Paddy Disease Detection System Using Image Processing

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SUPERVISOR DECLARATION

"I hereby declare that I have checked this project and in my opinion this project is satisfactory in term of scope and quality for the award of degree of Bachelor Computer Science (Software Engineering)".

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DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged.

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ABSTRACT

The main objectives of this research is to develop a prototype system for detect the paddy disease which are Paddy Blast Disease, Brown Spot Disease, Narrow Brown Spot Disease. This paper concentrate on the image processing techniques used to enhance the quality of the image and neural network technique to classify the paddy disease. The methodology involves image acquisition, pre-processing and segmentation, analysis and classification of the paddy disease. All the paddy sample will be passing through the RGB calculation before it proceed to the binary conversion. If the sample is in the range of normal paddy RGB, then it is automatically classify as type 4 which is Normal. Then, all the segmented paddy disease sample will be convert into the binary data in excel file before proceed through the neural network for training and testing. Consequently, by employing the neural network technique, the paddy diseases are recognized about 92.5 percent accuracy rates. This prototype has a very great potential to be further improved in the future.

ABSTRAK

Objektif utama kajian ini adalah untuk membangunkan satu sistem prototaip bagi mengesan penyakit padi iaitu Penyakit Karah Padi, Penyakit Spot Coklat, Penyakit Spot Sempit Coklat . Karya ini menumpukan perhatian kepada teknik-teknik pemprosesan imej yang digunakan untuk meningkatkan kualiti imej dan teknik rangkaian neural untuk mengklasifikasikan penyakit padi. Metodologi melibatkan pemerolehan imej, pra-pemprosesan dan segmentasi, analisis dan klasifikasi penyakit padi. Semua sampel padi akan melalui pengiraan RGB sebelum ia meneruskan untuk penukaran binari. Jika sampel adalah dalam julat RGB padi normal, maka ia secara automatik mengklasifikasikan sebagai jenis 4 iaitu Normal. Kemudian, semua sampel penyakit padi yang telah disegmentasi akan menukar ke data binari dalam bentuk fail excel sebelum meneruskan melalui rangkaian neural untuk latihan dan ujian. Oleh itu, dengan menggunakan teknik rangkaian neural, kadar ketepatan penyakit padi diiktiraf kira-kira 92,5 peratus. Prototaip ini mempunyai potensi yang sangat besar untuk terus meningkat pada masa hadapan.

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CHAPTER I

INTRODUCTION

This chapter discuss about an overview of the study conducted. The title of my project is Paddy Disease Detection System Using Image Processing .It consists of background, problem statements, objectives and the scope of study. The background briefly describes the identification of projects and related issues. Problem statements describes the problems that arise and make the selected projects to be undertaken. The objectives are the goals list for the projects to be achieves. Scope of study discuss about the limitations of projects and users. Lastly, thesis organization gives a summary of the sequence for each chapter in the thesis.

1.1 Background

A product quality control is fundamentally required in order to gain more value-added products[2]. Many studies show that quality of agricultural products can be reduced from many causes. One of the most important factors of such quality is plant diseases. Consequently, minimizing plant diseases allows substantially improving quality of the products.

Rice known as Oryza Sativa (specific name), is one of the most utilized food plants and widely grown originated in ASIA. [4] Rice is an important crop worldwide and over half of the world population relies on it for food. Many people in the world including Malaysia eat rice as staple food. However, there are many factors that make paddy rice production become slow and less productive. One of the main factors is paddy disease.

An abnormal condition that injures the plant or leads it to function improperly is called as a disease. Diseases are readily recognized by their symptoms. There are a lot of paddy disease types which are Bakanae, red disease virus, brown spot disease and many more.[1] Image processing and computer vision technology are very beneficial to the agricultural industry. They are more potential and more important to many areas in agricultural technology [1].

Paddy Disease Detection System is one of the very beneficial systems. It can help the paddy farmer detect the disease faster. This study aims to develop a prototype system to automatically detect and classify the paddy diseases by using image processing technique as an alternative or supplemental to the traditional manual method.

1.2 Problem Statement

Paddy will be harvest twice in a year. Most of paddy farmer faces many problems to harvest their paddy because they had been attack by snail, worm and fungi. Furthermore, when the paddy had been infected or attacked, the others areas had been exposed to be infected. Thus, it will decrease paddy farmer's income and lead to significance losses to farmer. Currently, the paddy farmer determines the type of disease manually. The errors might occur in order to determine the type of diseases. Paddy farmer also have to spend a lot of time to detect the type of disease. It also takes a time as the paddy farmers manually check the disease since the paddy field is in wide area.

1.3 Objective

There are three objectives to achieve in this project:

i. to develop the prototype of paddy disease detection system

ii. to detect the paddy disease by using image processing

iii. to apply image processing technique to analyze the pattern of paddy disease

1.4 Scope

- The users of this system are paddy farmers.
- The prototype will be develop by using MATLAB 7.10
- 10 samples each of the normal, brown spot disease, narrow brown spot disease and blast disease will be used in this project.

1.5 Thesis Organization

This thesis consists of 6 chapters ranging from Chapter 1 until Chapter 6. Chapter 1 gives an overview of the study conducted. It also consists of problem statements, objectives and the scope of study. Meanwhile, Chapter 2 reviews the previous research works that was conducted by others researches. All the relevant technical paper, journals and books taken from those researches will be discussed in detail. Chapter 3 focuses about the methodology for system development and process flow in detail of this research. It reveals the technique and the algorithms that will be used in performing this study. Chapter 4 concentrates on details of the implementation of the system which consists of coding phase and their explanation of the coding function. Results of the testing are to be expounding in Chapter 5 that consist of expected result or output, constraint of project and further research. Lastly, Chapter 6 concludes the overall study and research.

CHAPTER II

LITERATURE REVIEWS

This chapter briefly reviews, explains and discusses on existing literature review related with the current project which is “Paddy Disease Detection System Using Image Processing” that will be developed later. This chapter comprises three sections. The first section describes the overviews of paddy. The subsections are the definition, type of paddy disease, paddy symptom and paddy management. The second section is the review of some existing system that used same techniques and methods. The third section discusses the review on technique and method used by the system. The subsections are image acquisition, image segmentation and artificial neural network.

2.1 Paddy Overviews

In this section, firstly presents a definition of paddy. After that, this subsection briefly discusses on type of paddy disease, symptoms and management of paddy disease.

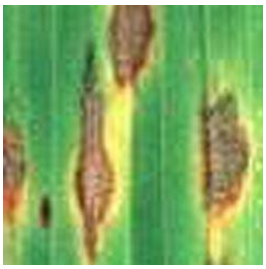
2.1.1 Definition of Paddy

Paddy also known as rice is the starchy seeds of an annual southeast Asian cereal grass (*Oryza sativa*) that are cooked and used for food. This cereal grass that is widely cultivated in warm climates for its seeds and by-products [8]. Rice is one of the most utilized food plants and widely grown originated in ASIA. Rice is an important crop worldwide and over half of the world population relies on it for food. Many people in the world including Malaysia eat rice as staple food.

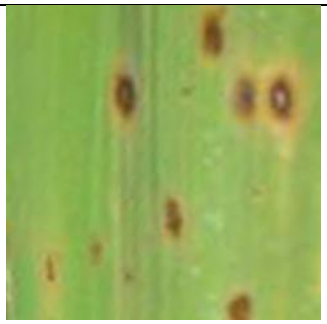
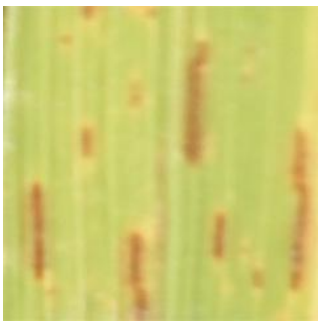
2.1.2 Paddy Diseases, Symptoms and Management

There are many factors that make paddy rice production become slow and less productive. One of the main factors is paddy disease. The table below will show you type of paddy disease, the symptom of paddy disease and the management of paddy disease. This researches focus on three types of diseases, which are paddy blast, brown spot disease and narrow brown spot disease.

The following paddy diseases are shown below:

No	Disease	Disease Symptoms
1	**Paddy Blast**  **Fig. 2.1 : Blast disease on leaf**	**Paddy Blast Symptoms** • Disease can infect paddy at all growth stages and all aerial parts of plant (Leaf, neck and node). • Among the three leaves and neck infections are more severe. • Small specks originate on leaves - subsequently enlarge into spindle shaped spots(0.5 to 1.5cm length, 0.3 to 0.5cm width) with ashy center. • Several spots coalesce -> big irregular patches **Management** • Avoid excess N - fertilizer application • Apply nitrogen in three split doses. • Removes weed hosts from bunds. • Use of tolerant varieties (Penna, Pinakini, Tikkana, Sreeranga, Simphapuri, Palghuna, Swarnamukhi, Swathi, Prabhat, Co 47, IR - 64, , IR - 36, Jaya) • Burning of straw and stubbles after harvest • Dry seed treatment with *Pseudomonas fluorescens*talc formulation @10g/kg of seed. • Stagnate water to a depth of 2.5cm over an area of 25m2 in the nursery. Sprinkle 2.5 kg of *P. fluorescens* (talc) and mix with stagnated water. Soak the root system of seedlings for 30 min and transplant. • Spray *P. fluorescens* talc formulation @ 0.5% from 45 days after transplanting at 10 day intervals, three times.

		• Seed treatment at 2.0 g/kg seed with Captan or Carbendazim or Thiram or Tricyclazole. • Spraying of Tricyclazole at 1g/lit of water or Edifenphos at 1 ml/lit of water or Carbendazim at 1.0 gm/lit. • 3 to 4 sprays each at nursery, tillering stage and panicle emergence stage may be required for complete control. **Nursery stage** • Light infection - Spray Carbendazim or Edifenphos @ 0.1 %. **Pre-Tillering to Mid-Tillering** • Light at 2 to 5 % disease severities - Apply Edifenphos or Carbendazim @ 0.1 %. Delay top dressing of N fertilizers when infection is seen. Panicle initiation to booting • At 2 to 5% leaf area damage spray Edifenphos or Carbendazim or Tricyclazole @ 0.1 %. F**lowering and after** At 5 % leaf area damage or 1 to 2 % neck infection spray Edifenphos or Carbendazim or Tricyclazole @ 1 g /lit of water.
2	**Paddy Brown Spot Disease**	**Paddy Brown Spot Disease** • Initial lesions are water-soaked to greenish gray and later become grayish white with brown margin • Lesions on leaf sheaths near waterline • Presence of sclerotia • Lesions may coalesce death of the whole leaf

	 **Fig 2.2: Paddy Brown Spot Disease**	• Partially filled or empty grains **Management** • Apply FYM 12.5 t/ha or green manure 6.25 t/ha to promote antagonistic microflora. • Soil application of *P. fluorescens* @ 2.5 kg/ha mixed with 50 kg FYM after 30 days of transplanting. • Foliar spraying of *P. fluorescens* @0.2% at boot leaf stage and 10 days later. • Avoid flow of irrigation water from infected to healthy field. • Carbendazim (1 g/lit), Propiconazole (1ml/lit) may be applied. • Spraying of infected plants with fungicides, such as Benomyl and Iprodione, and antibiotics, such as Validamycin and Polyoxin, is effective against the disease • Reduce Nitrogen dosage and skip top dressing
3	**Narrow Brown Spot Disease**  **Fig 2.3 : Narrow Brown Spot Disease**	**Symptoms** • Short, narrow, elliptical to linear brown lesions usually on leaf blades but may also occur on leaf sheaths, pedicels, and glumes or rice hulls • Lesions about 2-10 mm long and 1 mm wide • Lesions narrower, shorter, and darker brown on resistant varieties • Lesions wider and lighter brown with gray necrotic centers on susceptible varieties • Leaf necrosis may also occur on susceptible varieties • Lesions occur in large numbers during the later growth stages

		Why Occurs? • The disease is observed on rice crops grown on soil deficient in potassium. • Temperature ranging from 25-28° C is favorable for the optimum growth of the disease. Susceptibility of the variety to the fungus and the growth stage of the rice crop are other factors that affect the development of the disease. Although rice plants are susceptible to the fungus at all stages of growth, they are more susceptible from panicle emergence to maturity, thus, becoming more severe as rice approaches maturity. **Management** • Cultural practices, such as the use of potassium and phosphorus fertilizers, and planting of early maturing cultivars early in the growing season, are recommended to manage the narrow brown leaf spot. • The use of resistant varieties is the most effective approach to manage the disease. However, the resistant varieties and lines are only grown in United States and India. • Spraying of fungicides such benomyl, propicanazole,carbendazim, propiconazole, and iprodione, when the disease is observed in the field is effective.

Table 2.1: Paddy Disease, Symptom and Management

2.2 Case Study on Existing System

2.2.1 Investigating on Image Processing Techniques for Diagnosing Paddy Diseases

A study conducted by Nunik Noviana Kurniawati, Siti Norul Huda Sheikh Abdullah, Salwani Abdullah, Saad Abdullah from Universiti Kebangsaan Malaysia aims to develop a prototype system to automatically and correctly detect and classify the paddy diseases with Blast Disease (BD), Brown Spot Disease (BSD), and Narrow Brown Spot Disease (NBSD) using image processing technique as an alternative or supplemental to the traditional manual method.[1]

2.2.1.1 Method

The methodology for diagnosing paddy diseases can be simplified as Fig. 2.4. This process involves several tasks, such as image acquisition and collection, image segmentation and pre-processing, shape feature extraction and color feature extraction, and paddy diseases classification based on lesion type, boundary color, spot color, and broken paddy leaf color.
Cunha [18] used recognition technique to analyze the pathological stress conditions and characterization of the fruits or plant leafs. Runtz and Dave [19,20] applied image processing technique for classification and identifying of the plant species.

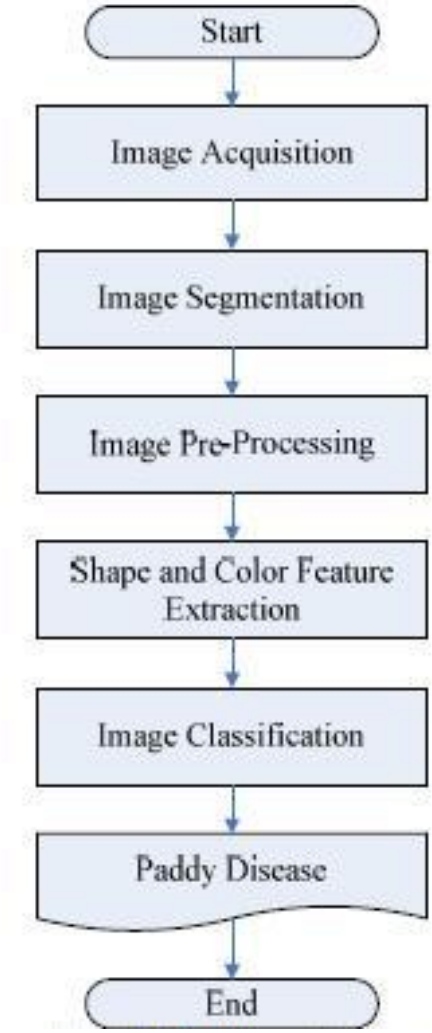
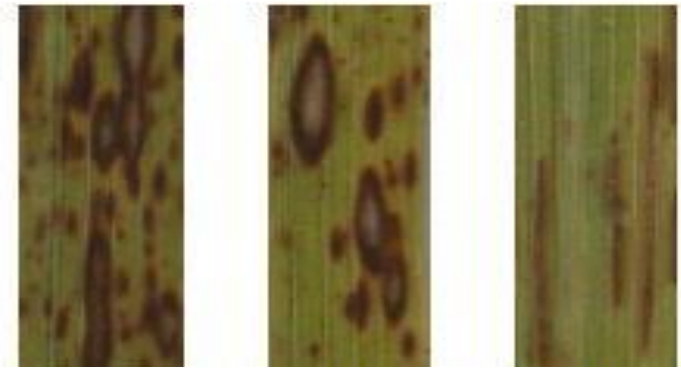


Figure 2.4: The methodology

A Image Acquisition

The RGB colour images of paddy leaf are captured using a Canon PowerShot G2 digital camera, with pixel resolution 768x1024. The digitized images are about 225 KB size each. Those images are cropped into a smaller image with dimension of 109 x 310 pixels. There have collected about 94 data samples. It consists of three types of paddy diseases as shown in Fig. 2.5. Images are stored in BMP format. The prototype uses Matlab image processing library.

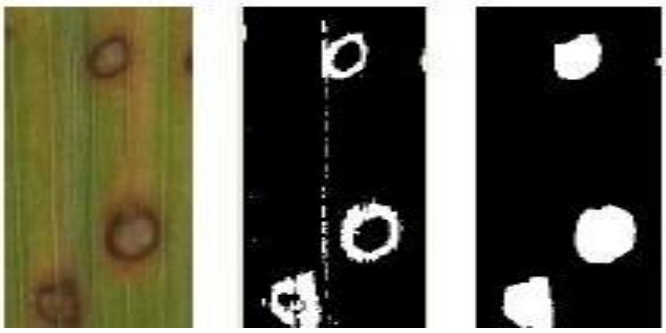


(a) **(b)** **(c)**

Fig 2.5 : (a) Blast Disease ; (b) Brown Spot Disease; (c) Narrow Brown Spot Disease

B Image Segmentation and Pre-Processing

The main objective of this process is to obtain the binary image with less noise or noise free. In order to achieve high accuracy, an appropriate silhouette should be obtained. The RGB image (Fig. 2.6(a)) is converted into a binary image using threshold method, as shown in Fig. 2.6(b). They used local entropy threshold methods of Eliza and Chang [11] and Otsu method. A morphological algorithm is used to remove noises by using region filling technique.



(a) (b) (c)

Fig 2.6 : (a) RGB image ; (b) Binary image with noise; (c) Binary image with noise free

C Feature Extraction using Texture Analysis

The image analysis focused on the shape feature extraction and color based segmentation.

D Image Classification

The production rules have been developed through serial interviews with agricultural expert based on above characteristics, such as lesion type, boundary color, spot color, and broken paddy leaf color, paddy diseases is recognized using production rule method with forward-chaining method.

2.2.2 Grape Leaf Disease Detection from Color Imagery using Hybrid Intelligent System

A study conducted by A. Meunkaewjinda, P. Kumasawat, K. Attakitmongcol and A. Srikew on Grape Leaf Disease Detection from Color Imagery using Hybrid Intelligent System [2]. Vegetable and fruits are the most important export agricultural products of Thailand. In order to obtain more value added products, a product quality control is essentially required. Many studies show that quality of agricultural products may be reduced from many causes. One of the most important factors of such quality is plant disease. Consequently, minimizing plant diseases allows substantially improving quality of the products. This system shows an automatic plant disease diagnosis using multiple artificial intelligent techniques. The system can analyze or diagnosis plant leaf disease without maintain any expertise once the system is trained.

2.2.2.1 Method

There are several steps must be achieve of this system which are grape leaf color segmentations, grape leaf disease segmentation and analysis and classification of the disease.

A Grape leaf color segmentation

The grape leaf color segmentation is pre-processing module which segments out of any irrelevant background information. A self-organizing features map together with a back-propagation neural network is deployed to recognize colors of grape leaf. This information is used to segment grape leaf pixels within the image. The input is enhanced by using anisotropic diffusion technique [12] to preserve information of the affected pixels before extracting grape color from the background.

(a) Original image (b) Grape leaf with color extraction

Fig. 2.7 : Example of grape leaf color extraction

B Grape leaf disease segmentation

The grape leaf disease segmentation is performed using modified self-organizing features map with genetic algorithms for optimization and support vector machines for classification. Using modified self-organizing feature map (MSOFM) [13], the clustering process does not require any training nor predefined number of color groups.

