technique, diagnosis concept and the benefit of the existing systems such as:

i. Expert System for Paddy Production Management
ii. Web based Expert System for Diagnosis of Micro Nutrients Deficiencies in Crops
iii. AMRAPALIKA: An expert system for the diagnosis of pests, diseases and disorders in Indian mango
iv. Dr. Wheat: A Web-based Expert System for Diagnosis of Diseases and Pests in Pakistani Wheat
v. Image Based Rapeseed-Mustard Disease Expert System: An Effective Extension Tool (R-MDI&M)
vi. An Expert System for diagnosis of diseases in Rice Plant

2.3.1 Expert System for Paddy Production Management

Expert System for Paddy Production Management (Soliman, et al., 2000) is an expert system for diagnosis of the disease for paddy plants. It's has been gained a considerable experience in developing expert systems in agricultural domain. This knowledge based systems cover different agricultural production management problems and applied for different crops (Rafea, M, et al., 1997). The objective of this expert system is to present an expert system for paddy production that covers the tactic and strategic knowledge based systems (S. Edrees et al., 1999). The strategic part consists of variety selection, land preparation, irrigation, and, fertilization subsystems. The tactic part consists of disorders diagnosis and treatment subsystems.

Expert system concept has been used during the development of this system. CommonKADS methodology (B. J. Wielinga, 1994) is used to represent the knowledge. The paddy expert system was implemented using Knowledge Representation Object Oriented Language (KROL) shell under Windows 98 (Shaalan, et al., 1998). The benefit of this system

is giving strategic advice, which enable paddy growers to apply the right operation at the specific time. This enables users to avoid the problems that may occur during growing season. The system also solves tactic problems that may occur during growing season. It diagnoses the problems and advises users how to control these problems either by agricultural operations or chemical operations

2.3.2 Web based Expert System for Diagnosis of Micro Nutrients Deficiencies in Crops

Web based Expert System for Diagnosis of Micro Nutrients Deficiencies in Crops (S.S.Patil, et al., 2009) is a system that provides a guide to identify essential and functional plant nutrient disorders. The diagnosis process involves giving support to identify the deficiency of nutrient in the deficient part of plants. Diagnosis identification can be in leaf, stem or root.

This virtual diagnosis framework was developed using the ServCLIPS tool to support the building and the running of the expert system by web. The ServCLIPS uses the inference engine and the programming language of the CLIPS to develop the expert system. The knowledge base of this system contains production rules derived from a decision tree. This tree was generated from literature and interviews with experts in the area and the researchers. The structure and organization of the knowledge was modified in the form of the decision tree, the methods to process this knowledge were defined along with the software tool to use in the implementation of the system. The Production rules were generated from the decision tree and the experts system was implemented based on production rules (IF <effects> THEN <causes>) (S.S.Patil, et al., 2009).

2.3.3 AMRAPALIKA: An expert system for the diagnosis of pests, diseases and disorders in Indian mango

AMRAPALIKA (R. Prasad, et al., 2006) is an expert system for diagnosis of the most common diseases occurring in Indian mango. The objective of developing of this system is to provide computer-based support for agricultural specialists or farmers.

Expert system concept has been used during the development of this system. This system applied ruled-based expert system which used prolog based Expert System Shell for Text Animation (ESTA). The knowledge base of this system contains knowledge about symptoms and remedies of 14 diseases of Indian mango tree appearing during fruiting season and non-fruiting season. The knowledge is represented in the form of IF-THEN rules which reasoning by backward chaining. This system will make diagnosis based on the responses of the user made against queries related to particular disease symptoms. There are few steps to be followed to develop this system using ESTA which are problem identification, knowledge acquisition and knowledge representation in accordance with the syntax of ESTA (R. Prasad, et al., 2006).

2.3.4 Dr. Wheat: A Web-based Expert System for Diagnosis of Diseases and Pests in Pakistani Wheat

Dr. Wheat: A Web-based Expert System for Diagnosis of Diseases and Pests in Pakistani Wheat (F.S.Khan Khan, et al., 2008) is a web-based expert system for wheat crop in Pakistan. This system covers the main problems such as disease and pests. 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 wheat. This system also constructed using e2gLite™ expert system shell. It's allows a JAVA interface to process its input and output sets. The system can act as a powerful tool with extensive potential in agriculture especially in situations where agriculture specialist assistance is not readily available when farmer need.

The knowledge base for e2glite expert system shell consists of simple if-then rules. The rules are usually fired on the basis of internal logic of inference engine. Forward chaining and backward chaining techniques represent the fundamental reasoning approaches implemented in rule-based expert systems. Forward chaining is data driven whereas backward chaining is goal driven (F.S. Khan, et al., 2008).

2.3.5 Image Based Rapeseed-Mustard Disease Expert System: An Effective Extension Tool (R-MDI&M)

R-MDI&M (V. Kumar, et al., 2008) is a computerized expert tool image based Rapeseed-Mustard disease. This expert system was developed to help extension personals, researchers and farmers in identification and management of these diseases. User can easily identify the disease on the bases of photos of symptoms and text description of disease. The objective of this research is to collect information on various aspects of rapeseed-mustard diseases, preparation of knowledge base, development of an initial version of 'R-MDI&M' software and updating with new features to derive the final version.

This system is stand-alone and PC-based which uses a hierarchical classification and a mix of the text description, photographs and artistic pictures (G. Andujar, et al., 2006). The system is supported by a database containing information about 8 diseases of rapeseed-mustard and 40 color images of various symptoms. The system involves two main sub-tasks, namely, diagnosis and management. Diagnose sub-task finds out the disease and their cause on the bases of photos and clips of diseases symptoms appears on plant. Management sub-task provides a management plan for the diseases. The user-friendly software designed and developed using Visual Basic as front-end and Microsoft Access-2000 as back-end (V. Kumar, et al., 2008).

2.3.6 An Expert System for diagnosis of diseases in Rice Plant

An Expert System for diagnosis of diseases in Rice Plant is an application of expert system in agriculture domain. This system is developed with rule based expert system using the shell ESTA (Expert System for Text Animation). ESTA programming is based on logic programming approach in this system. This system is useful for those farmers who are not getting the agricultural specialists at any time for their help to control the problems in their rice plant.

The designed is intended for the diagnosis of common diseases occurring in the rice plant. The system integrates a structured knowledge base that contains knowledge about symptoms and remedies of diseases in the rice plant appearing during their life span. For making decision support more interactive, an image database is also integrated with the system. The intelligent system module prompts these with the interface based on rule based decision making algorithm and the picture related to disease symptoms are stored in the picture database. The results given by the system have been validated with domain experts after tested with domain dataset. The knowledge is represented in the form of IF-THEN rules which reasoning by backward chaining. It contains the logical rules that direct the expert system how to solve problem, actions to perform such as giving advice, going to other sections, calling to routines etc (http://www.cscjournals.org).