(a) Original image (b)Grape leaf disease color extraction

Fig 2.8: Example of grape leaf disease segmentation

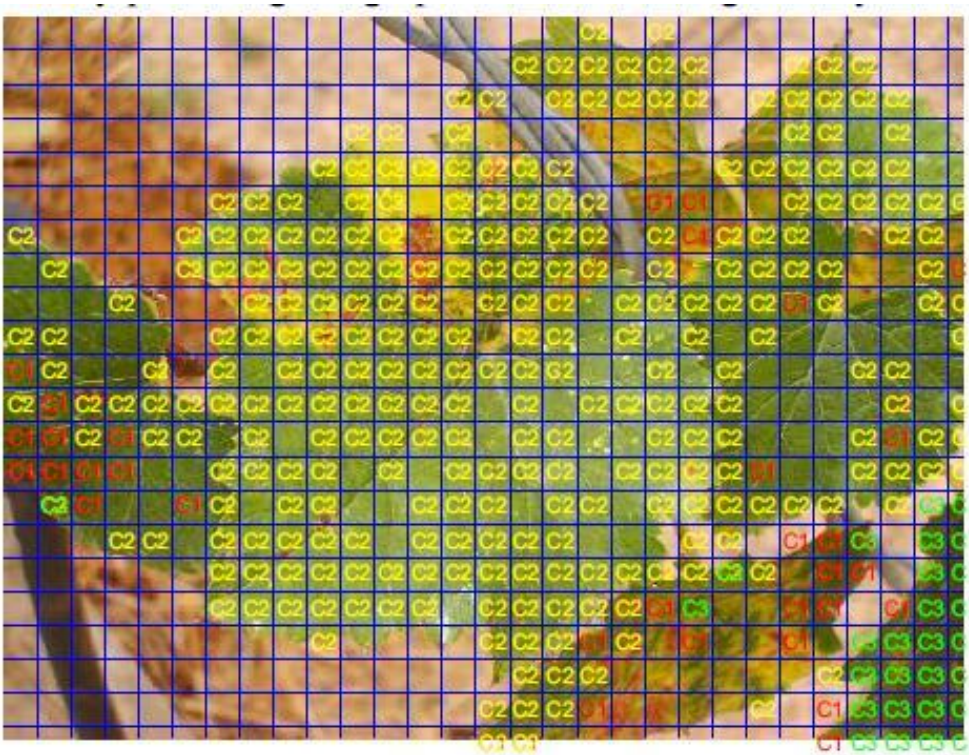
C Analysis and Classification of Disease

The resulting segmented image is filtered by Gabor wavelet [14] which allows the system to analyze leaf disease color features more efficient. The support vector machines are then again applied to classify types of grape leaf diseases. The image can be able to categorize the image of grape leaf into three classes:

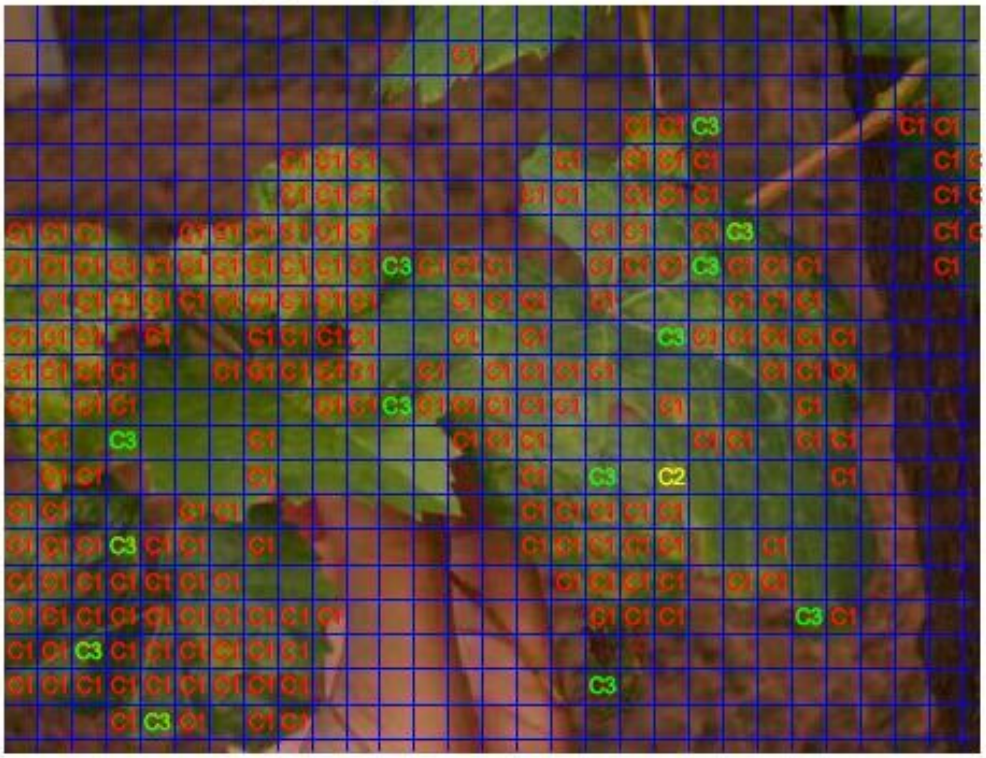
i) Scab disease

ii) Rust disease

iii) No disease



(a) Example of rust disease detection



(b) Example of scab disease detection

2.2.3 A Framework for Detection and Classification of Plant Leaf and Stem Disease

A study conducted by Dheeb Al Bashish, Malik Braik, and Sulieman Bani-Ahmad on a framework for Detection and Classification of Plant Leaf and Stem Diseases. Studies show that relying on pure naked-eye [15] observation of experts to detect such diseases can be prohibitively expensive, especially in developing countries. Providing fast, automatic, cheap and accurate image processing-based solutions for that task can be of great realistic significance.

2.2.3.1 Method

The proposed framework is image processing-based and is composed of the following main steps;

a) The images at hand are segmented using the K-Means technique

b) The segmented images are passed through a pre-trained neural network.

A Clustering method

K-means clustering is used to partition the leaf image into four clusters in which one or more clusters contain the disease in case when the leaf is infected by more than one disease.The k-means clustering algorithms tries to classify *objects* (pixels in our case) based on a set of features into K number of classes. The classification is done by minimizing the *sum of squares* of distances between the objects and the corresponding cluster or class *centroid*. On this experiment, the K-means clustering is set to use squared Euclidean distances.

B Feature Extraction

The method followed for extracting the feature set is called the *Color Co-occurrence Method* or CCM method in short. It is a method, in which both the color and texture of an image are taken into account, to arrive at unique features, which represent that image.

- Co-occurrence Methodology for Texture Analysis
- Normalizing the CCM matrices
- Texture features identification

As a testbed, D. Al Bashish (2001) use a set of leaf images taken from Al-Ghor area in Jordan. There are five diseases which effect on the plants;

a) Cottony mold
b) Early scorch
c) Ashen mold
d) Late scorch
e) Tiny whiteness.

The experimental results indicate that the proposed approach can significantly support accurate and automatic detection of leaf diseases. The developed Neural Network classifier that is based on statistical classification perform well and could successfully detect and classify the tested diseases with a precision of around 93%.

2.3 Propose System

There is a growing demand of image processing in diverse application areas, such as multimedia computing, secured image data communication, biomedical imaging, biometrics, remote sensing, texture understanding, pattern recognition, content-based image retrieval, compression and so on. To improve the quality of paddy, there must be a system that can accurately detect the disease so that the paddy farmer can cure it as soon as possible. The methodology consists of the pre-processing and segmentation of paddy disease and classification of the disease. The techniques that will be applied for the classification of paddy disease in this system are feed-forward neural network technique.

2.4 Conclusion

Based on the previous system, there are a lot of methods and techniques can be applied to the system such as rule method with forward-chaining method, modified self-organizing feature (MSOFM), k-means and pre-trained neural network. The details of methodology and techniques will be discussed on the next chapter.

CHAPTER III

METHODOLOGY

3.1 Introduction

The purpose of this chapter is to discuss the approach and framework for the project. Method, technique or approach that will be or has been used while designing and implementing the project included in the content. This chapter also explains about the justification of method or approach used and hardware and software necessity. This project will be conducted based on the Iterative and Incremental Method.

3.2 The justification of Iterative and Incremental Development Methodology

Typically agile software development combines iterative and incremental techniques to deliver functionality early and often [21]. Iterative means perform repeatedly. Iterative also can be refers as repeated application of a procedure, applying it each time to the result of the previous application. Besides, iterative development refactors code repeatedly, making progress through successive refinement. Increment means an increase or addition. Incremental development builds and delivers software to a production environment as a series of small and regular releases with expanding functionality. Agile software development employs both iterative and incremental development techniques but also applies feedback across releases or increments or iteration. Moreover, incremental development becomes evolutionary, where the previous iteration guides the next iteration. Iterative and Incremental development developed in response to the weakness of the waterfall model. It starts with an initial planning and ends with deployment with the cyclic interaction in between [22].

3.3 Iterative and Incremental Development Method

Paddy Disease Detection System contains some stage or phase of development method such as planning stage, requirement, analysis and design, implementation, testing, evaluation and maintenance.

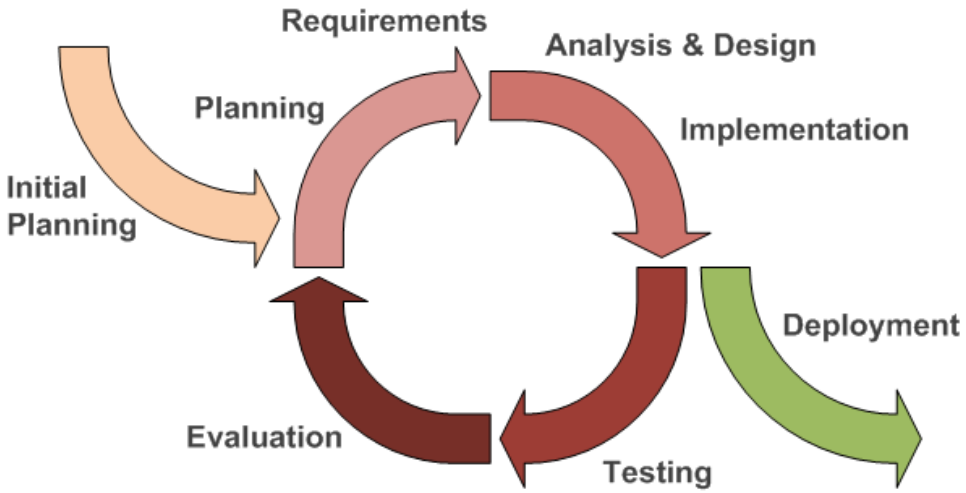


Fig 3.1 : Iterative and incremental development method

3.3.1 Planning Stage

The first stage to start the development of Paddy Disease Detection System using Image Processing is planning. Planning is the process of gathering all the information including problem statements, objectives and the scope of the system from the journal and article reading from the internet.

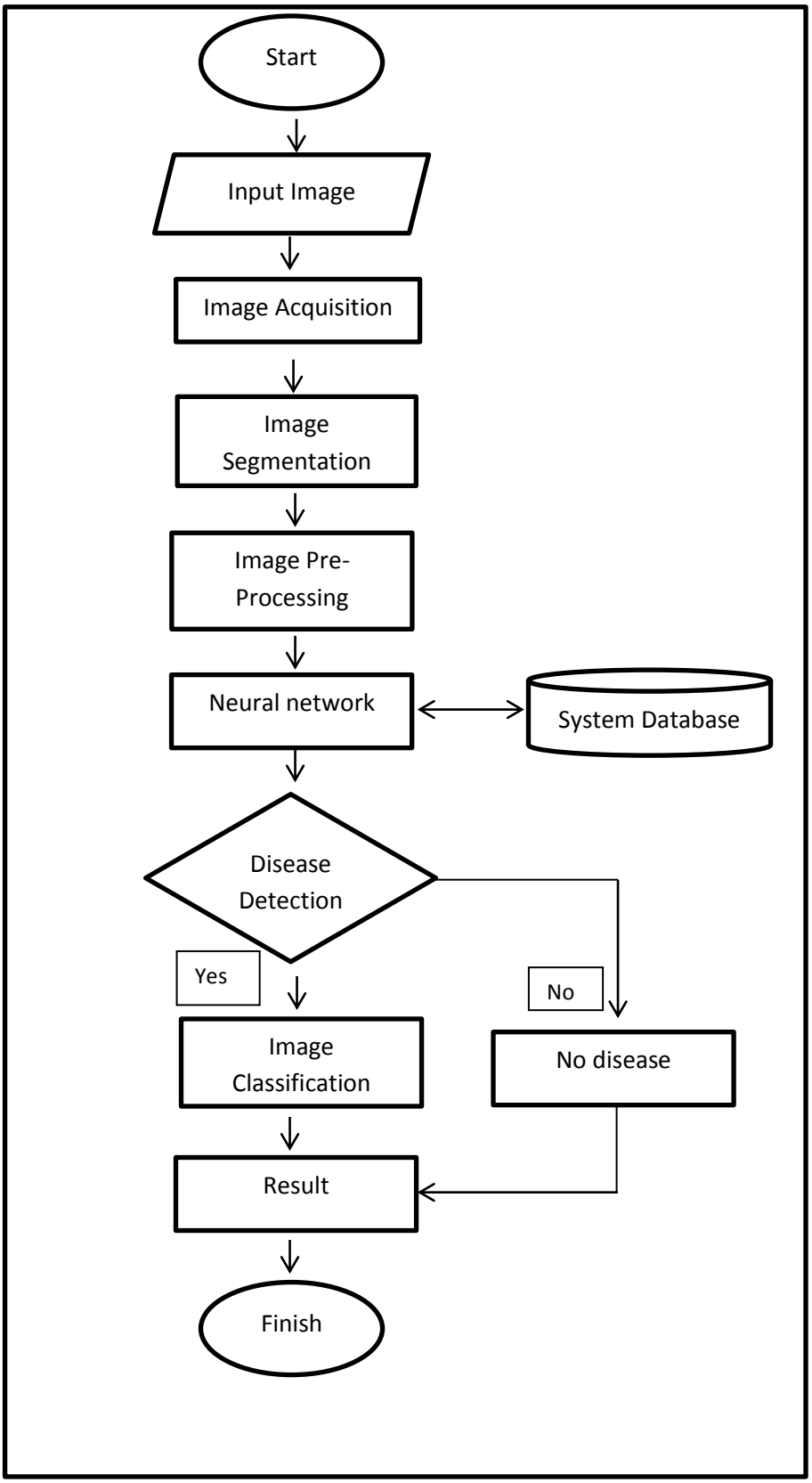


Fig 3.2: Flow chart of Paddy Disease Detection System

3.3.2 Software and Hardware Requirement/Specification

There are several things that should be considered to make sure the development stage of the system can run successfully. There are software and hardware specification. Software is a conceptual entity which is a set of computer programs, procedures, and associated documentation concerned with the operation of a data processing system. Hardware is component devices which are typically installed into or peripheral to a computer case to create a personal computer upon which system software is installed including a firmware interface.

3.3.2.1 Software Requirement

The software requirement for Paddy Disease Detection System development has been identified as shown in table below:-

	Software	**Purpose**
Operating System	Microsoft Windows Vista ™ Ultimate service pack 1	As the operating system
Software	Microsoft Office Word 2010	For documentation
	Microsoft Office Project 2010	Gantt chart
	Microsoft Office Visio 2010	Flowchart
	Microsoft Power Point 2010	For slide presentation
	Adobe Acrobat Reader X	For reading from the internet resources
	MATLAB 7.10	Developments tools

Table 3.1 : Software requirement

3.3.2.2 Hardware Requirement

The hardware requirement for Paddy Disease Detection System development has been identified as shown in table below:-

	Component	**Minimum Requirement**
Laptop	Processor	Intel® Core(TM)2 duo CPU T6500 @ 2.10 GHz
	RAM	3 GB
	CPU	32-bit operating system
Camera	Sensor	12 megapixel
	Zoom	4x optical zoom.
	Display	2.7-inch
	Card Slot	SD/SDHC

Table 3.2 : Hardware requirement

3.3.3 Analysis and Design Stage

Analysis is the process determining the needs or conditions to meet for a new or altered the system. Design is the process of problem solving and planning for a software solution. It includes low-level component and algorithm implementation issues as well as architectural view. There is a growing demand of image processing in diverse application areas, such as multimedia computing, secured image data communication, biomedical imaging, biometrics, remote sensing, texture understanding, pattern recognition, content-based image retrieval, compression and so on.

3.3.3.1 Formulation

A. Image Acquisition

In this process, it is a preparation process to obtain paddy leaf images. The RGB color images of paddy leaf are captured using Olympus *fe*-4050 digital camera with pixel resolution 2048x1024. Those image are cropped into smaller image. Images are stored in BMP format. The prototype uses Matlab image processing library.

Figure 3.3(a): Blast Disease

Figure 3.3(b): Brown Spot Disease

Figure 3.3(c): Narrow Brown Spot Disease

B. Image Segmentation and Image Pre-Processing

i. Converting RGB to gray scale image

The segmentation and pre-processing task are the initial stage before the image is used for the next process. The main objective of this process is to obtain the binary image with Otsu method. The Otsu method is based on selecting the lowest point between two classes of the histogram by considering the between-class variance.

Figure 3.4 (a): RGB Image

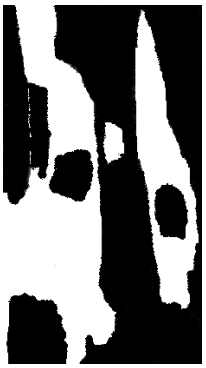


Figure 3.4(b): Binary Image with Noise

Figure 3.4(c): Binary Image with Noise free

ii. Filtering

Averaging filter is implemented in this process. The average filter computes the mean (average) of the gray-scale values within a rectangular filter window surrounding each pixel. This has the effect of smoothing the image (eliminating noise). The filtered pixel will be calculated by:

$$r = (a1 + a2 + \ldots + a9)/9 \qquad (1)$$

C. Feed Forward Neural Network

The neural network is applied to pattern recognition, system identification and system control. The feed forward neural network was the first and arguably simplest type of artificial neural network devised. In this network, the information moves in only one direction, forward, from the input nodes, through the hidden nodes (if any) and to the output nodes. There are no cycles or loops in the network.

i. Training and testing of neural network

In this stage, there is training database, initialize neural network layer, train network. 10 samples of Blast Disease image, 10 samples of Brown Spot Disease image and 10 samples of Narrow-Brown Spot Disease image is used as training image.

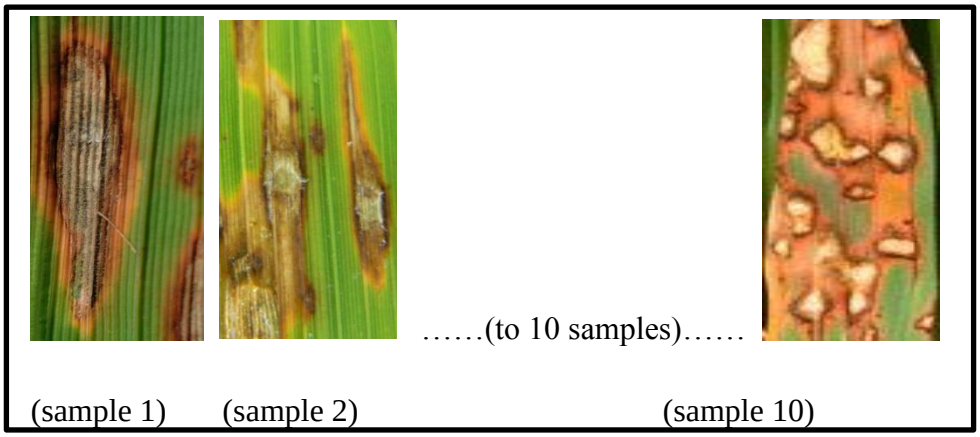


Figure 3.5(a): Sample of Blast Disease

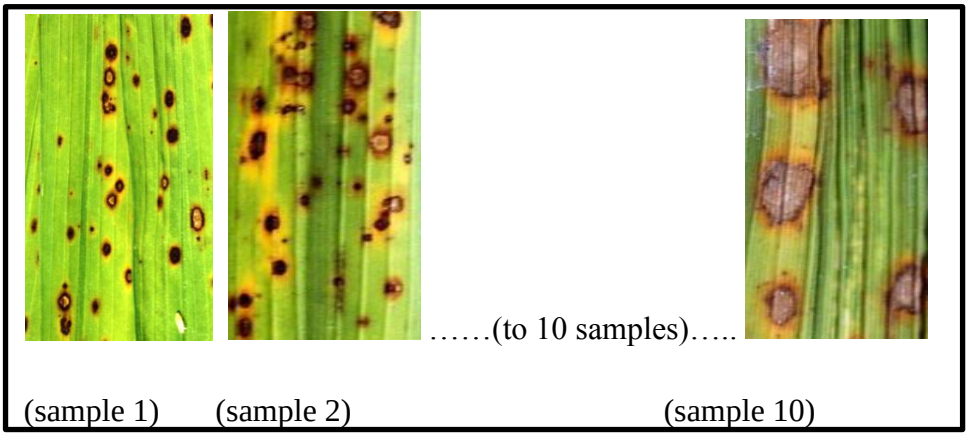


Figure 3.5(b): Sample of Brown Spot Disease

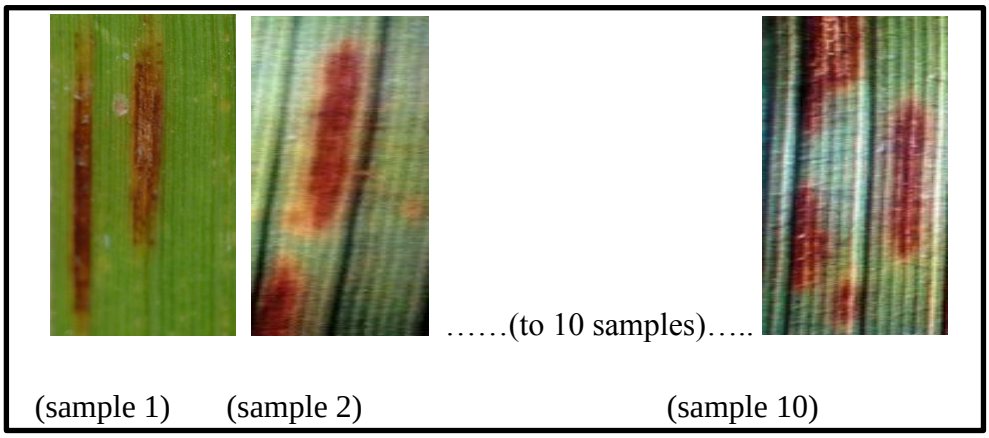


Figure 3.5(c): Sample of Narrow Brown Spot Disease

D. Image Classification

Based on above training and testing of neural network, the image will be classify weather it is paddy blast, brown spot disease and narrow brown spot disease with the feed forward neural network.

3.3.3.2 Interface Design

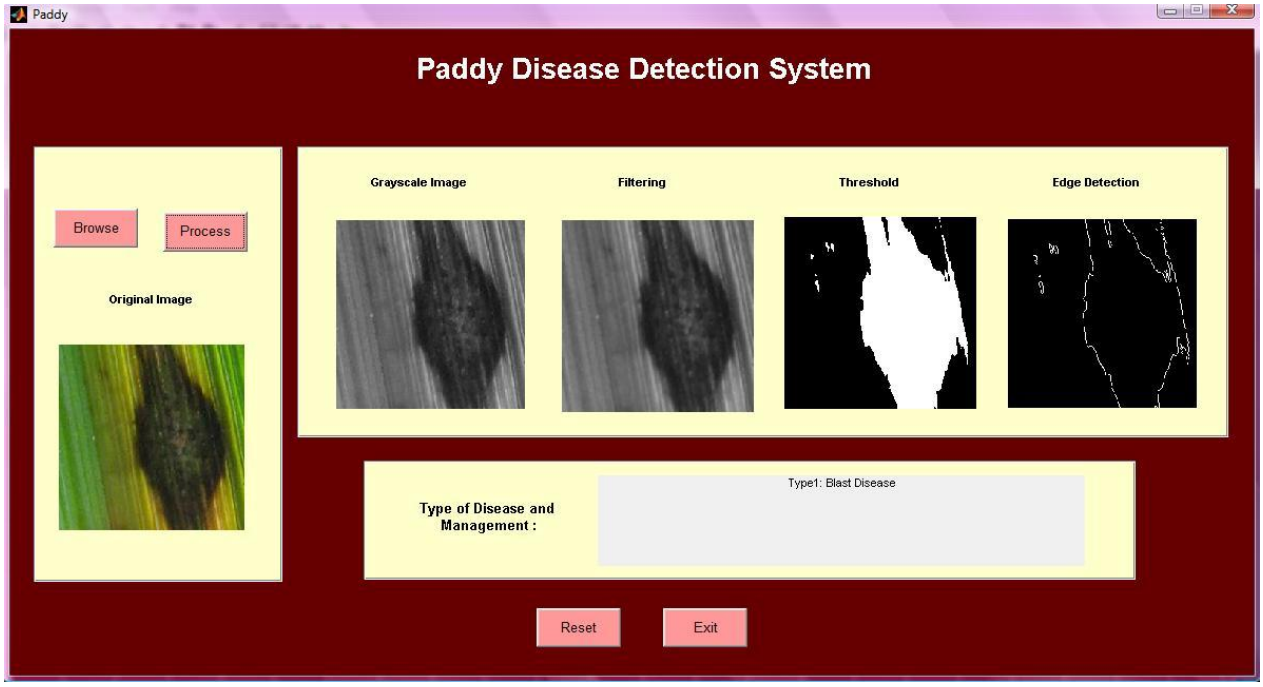


Fig 3.6: Prototype of paddy disease detection system

3.3.4 Implementation Stage

A software implementation method is a systematically structured approach to effectively integrate a software [23]. In this stage, the paddy system must be tested to make sure it is free from error. Besides, the implementation of the system includes the achievement of the goals/objective of the system and also to make sure the system can run smoothly. The designer should know and understand all the navigation key, coding and design.

3.3.5 Testing Stage

Software testing is an investigation conducted to provide information about the quality of the product or service under test[24]. Testing stage is the process of executing a program or application with the intent of finding software bugs (errors or other defects). A primary purpose of testing is to detect software failures so that defects may be discovered and corrected. The scope of software testing often includes examination of code as well as execution of that code in various environments and conditions as well as examining the aspects of code There are some criteria of validating and verifying that a software program/application/product of paddy system:

1. meets the requirements that guided its design and development;
2. works as expected; and
3. can be implemented with the same characteristics.

3.3.6 Deployment and Maintenance

Deployments are all of the activities that make a software system available for use[25]. Maintenance is the modification of a system after delivery to correct faults, to improve performance or other attributes[26]. The paddy system should be maintained from time to time by the administrator, if there is any correction or addition to the system in order to keep the user satisfaction.[27]

CHAPTER IV

IMPLEMENTATION

4.1. Introduction

This chapter briefly discusses the implementation of the project. As the software progresses, the implementation of Paddy Disease Detection System using Image Processing will need to test the software for improvement and proper implementation.

4.2 Image Acquisition

Image acquisition is the first step in system development to get the sample or image. For Paddy Disease Detection System using Image Processing, some of the sample is already taken from the internet and some of the sample manually captured in Kedah. The sample is already has kept into the folder in computer. So, there is no process of image acquisition.

The software platform that is used to execute the system is MATLAB 2010. In this system, the image is loaded from the folder in computer named "Paddy" by the user. User can choose which image to be load.

When the user browse the image by clicking the *Browse Button*, the system start to search the image stored.

```
% browse the image into the system
[filename1,pathname1] =
uigetfile({'*.jpg';'*.gif';'*.bmp';'*.*'}); ('Please
pick the paddy sample');

global imageSelected;
global sameImage;

imageSelected=(strcat(pathname1,filename1));
sameImage=(strcat(pathname1,filename1));

axes(handles.originalaxes);
imshow(imageSelected);

guidata(hObject, handles);
```

Figure 4.1 Image Acquisition source code

4.3 Image segmentation and pre-processing

4.3.1 Grayscale

First, the image is converted to the grayscale image. The function of `G = rgb2gray(Z)` is used to convert into the grayscale image. Then, the intensity of image is adjusted by calling function that specifies lower (bottom 1% of all pixel values) and upper limits (top 1% of all pixel values) that are used for contrast stretching the grayscale image.

```
% convert to grayscale image
global imageSelected;
global sameImage;



% convert to grayscale image
Z= imread(sameImage);
G = rgb2gray(Z);
axes(handles.grayscaleaxes);
imshow(G);
```

Figure 4.2 Grayscale source code

4.3.2 Filtering

Filtering is one of the processes in image enhancement. The function of filtering is to remove noise and to smooth out the image acquired. The average filtering is applied in this system. Filter `h = fspecial('average');` is applied to the image by function `F = imfilter(G,h,'symmetric').` Symmetric means input array values outside the bounds of the array are computed by mirror-reflecting the array across the array border.

```
% filtering

h = fspecial('average');
F = imfilter(G,h,'symmetric');
axes(handles.filtering);
imshow (F);
```

Figure 4.3 Filtering source code

4.3.3 Threshold

Threshold image is consist only with binary pixels where an object pixel is given a value ‘1’ (remarked by white color) while background pixel is given value of ‘0’ (remarked by black color). The image of grayscale image with fltering is convert to binary image by function `BW = im2bw(F,level)` as shown in figure 4.4.

```
% threshold

BW = im2bw (F,graythresh(F));
BW = ~ BW;
new = imfill(BW,'holes');
axes(handles.threshold);
imshow(new);
```

Figure 4.4 Threshold source code

4.4 Analysis and Classification of Paddy Disease

Before the image is convert into the binary data, the image will be pass through the RGB calculation. This is for detecting the normal paddy leaf by using the range of RGB calculation. Figure 4.5 (a) shows the calculation of RGB. After that, the resulting segmented image allows the system to analyze leaf disease features more efficient. The binary images are convert into the binary data excel files where the column is 1 and the row is 240. The format of the excel files is .csv.

```
img=imread(inputImage);
Red = img(:,:,1);
Green = img(:,:,2);
Blue = img(:,:,3);
if (Red(:) >=93 & Red(:) <=204 & Green(:) >= 142 &
Green(:) <=210 & Blue(:) >= 64 & Blue(:) <=155)
result= 'Type 4 :Normal';
```

Figure 4.5 (a) Calculation of range RGB for Normal leaf

```
Row1 = 1;
Column1 = 240;
new = imresize(new, [Row1 Column1]);
new = new'; %Take transpose.

% Get the current folder fullpath name
 p = mfilename('fullpath');
% break the fill path of ur .m file into parts
 [pathStr, excelFile, ext] = fileparts(p);
% Set the file path for the excel file that will be
create later

newExcelFile=(strcat(pathStr,'\ConvertedData\','csvDa
ta.csv'));
%output data from MatLab to a Text file with data 0
and 1.
 dlmwrite( newExcelFile, new,'delimiter', ',');
```

Figure 4.5(b) Binary image is converted into excel files.

The outputs of the data are 0 and 1. The excel files are then again applied to neural network to classify types of paddy diseases. The neural network can be able to categorize the image of paddy disease into four classes:

i) Paddy blasé disease

ii) Narrow Brown Spot Disease

iii) Brown Spot Disease

iv) Normal paddy leaf

```
Sample = 20; %number of samples made
Sample_Attribute = 240; %(That means Size: 60x4);

% Get the current folder fullpath name
 p = mfilename('fullpath');
% break the fill path of ur .m file into parts
 [pathStr, excelFile, ext] = fileparts(p);

imageClass=(strcat(pathStr,'\csvFile\','mask_Monochro
me_Combined.csv'));

imageTarget=(strcat(pathStr,'\csvFile\','mask_Monochr
ome_Target.csv'));

% importdata from folder TrainFile
alphabet = csvread(imageClass);
targets =  csvread(imageTarget);

%% create neural network using feedforward
net = newff(alphabet,targets,25);
net1 = net;
net1.divideFcn = '';

%% Train the Network
[net1,tr] = train(net1,alphabet,targets);
numNoisy = 2; %10;

% SET TESTING PARAMETERS
noise_range = 0:.05:.5;
max_test = 100;
network1 = [];
%network2 = [];
```

```
% PERFORM THE TEST
for noiselevel = noise_range
  errors1 = 0;
  errors2 = 0;

  for i=1:max_test
     x = alphabet +
randn(Sample_Attribute,Sample)*noiselevel;

    %% TEST NETWORK 1

    %simulate the network
    y = sim(net1,x);
    yy = compet(y);
    errors1 = errors1 + sum(sum(abs(yy-targets)))/2;
   end

  % AVERAGE ERRORS FOR 100 SETS OF 26 TARGET VECTORS.
  network1 = [network1 errors1/Sample/max_test];
end
 %Types of Paddy
Type1 =     ['Type1: Blast Disease.'...
             'Avoid excess N - fertilizer application.
Apply nitrogen in three split doses.'...
            'Removes weed hosts from bunds. Use of
tolerant varieties. '...
            'Burning of straw and stubbles after
harvest.'];
Type2 =     ['Type2: Narrow Brown Spot Disease '...
             'Cultural practices, such as the use of
potassium and phosphorus fertilizers, '...
             'and planting of early maturing cultivars
early in the growing season, '...
             'are recommended to manage the narrow brown
leaf spot.'...
             'The use of resistant varieties is the most
effective approach to manage the disease. '...
             'Spraying of fungicides such benomyl,
propicanazole,carbendazim, propiconazole, and iprodione';]
```

```
Type3 =     ['Type3: Brown Spot Disease'...
              'Apply FYM 12.5 t/ha or green manure 6.25
t/ha. '...
              'Soil application of P. fluorescens @ 2.5
kg/ha mixed with 50 kg FYM after 30 days of
transplanting.'...
              'Foliar spraying of P. fluorescens @0.2percent
at boot leaf stage and 10 days later.'
              'Avoid flow of irrigation water from infected
to healthy field.'];
Type4 =     'Type4: Normal';

%Testing

noisyJ = double(column1);

%plotchar60x40(noisyJ);
y = sim(net1,noisyJ);
y = compet(y);
answer = find(compet(y) == 1);
%plotchar60x40(alphabet(:,answer));

if answer == 1
    result=Type1;
elseif answer == 2
    result=Type2;
elseif answer == 3
    result=Type3;
else
    result=Type4;
end;
```

Fig 4.6 Neural Network source code

CHAPTER V

RESULT, DISCUSSION AND CONCLUSION

5.1 Introduction

There are 30 samples of paddy image used as sample data in the testing phase of this development. The paddy images samples had gone through the phases as discuss in the chapter 3 and 4. This chapter will briefly describe about the output result of each phases.

5.2 Image Acquisition

Some of the paddy images for testing are collected from the paddy field in Kedah, and some of them were collected from the internet. The samples of paddy were taken based on the 3 types of disease including the normal leaf. Figure 5.1 show the sample captured image for testing phase.

Fig. 5.1 : Original image

5.3 Image Segmentation and Pre-Processing

After the image is captured and cropped, it then will undergo to the next process. The sample will converted into gray scale image, filtered with average filter, and threshold.

5.3.1 RGB to Grayscale

The captured image which is in RGB format was converted to grayscale format as shown in figure 5.2. The output of grayscale image also display in the GUI.

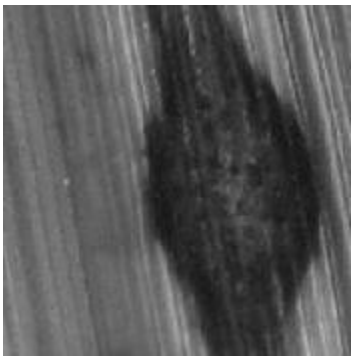


Fig 5.2 : Grayscale image

5.3.2 Filtering

After the image was converted to grayscale format, it will then filter using average filter to remove noise as shown in figure 5.3. The noise of the image cannot been seen by naked eye.

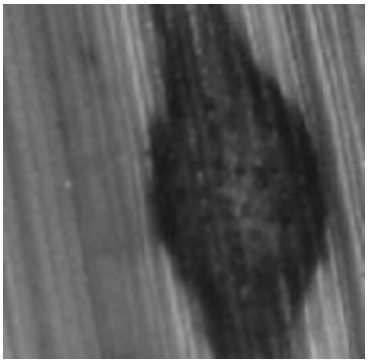


Fig 5.3 : Filtering image

5.3.3 Threshold

After the filtering process completed, the image then will be converted into the binary image as shown in figure 5.4.

Fig 5.4 : Binary image

5.4 Analysis and classification of paddy disease

The next step is create a neural network that will learn to identify the paddy disease. The feed forward network is used in this part for training and testing. Below is a picture of MLP structure with two hidden layer [25 10] neurons and sigmoid, linear activation function. Now the network is ready to be trained. The samples are automatically divided into training, validation ad test sets. The training set is used to teach network. Training continues as long as the network continues improving on the validation set. The test set provides a completely independent measure of network accuracy.

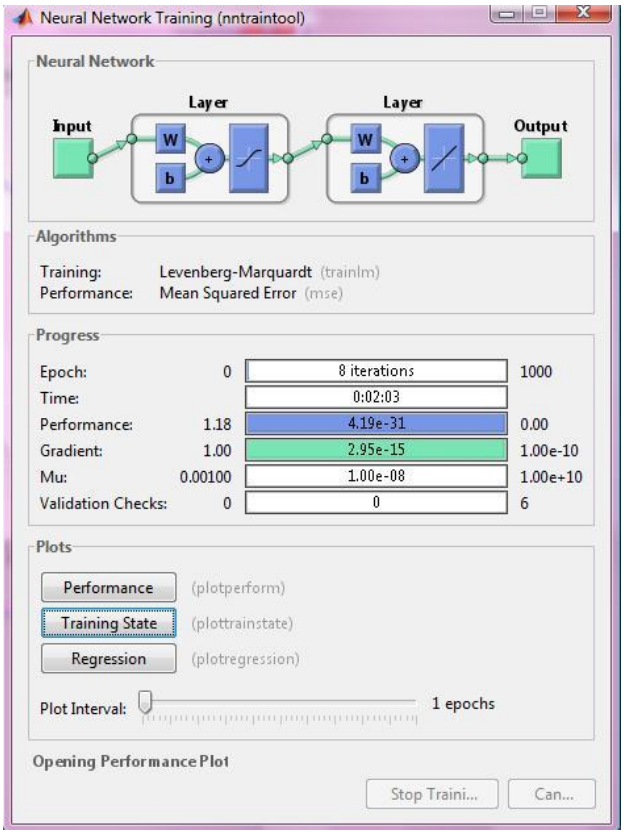


Figure 5.5 : Training the Neural Network

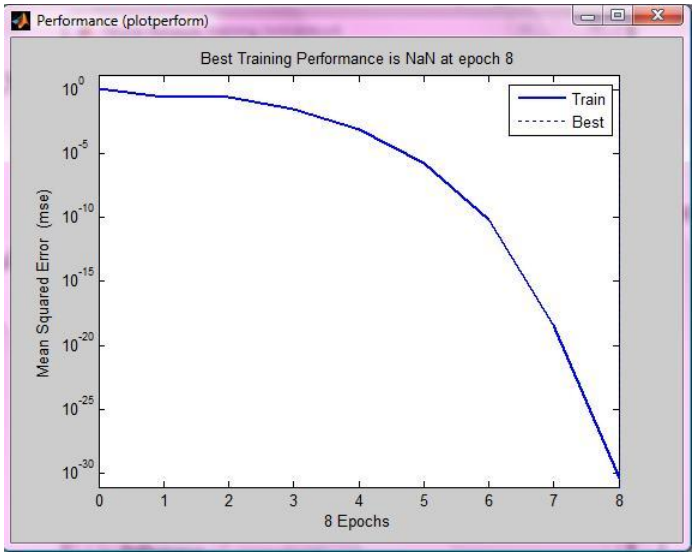


Figure 5.6 : Neural Network performance plot

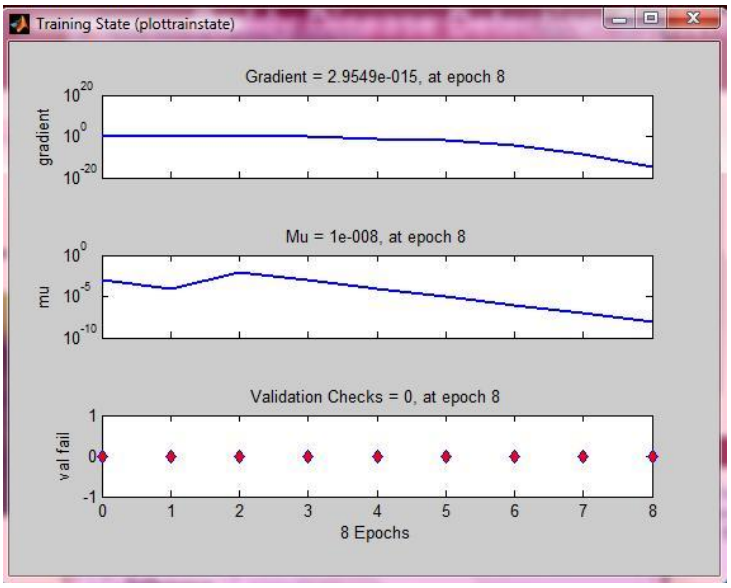


Figure 5.7: Neural network training state plot

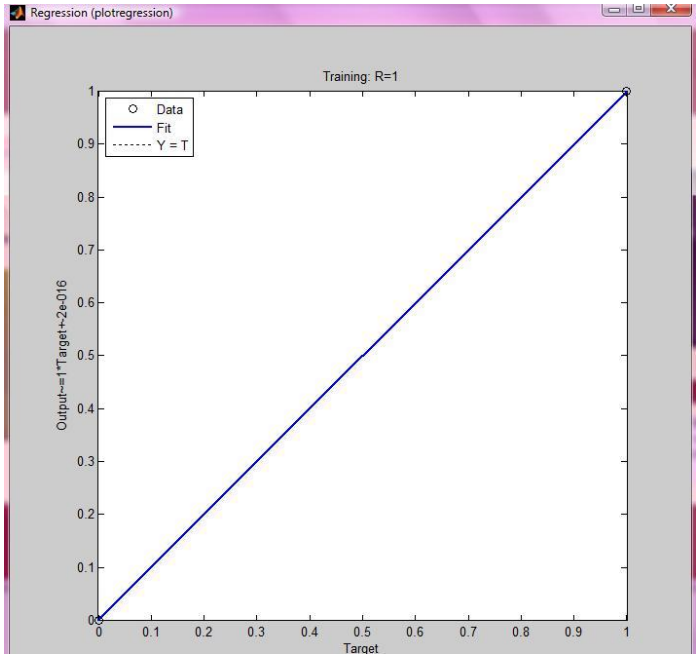


Figure 5.8: Neural network regression plot

5.5 Interface of the system

Figure 5.9 shows GUI that help the user to check the output of the prototype.

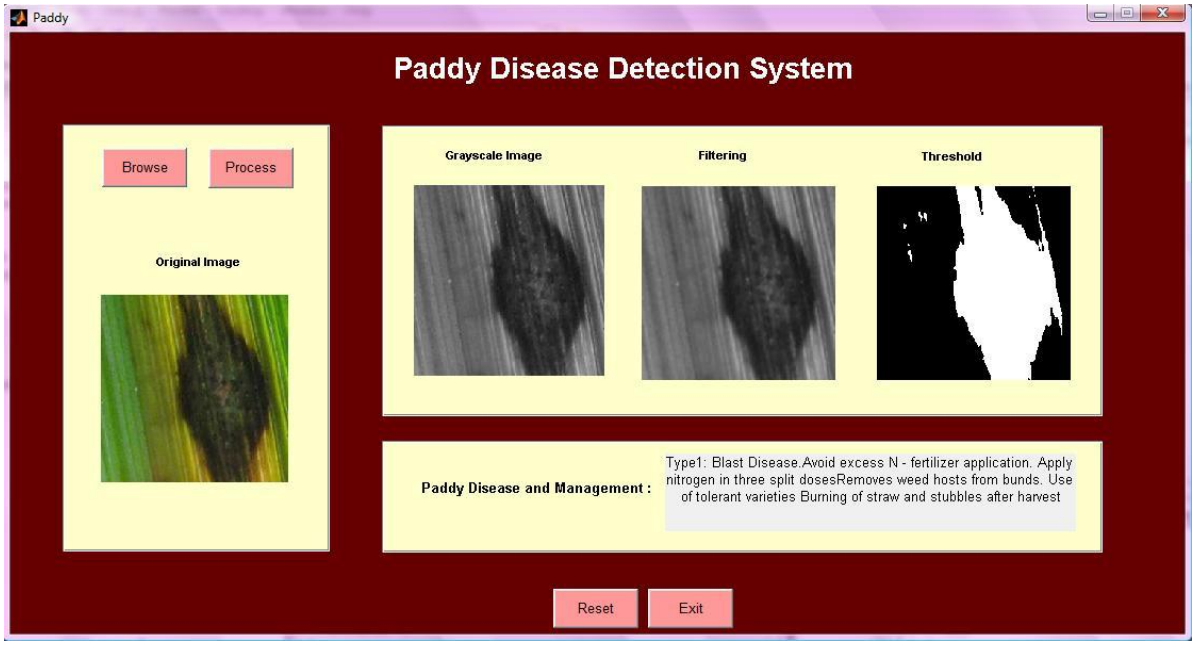


Figure 5.9: GUI of Paddy Disease Detection System

5.6 Advantages and disadvantages

The system has some advantages and disadvantages which should be enhance in the future.

5.6.1 Advantages

i) This system used the neural network to classify the paddy disease. Neural network is one of the accurate techniques that can be applied in the system for detecting disease

ii) This system can detect and classify the paddy disease automatically

iii) This is an alternative or supplement to replace the traditional manual method

iv) Human sight error can be eliminate when determine the paddy disease

5.6.2 Disadvantages

i) The image produce in threshold process gain a lot of noises that make the system confuse to classify the paddy.

5.7 Achieved objectives

The objectives of this project are:

i. to develop the prototype of paddy disease detection system

ii. to detect the paddy disease by using image processing

iii. to apply image processing technique to analyze the pattern of paddy disease

All the objectives stated above are achieved. The GUI has been developed for detect the paddy disease. This system also use some image processing in order to enhance the image and this system also applied the neural network technique to analyze the pattern of paddy disease which then classify it into 3 diseases.

5.8 Constraints

There are some constraints happen that effect the system when it is running. First, the image produces from the threshold process gain a lot of noise which affect the neural network training and testing. The quality of the image samples was blurring and sometimes it is not able to be process.

5.9 Assumption and further research

The system should be published and used in the agricultural sector especially in paddy industry to help the farmer detect the disease early. Farmer can protect their crop from being spread to the other crop area. Therefore, some assumptions have to be considered along with the development of this system. The camera must have a good pixel so that the picture was clear and easy to the system extract the feature.

In the view of the disadvantages stated, further research should be carried out to enhance the current research. There are some suggestion and recommendation for further research to publish the system in the agriculture industry. This system must be improved on the threshold method so that there is less noise or free noise. There still a lot of technique beside the Otsu method that can be implement in this system.

Furthermore, this system should be implementing in the mobile application development. So that the paddy farmers just carry their phone to know the types of paddy disease.

5.10 Conclusion

A system for diagnosis the paddy disease has been developed using the Matlab application. The image processing techniques is applied to improve and enhance the image to a better quality. Besides, the neural network is used to classify the paddy diseases which are paddy blast, brown spot disease, narrow brown spot disease and normal paddy leaf. The methodology involves image acquisition, pre-processing and segmentation, analysis and classification of the paddy disease. All the paddy sample will be passing through the RGB calculation before it proceed to the binary conversion. If the sample is in the range of normal paddy RGB, then it is automatically classify as type 4 which is Normal. Then, all the segmented paddy disease sample will be convert into the binary data in excel file before proceed through the neural network for training and testing. Consequently, by employing the neural network technique, the paddy diseases are recognized about 92.5 percent accuracy rates. This prototype has a very great potential to be further improved in the future.

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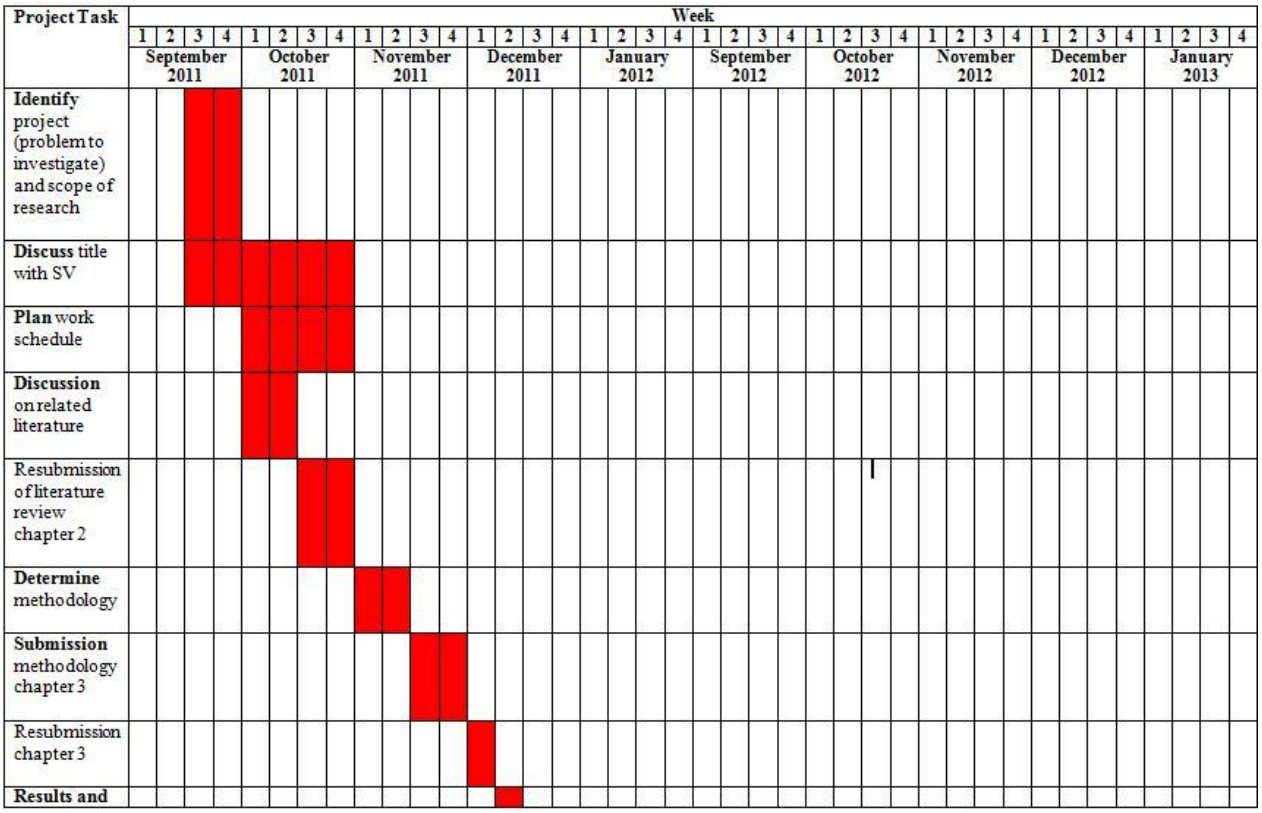
APPENDIX

A Gantt Chart



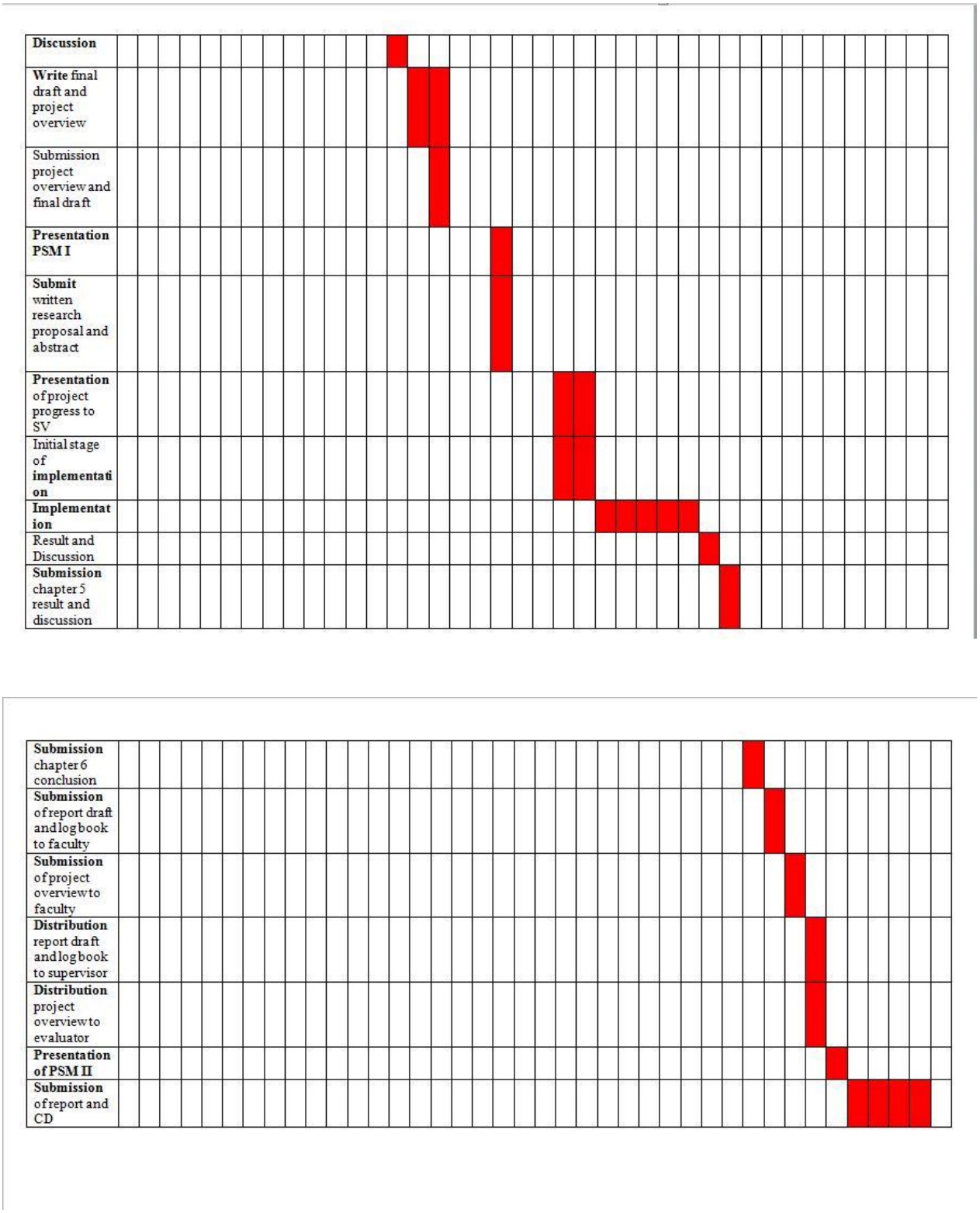


Figure 5.10 Gantt Chart

B Plagiarism

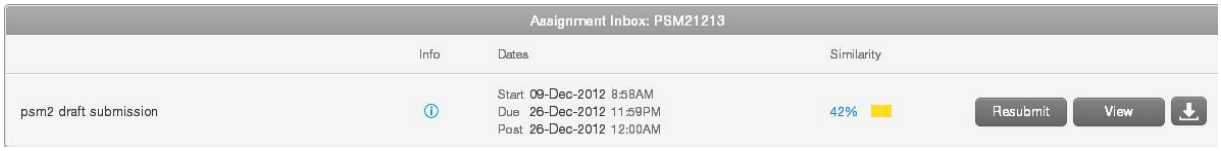


Figure 5.11 Plagiarism checker

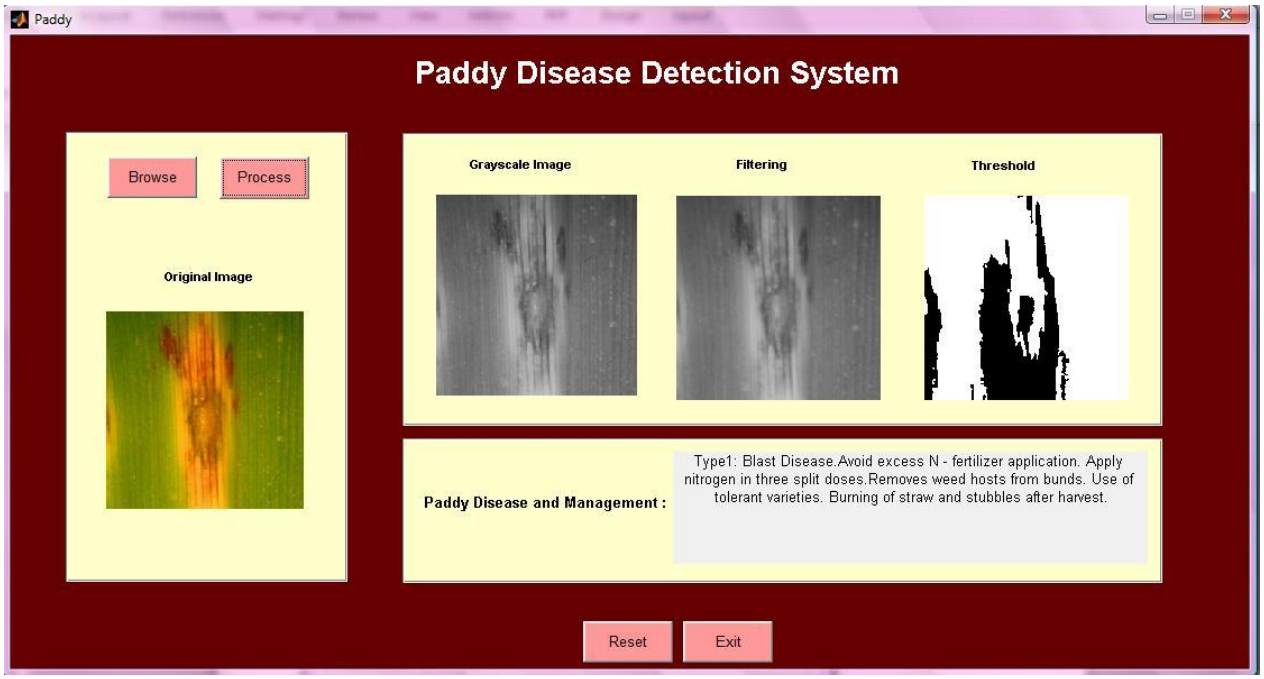
Result : 42 %

C Testing Result

No	Type of Paddy Disease	Total Sample	Sample Pass	Sample Fail	Accuracy for each sample
1.	Paddy Blast	10	9	1	90 %
2.	Narrow Brown Spot Disease	10	10	-	100 %
3.	Brown Spot Disease	10	8	2	80 %
4.	Normal	10	10	-	100 %
Total		**40**	**37**	**3**	**92.5 %**

Table 5.1 : Testing result

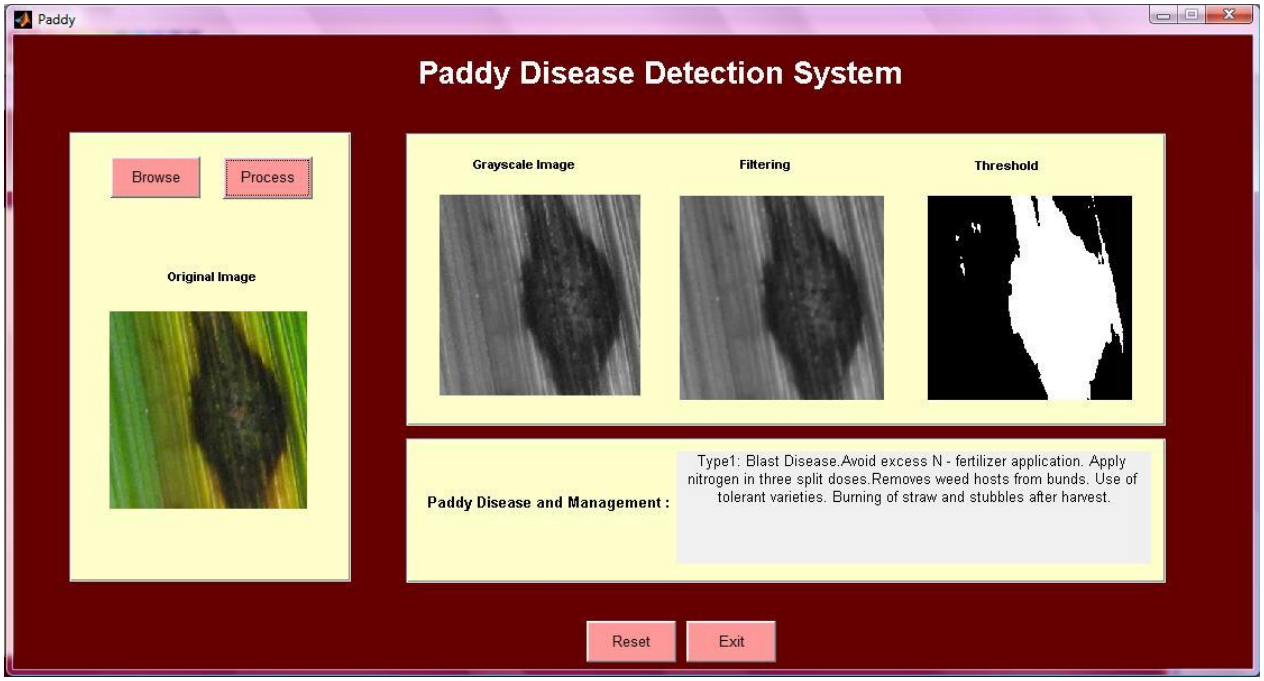
1)



Type of Disease : Paddy Blast Disease

Result : Pass

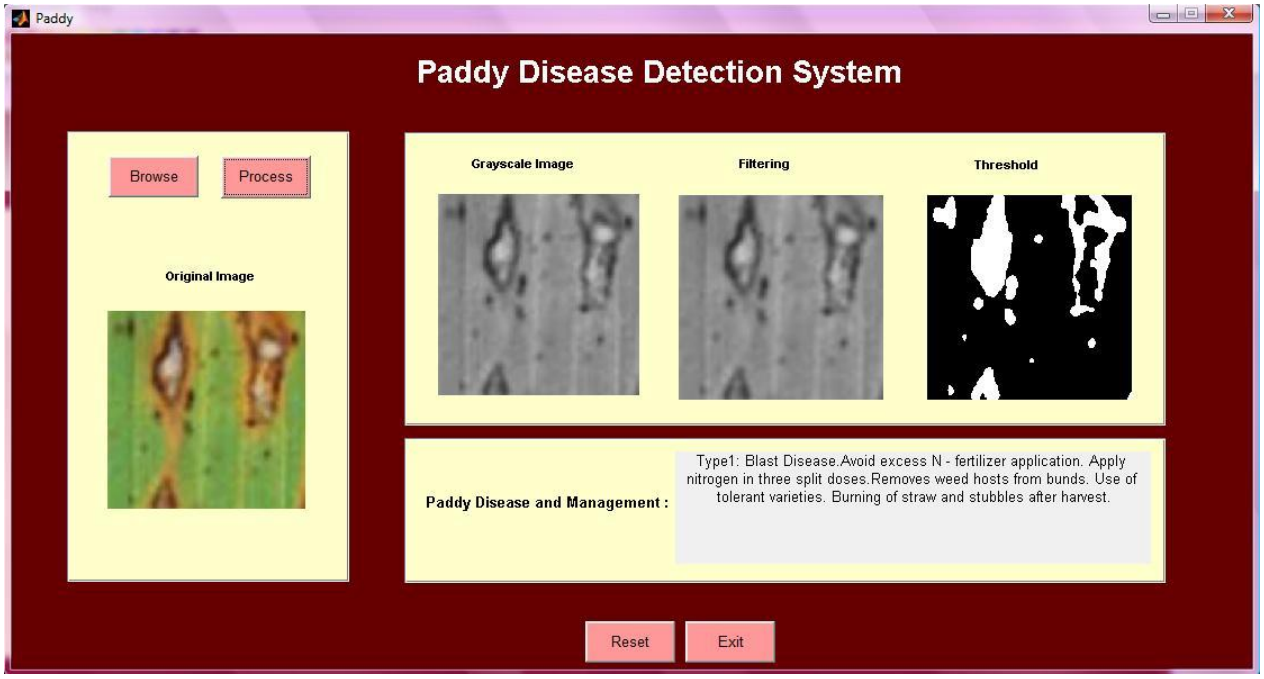
2)



Type of Disease : Paddy Blast Disease

Result : Pass

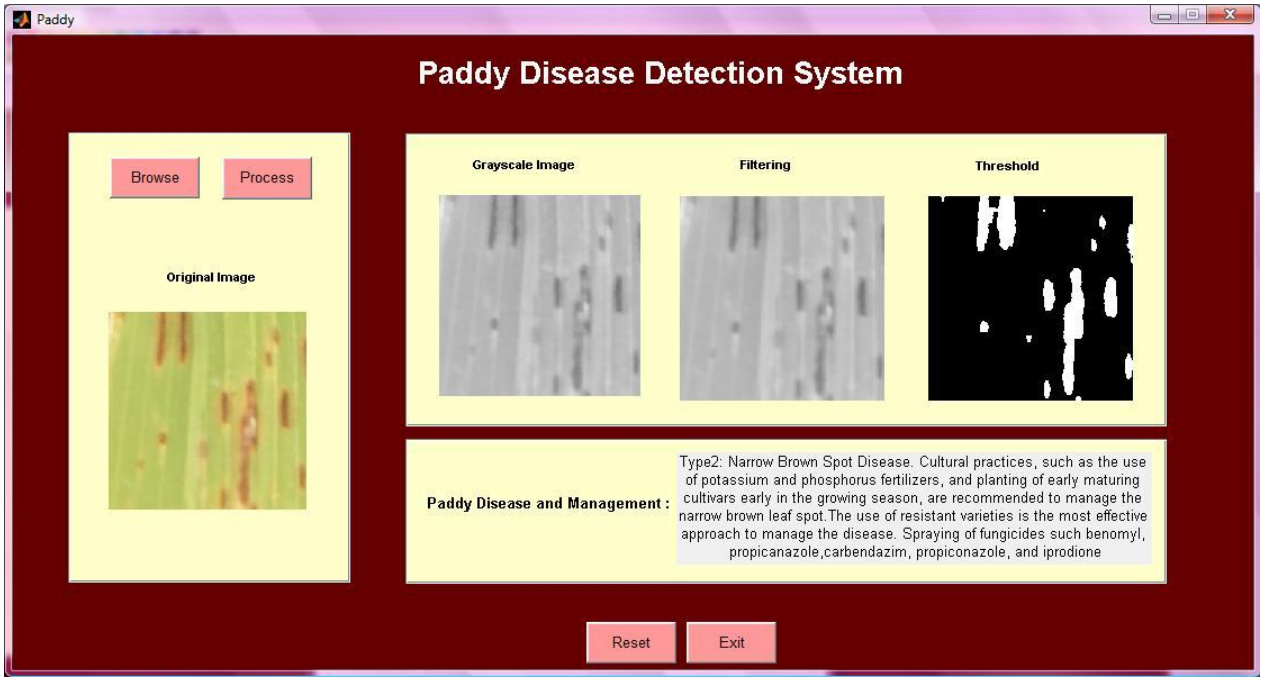
3)



Type of Disease : Paddy Blast Disease

Result : Pass

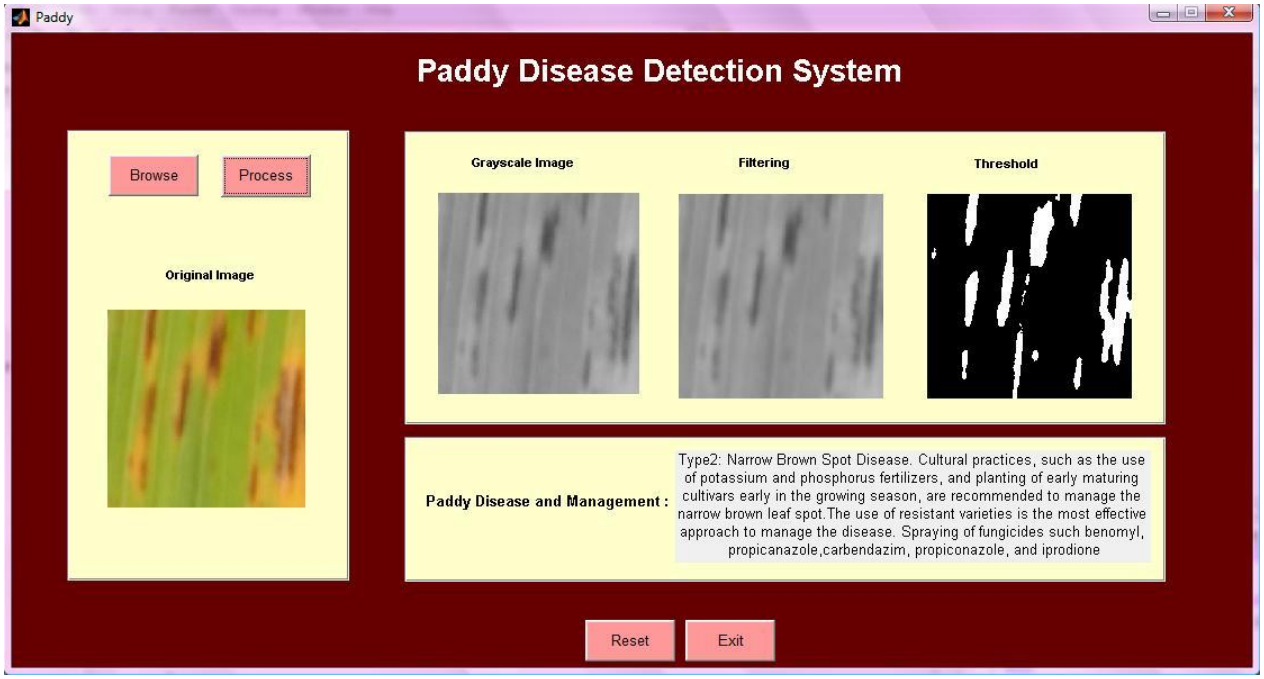
4)



Type of Disease : Narrow Brown Spot Disease

Result : Pass

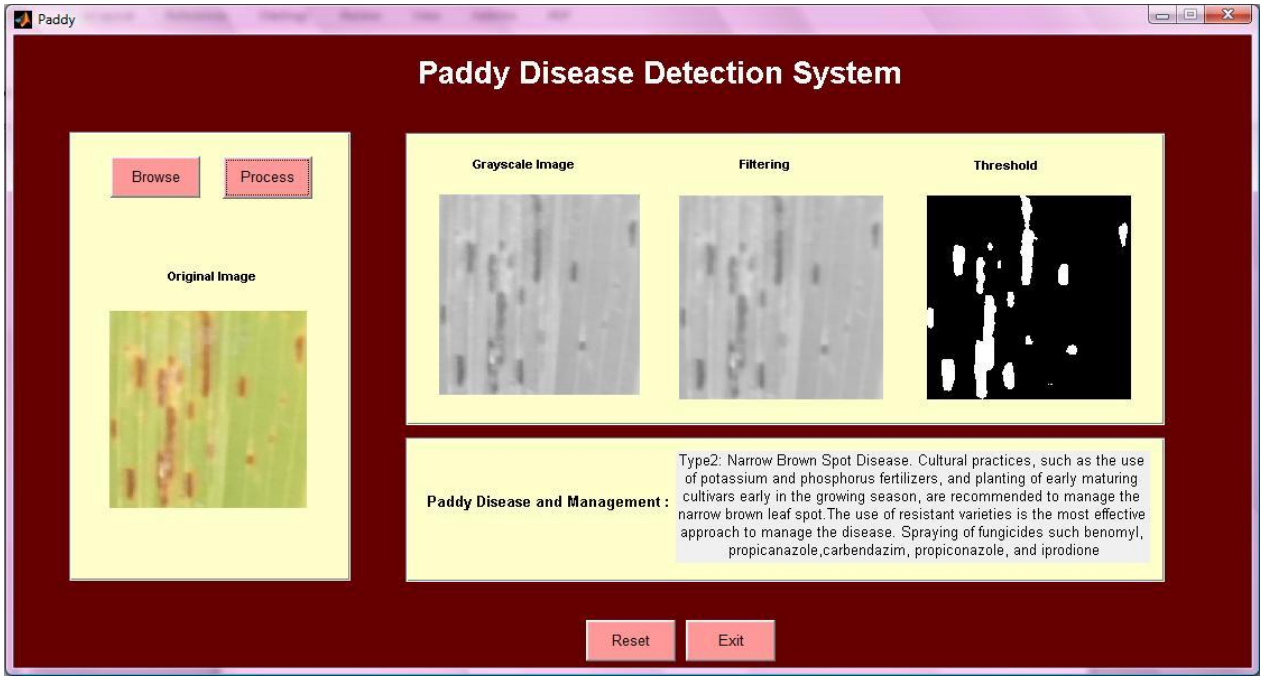
5)



Type of Disease : Narrow Brown Spot Disease

Result : Pass

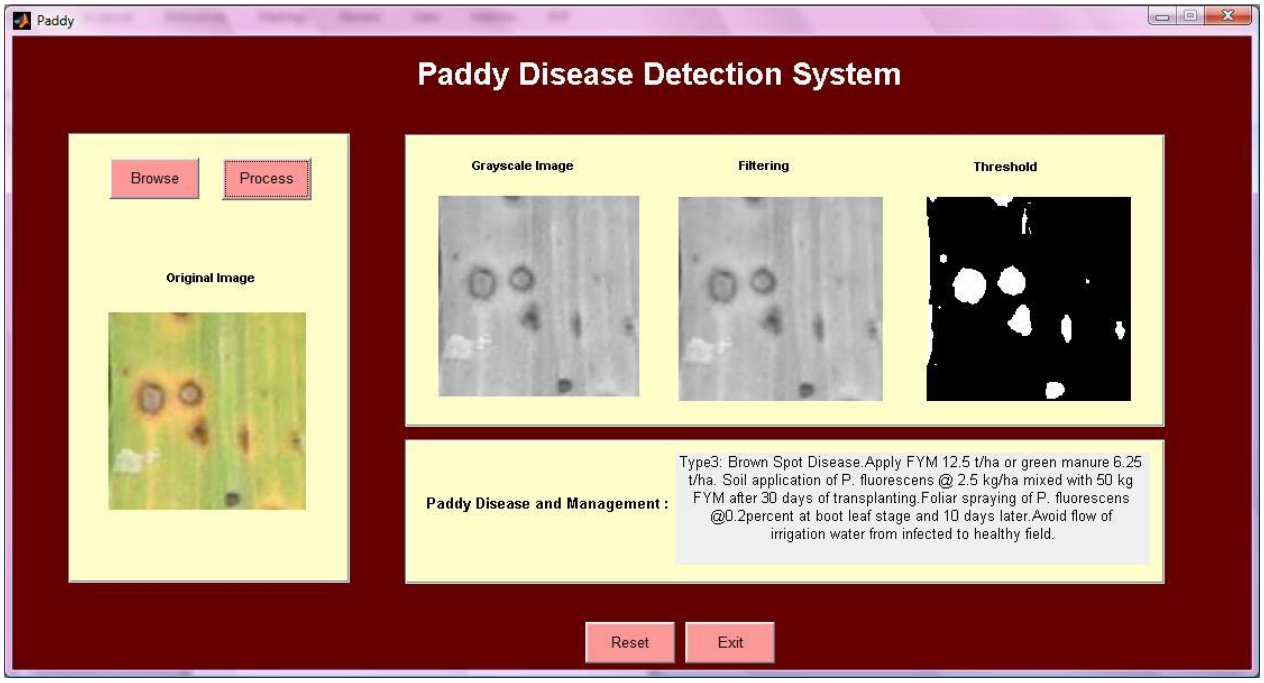
6)



Type of Disease : Narrow Brown Spot Disease

Result : Pass

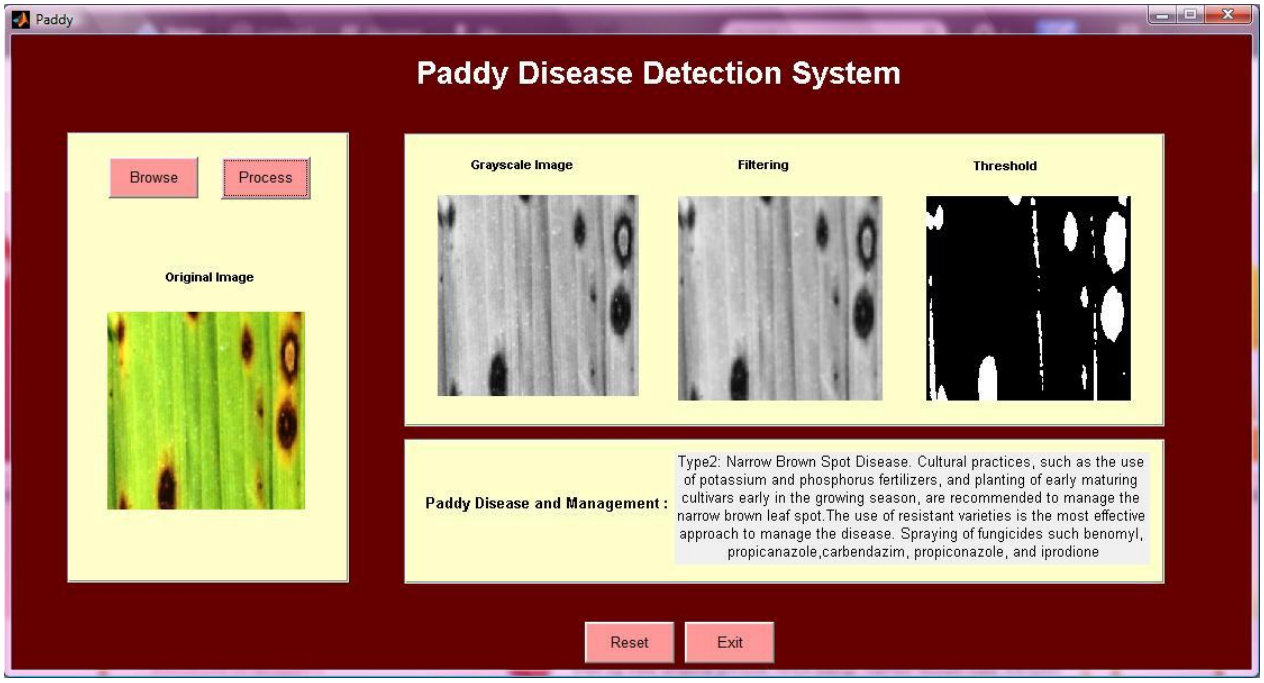
7)



Type of Disease: Brown Spot Disease

Result : Pass

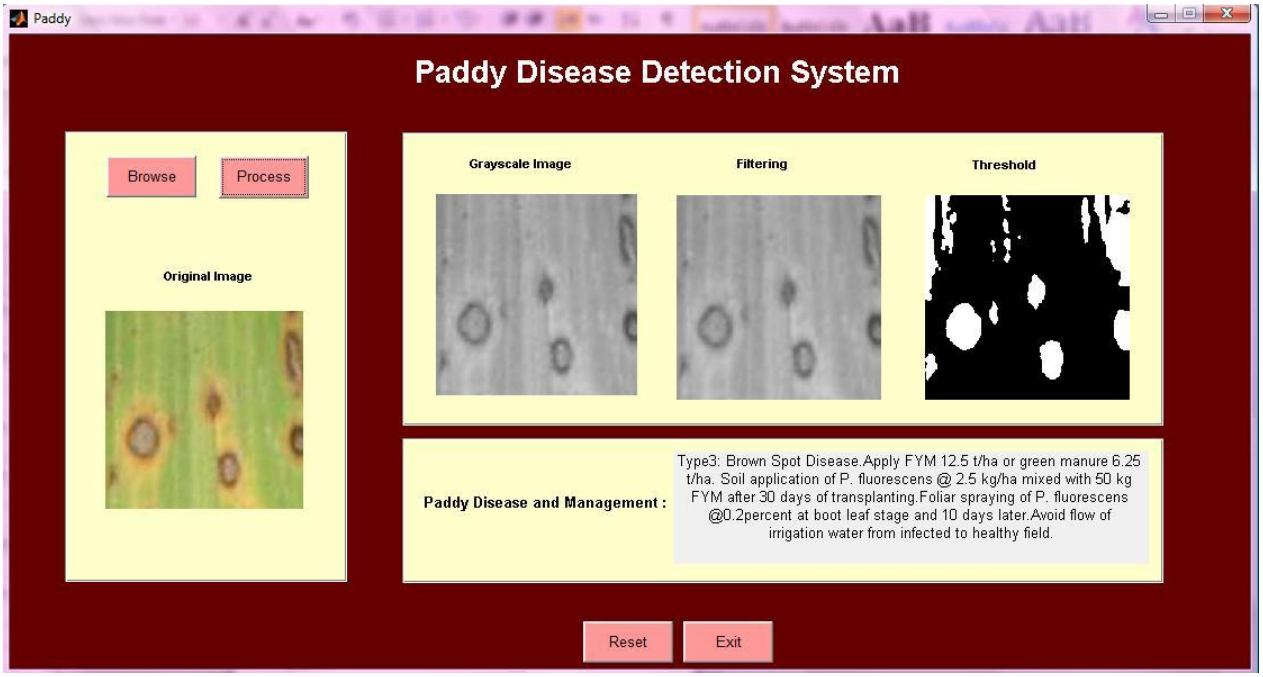
8)



Type of Disease: Brown Spot Disease

Result : Fail

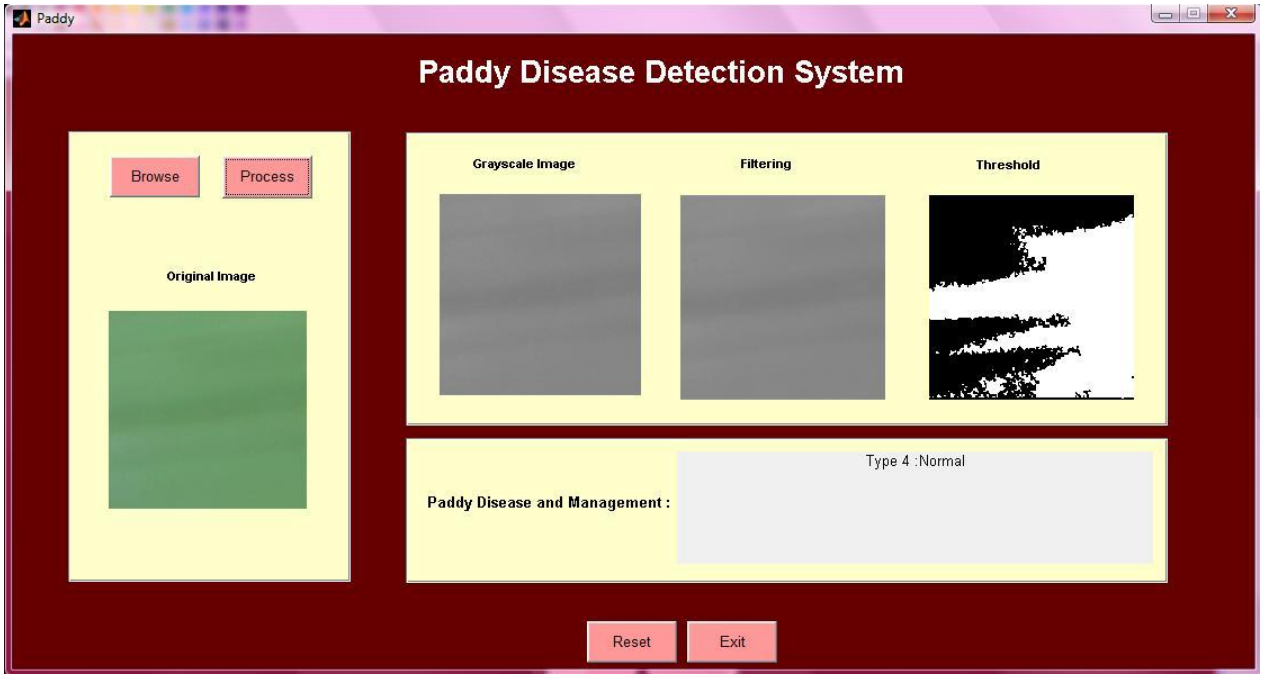
9)



Type of Disease: Brown Spot Disease

Result : Pass

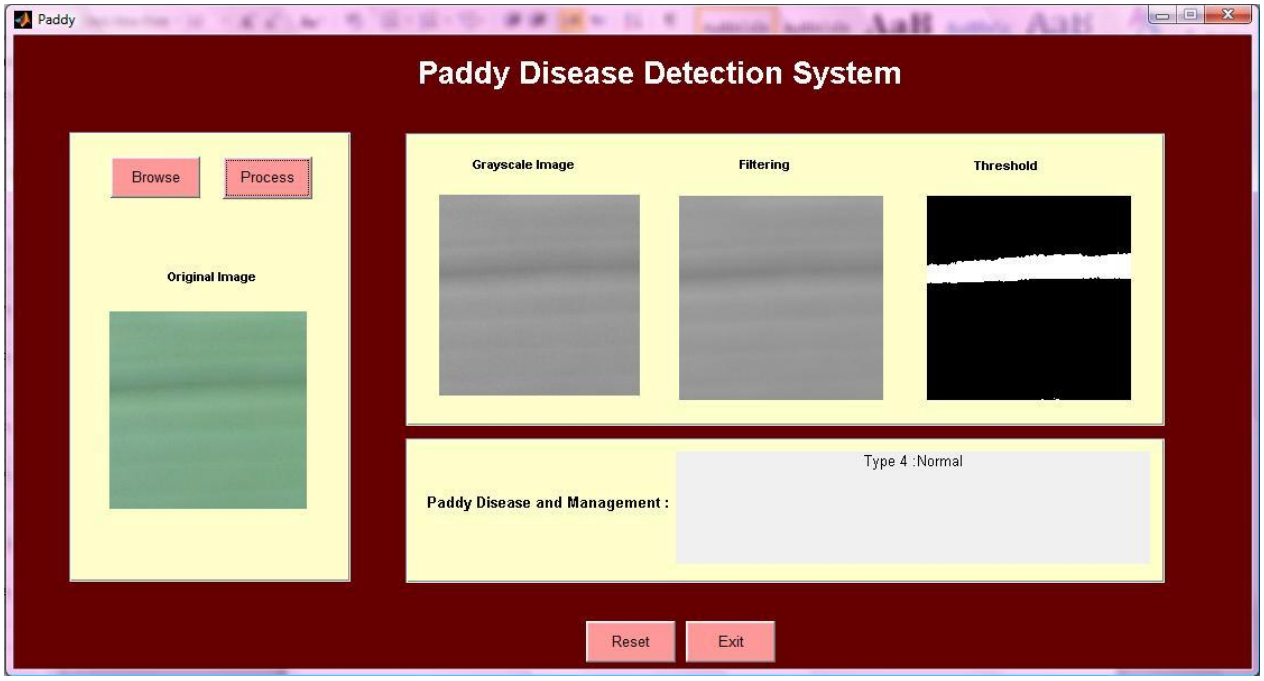
10)



Type of Disease: Normal Paddy

Result : Pass

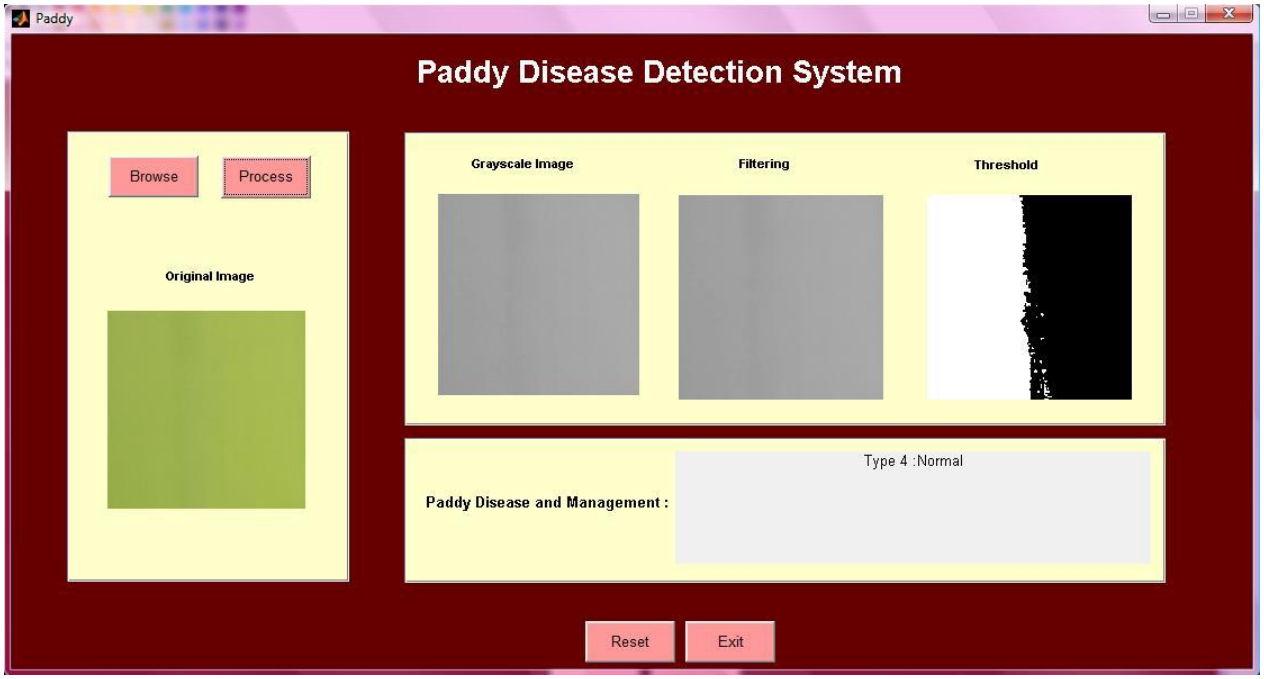
11)



Type of Disease: Normal Paddy

Result : Pass

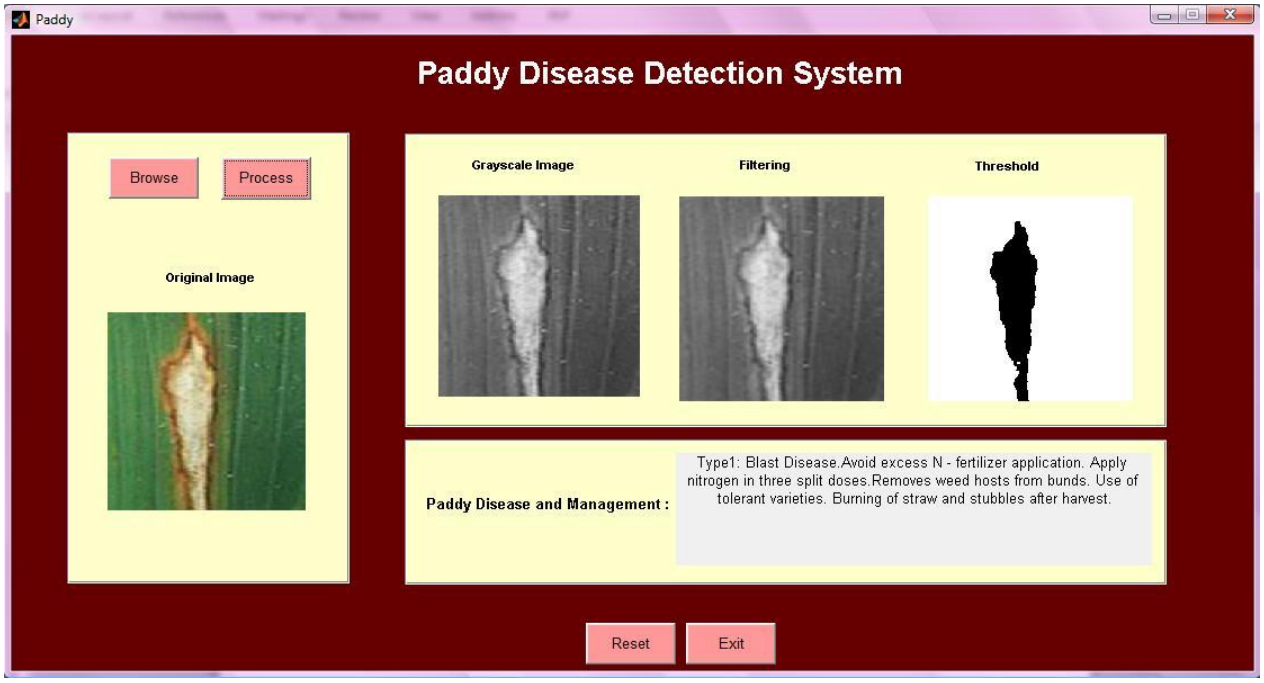
12)



Type of Disease: Normal Paddy

Result : Pass

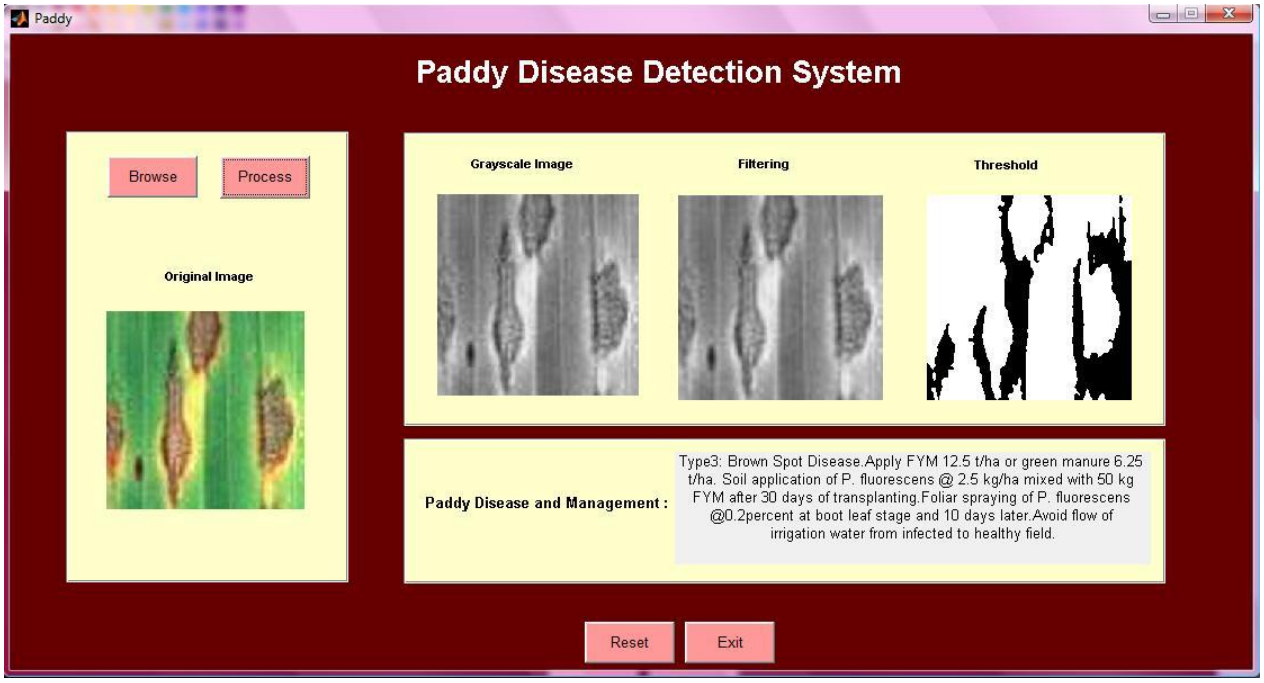
13)



Type of Disease: Paddy Blast

Result : Pass

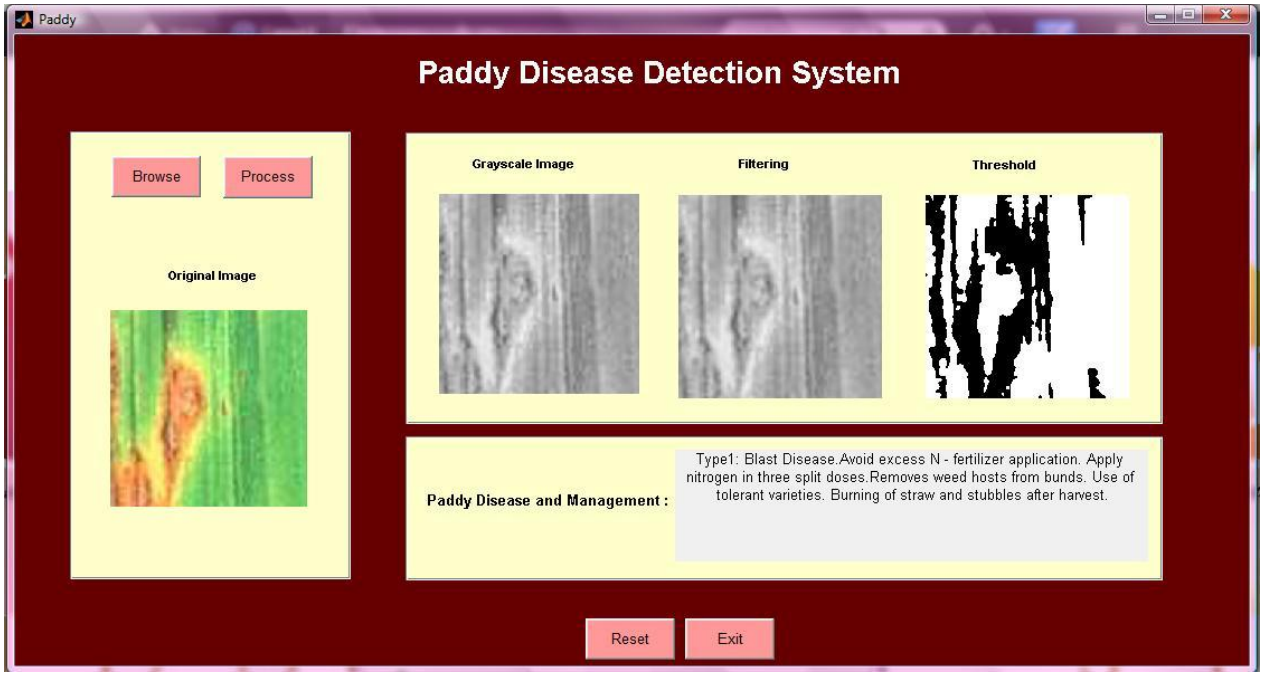
14)



Type of Disease: Paddy Blast

Result : Fail

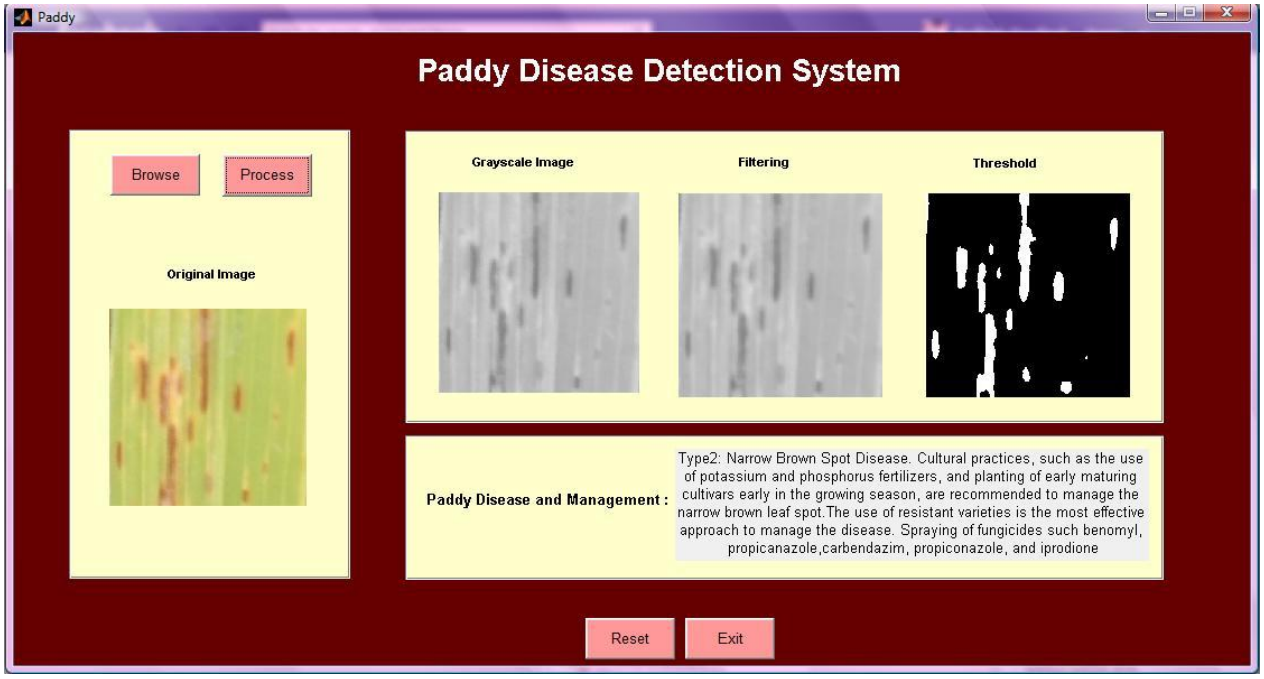
15)



Type of Disease: Paddy Blast

Result : Pass

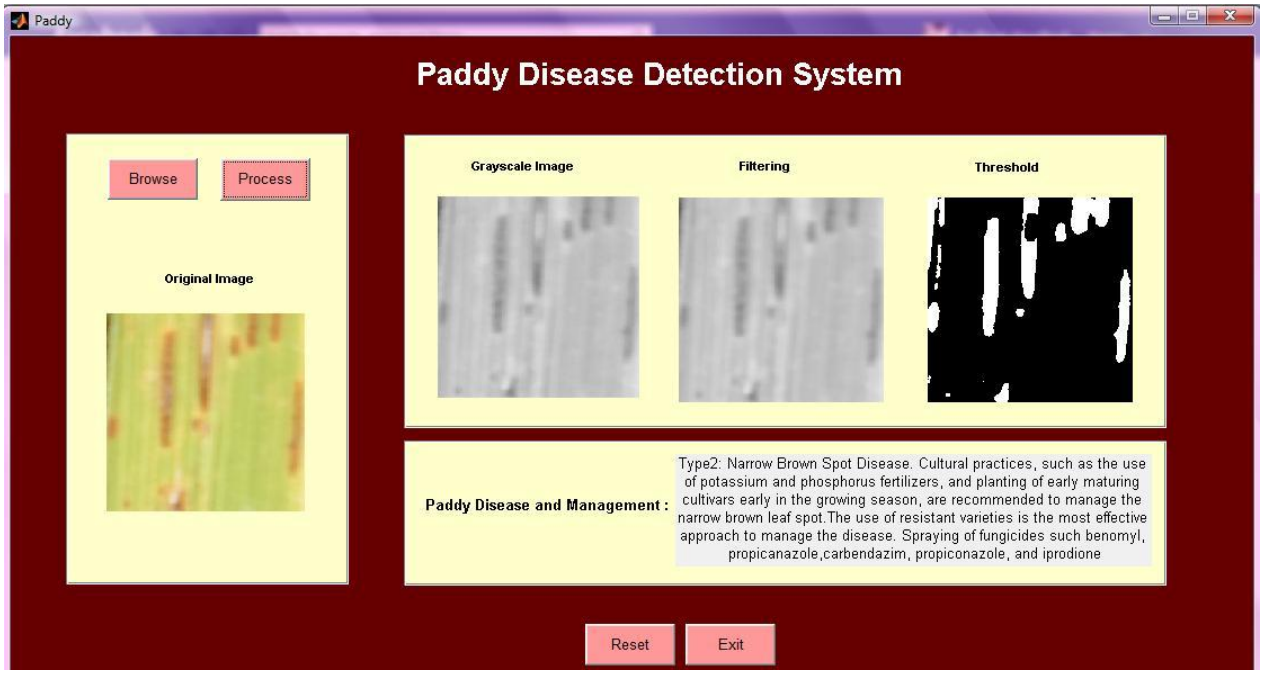
16)



Type of Disease: Narrow Brown Spot Disease

Result : Pass

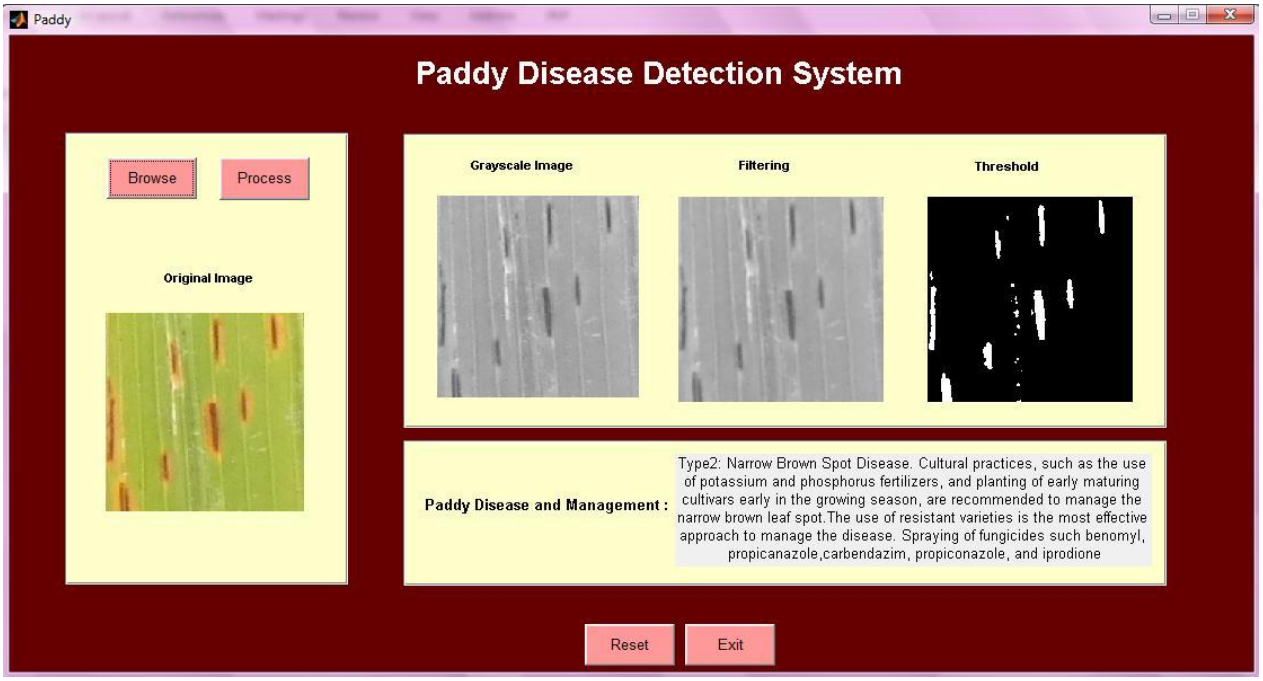
17)



Type of Disease: Narrow Brown Spot Disease

Result : Pass

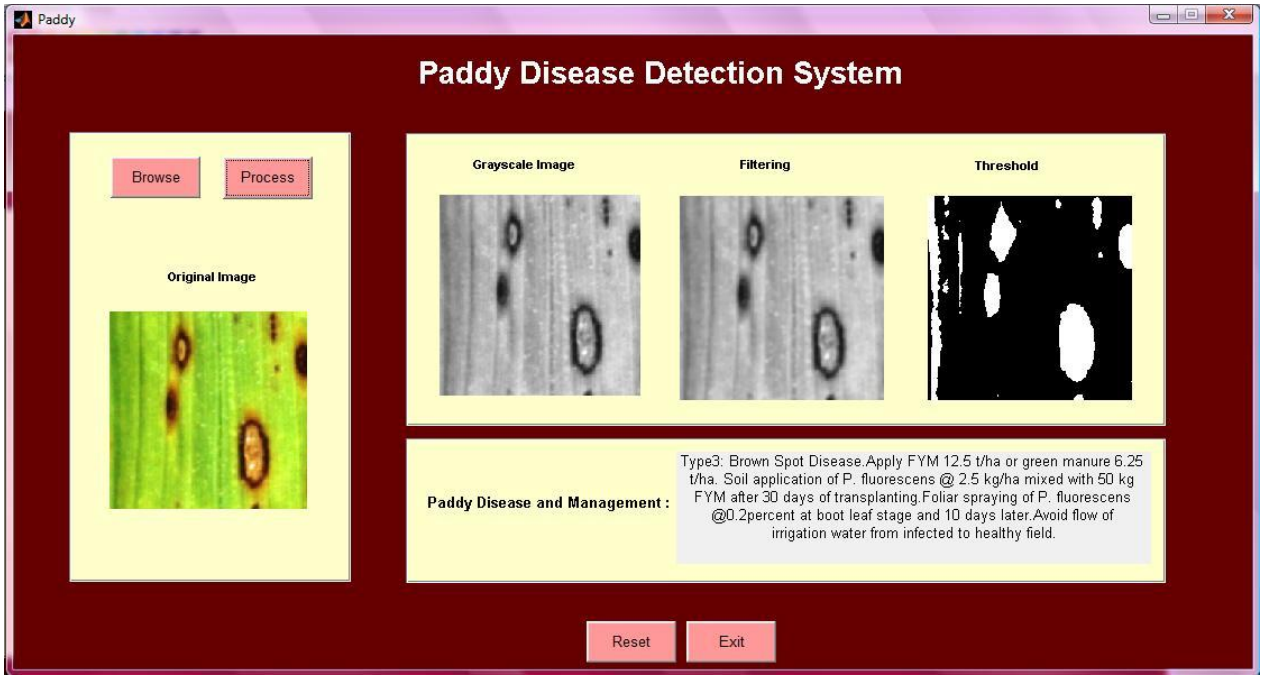
18)



Type of Disease: Narrow Brown Spot Disease

Result : Pass

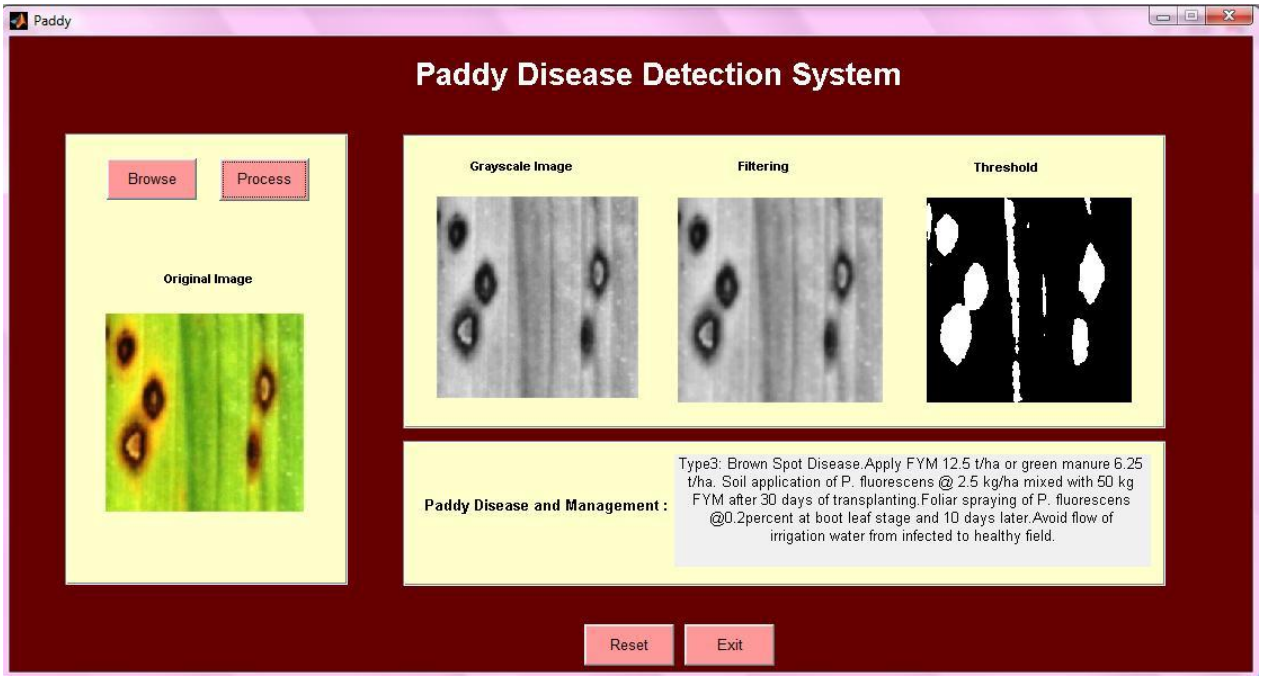
19)



Type of Disease: Brown Spot Paddy Disease

Result : Pass

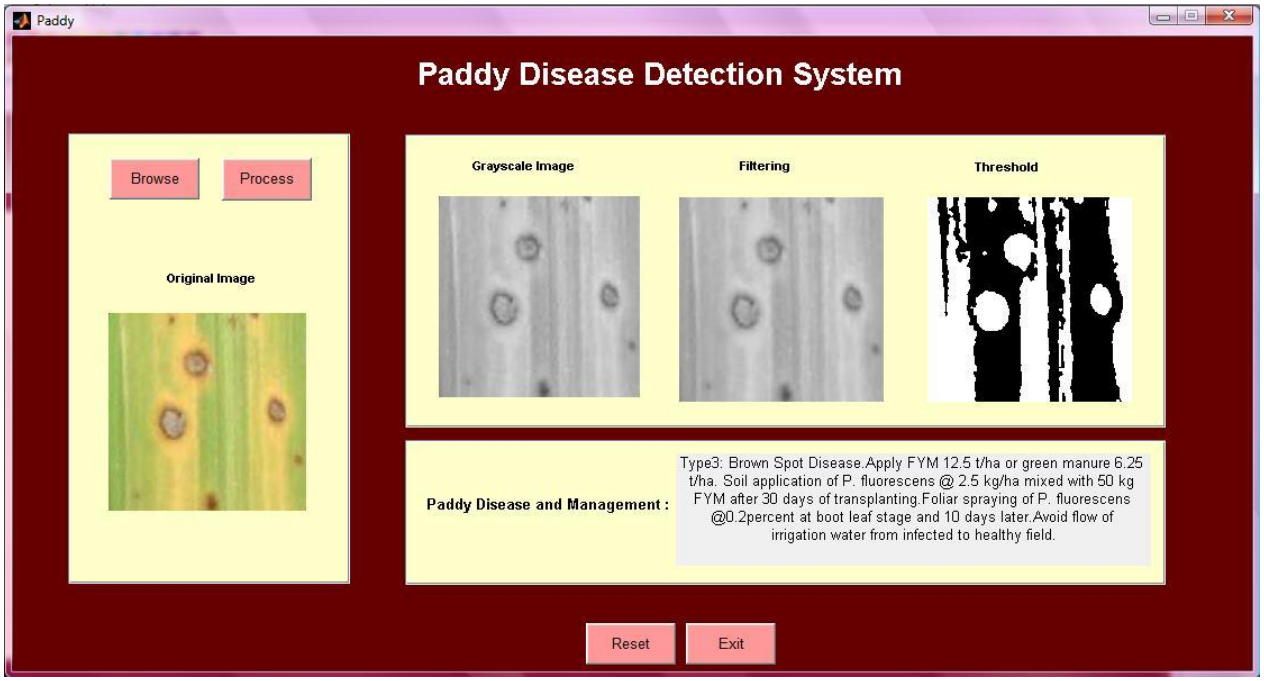
20)



Type of Disease: Brown Spot Paddy Disease

Result : Pass

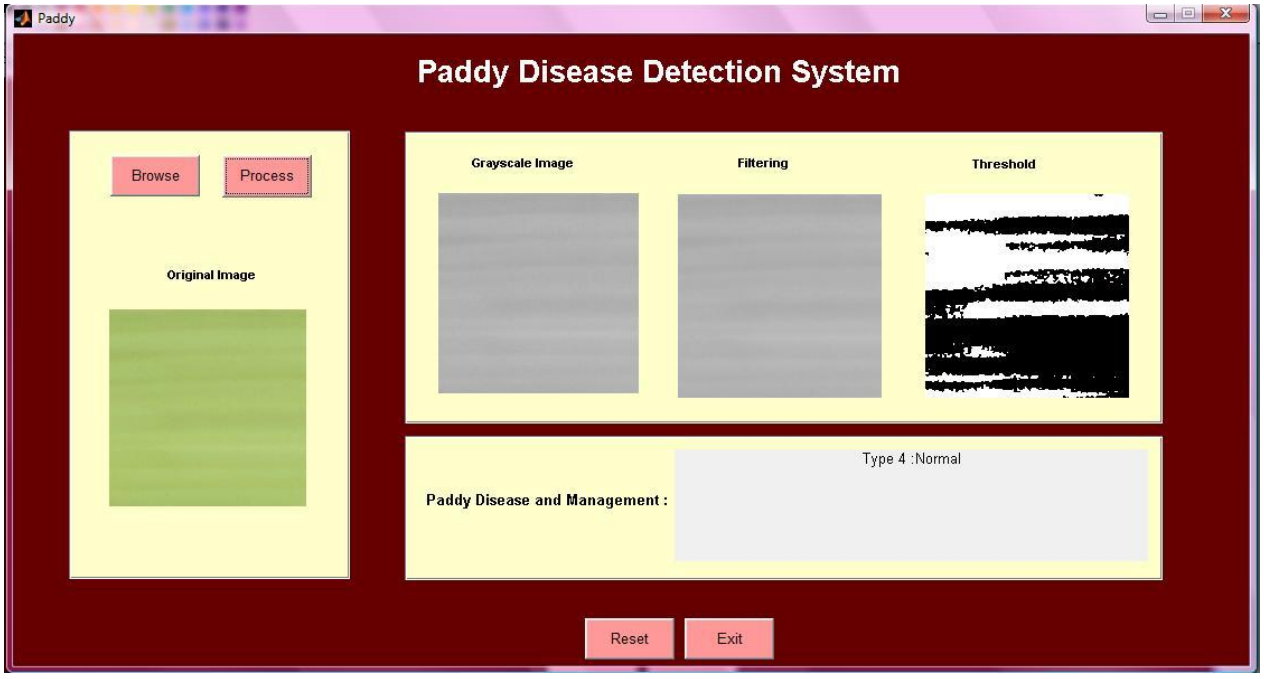
21)



Type of Disease: Brown Spot Paddy Disease

Result : Pass

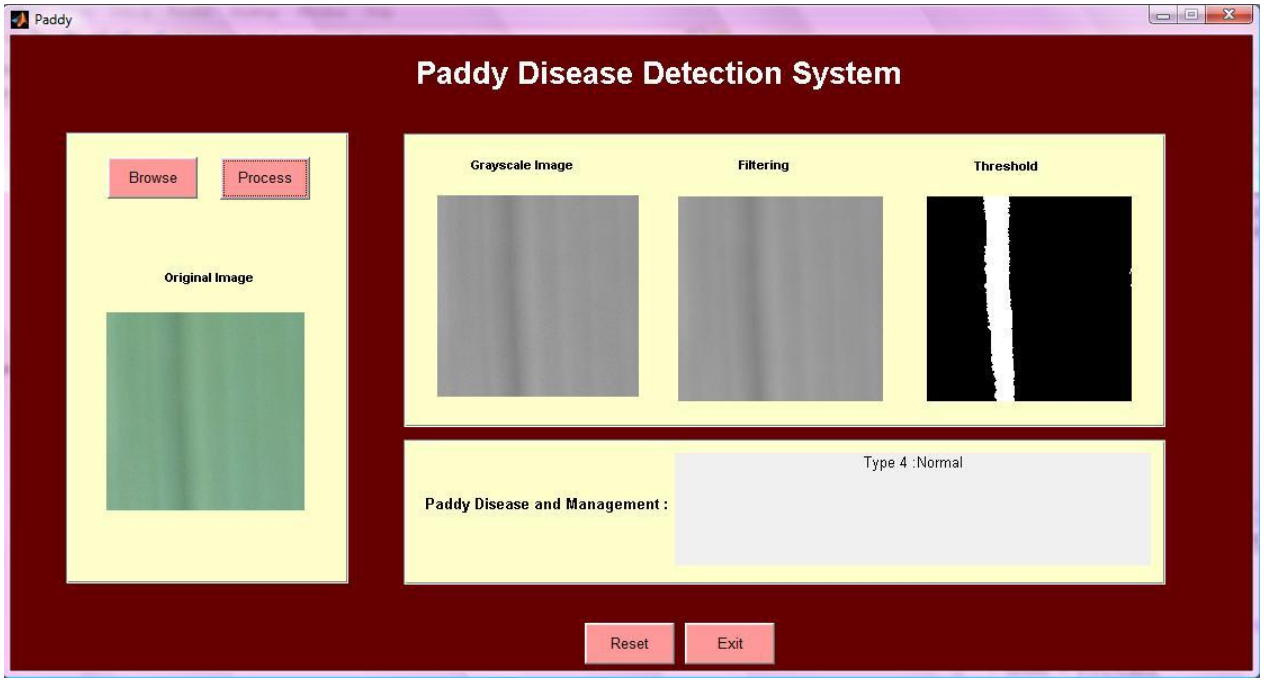
22)



Type of Disease: Normal Paddy

Result : Pass

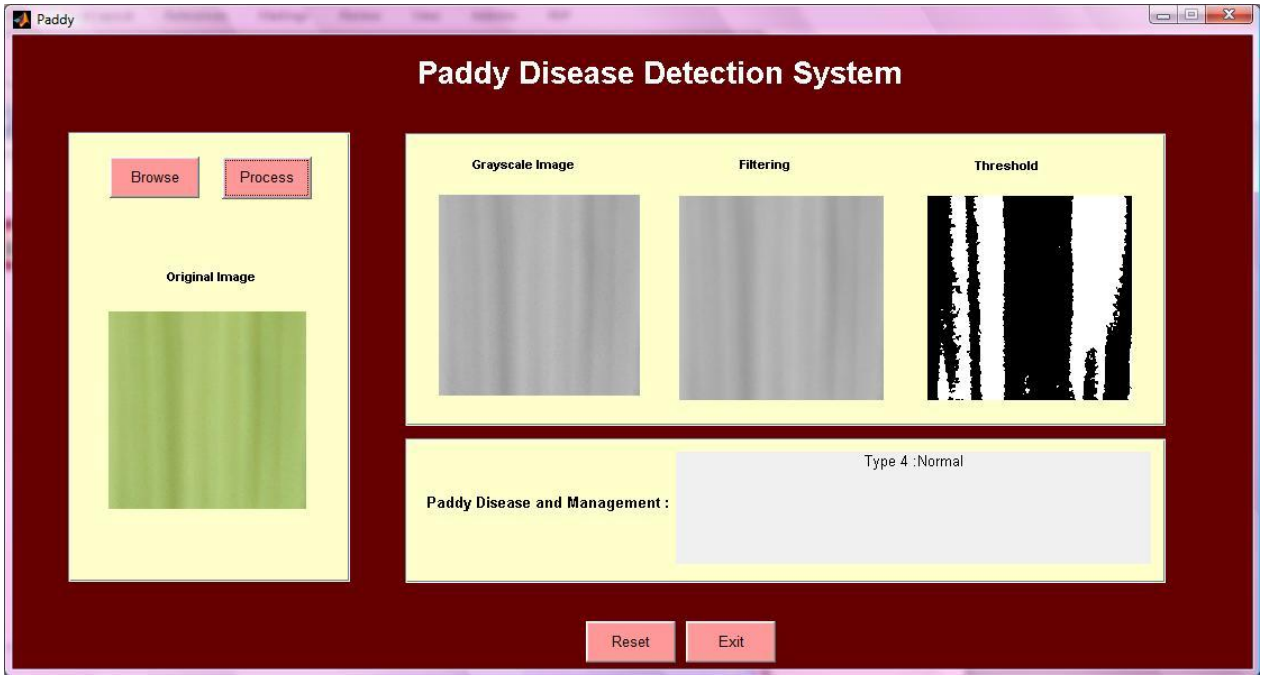
23)



Type of Disease: Normal Paddy

Result : Pass

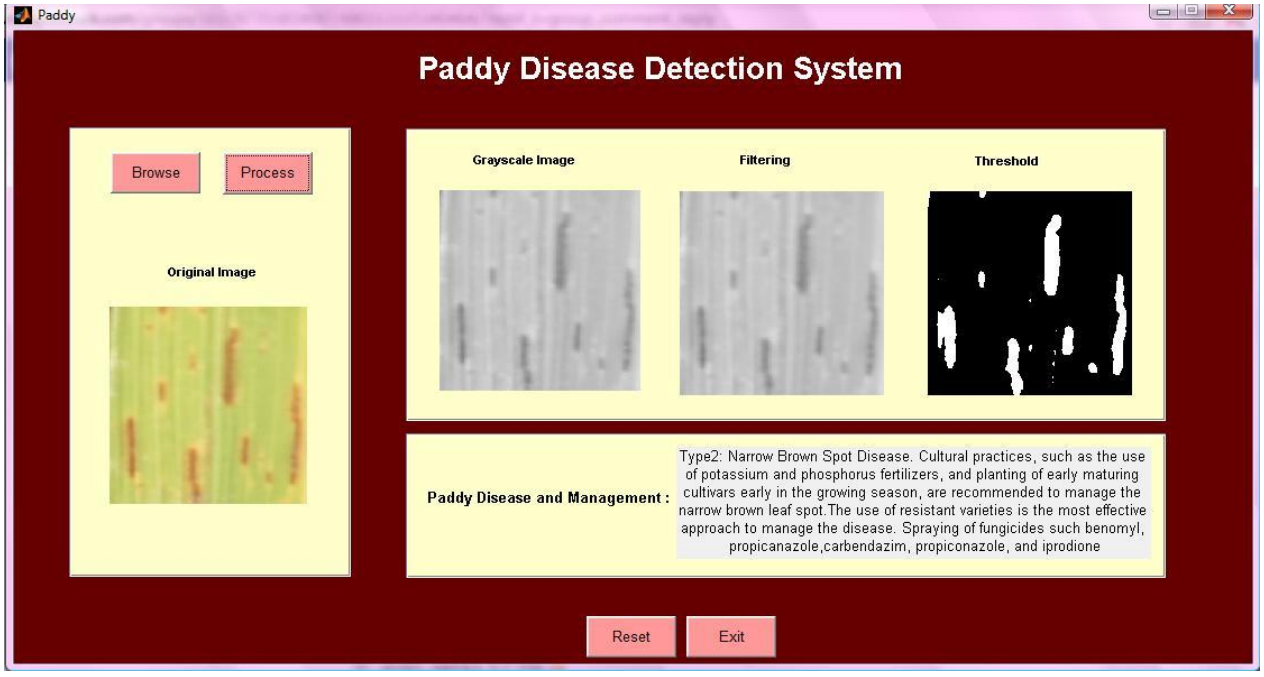
24)



Type of Disease: Normal Paddy

Result : Pass

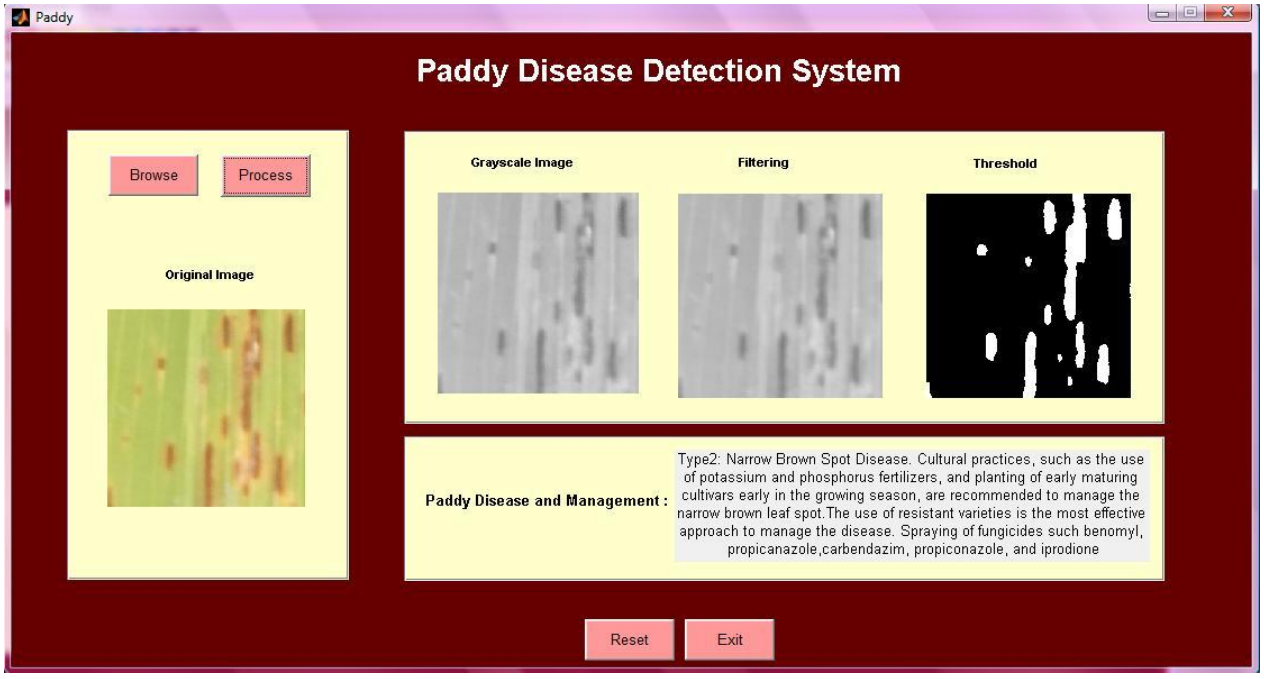
25)



Type of Disease: Narrow Brown Spot Disease

Result : Pass

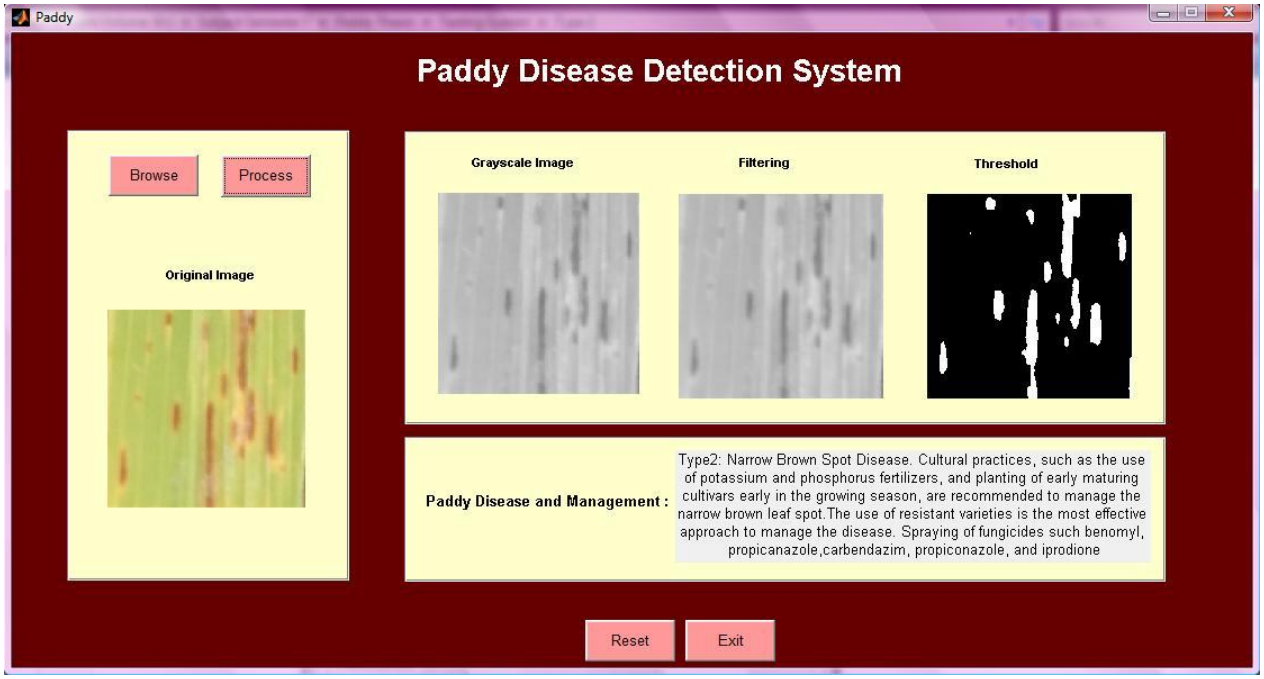
26)



Type of Disease: Narrow Brown Spot Disease

Result : Pass

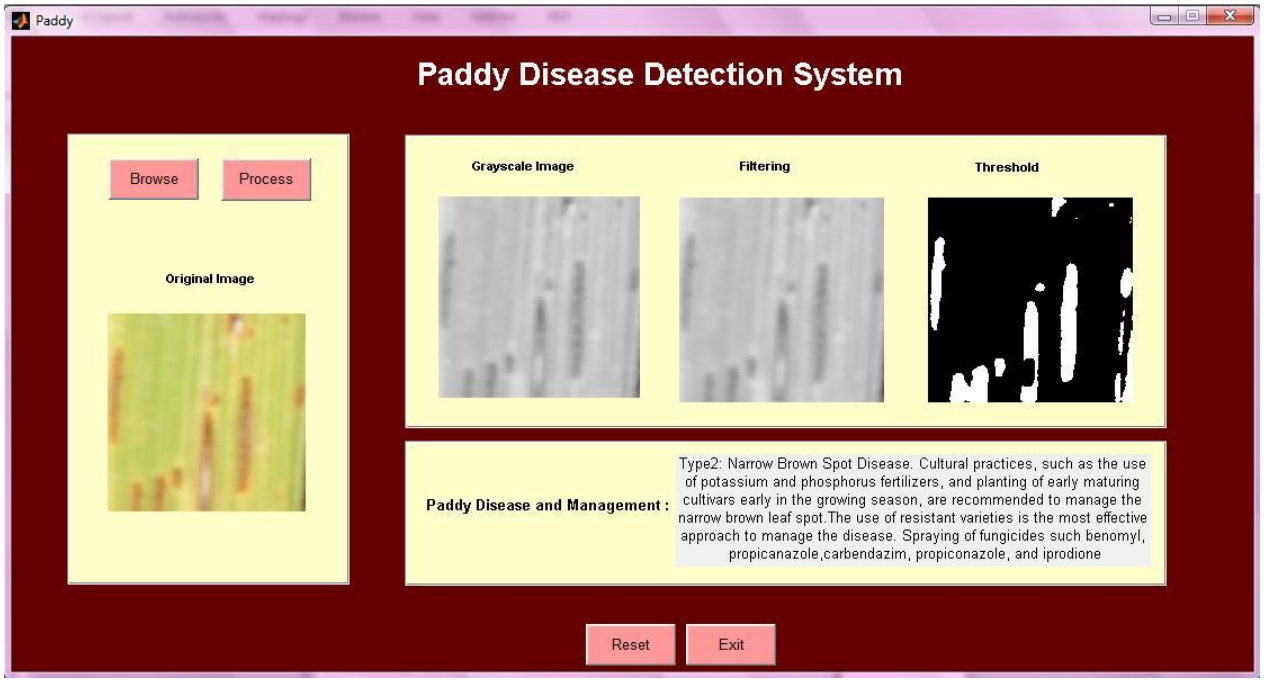
27)



Type of Disease: Narrow Brown Spot Disease

Result : Pass

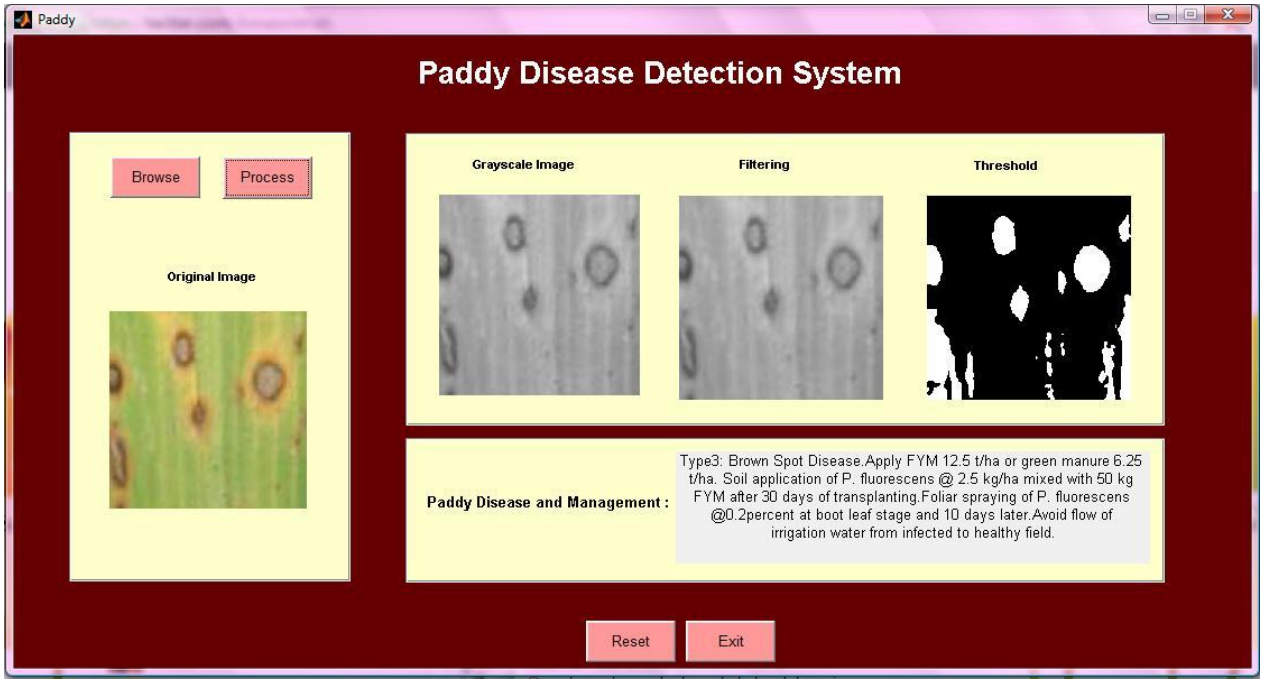
28)



Type of Disease: Narrow Brown Spot Disease

Result : Pass

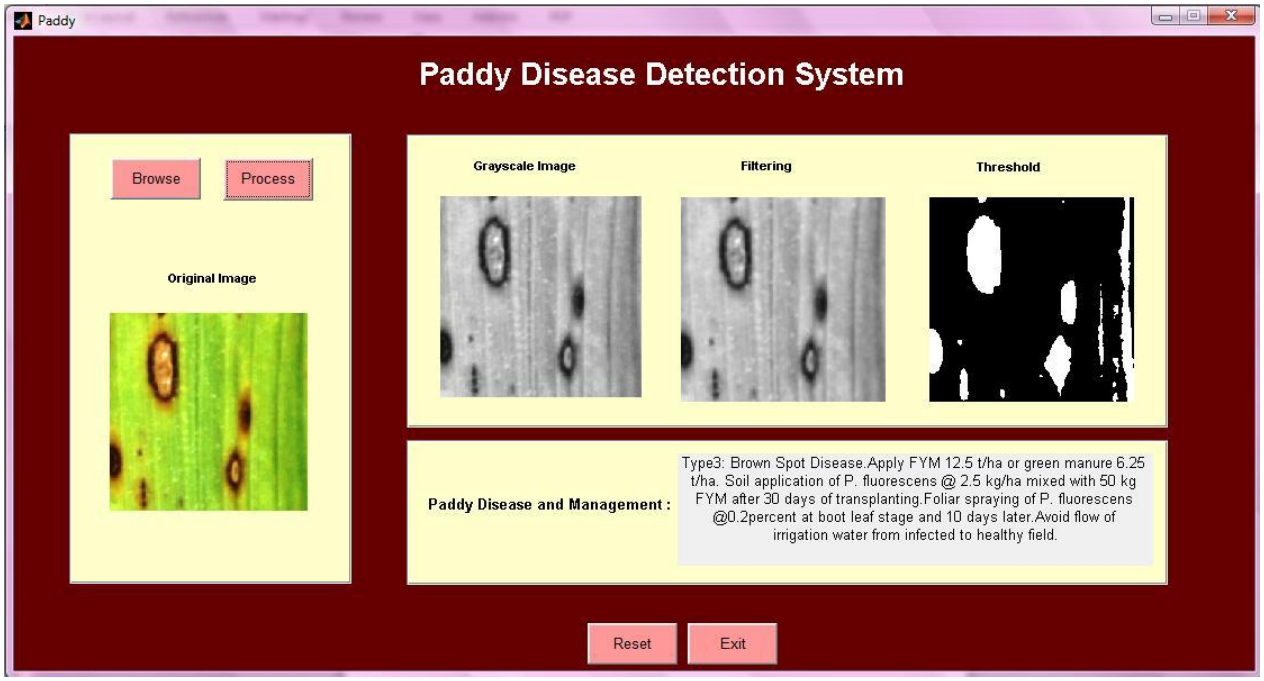
29)



Type of Disease: Brown Spot Paddy Disease

Result : Pass

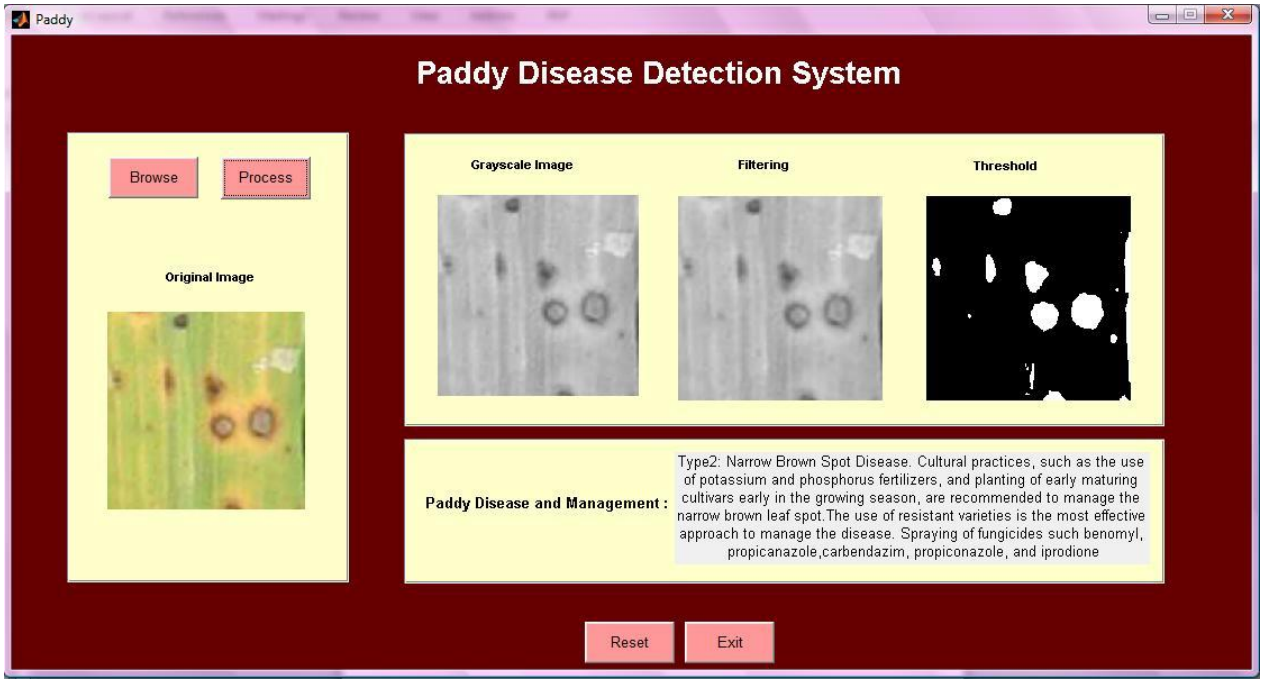
30)



Type of Disease: Brown Spot Paddy Disease

Result : Pass

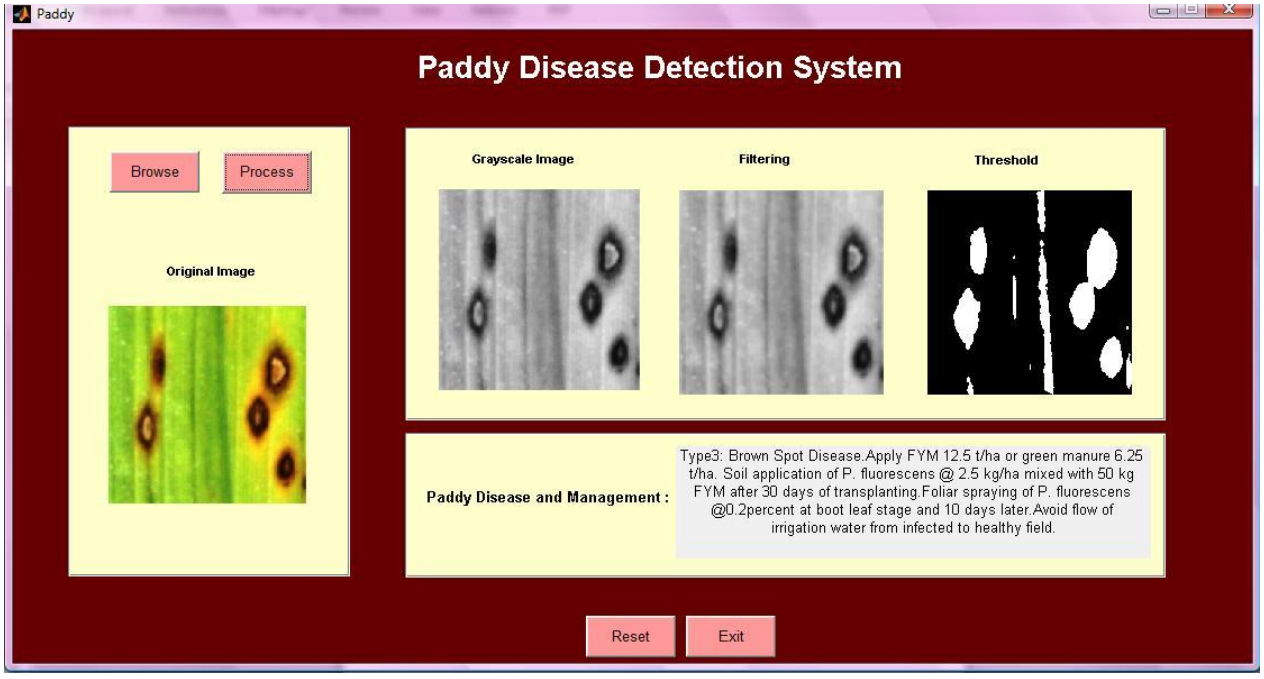
31)



Type of Disease: Brown Spot Paddy Disease

Result : Fail

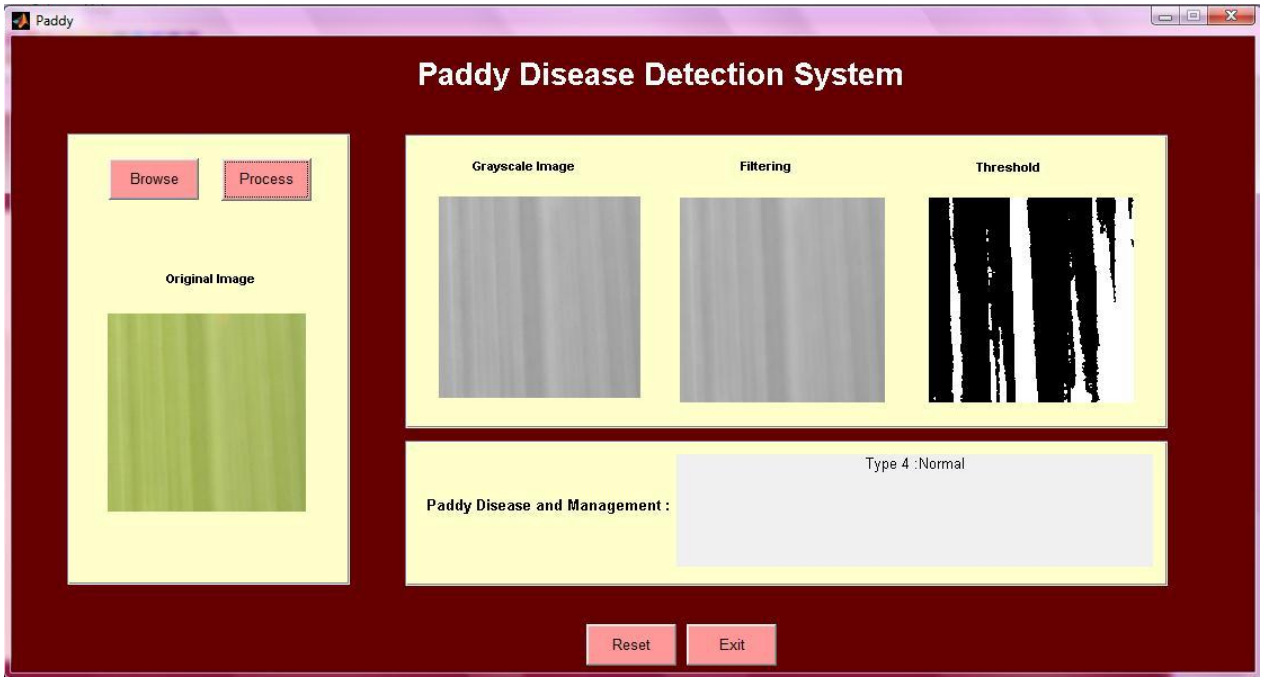
32)



Type of Disease: Brown Spot Paddy Disease

Result : Pass

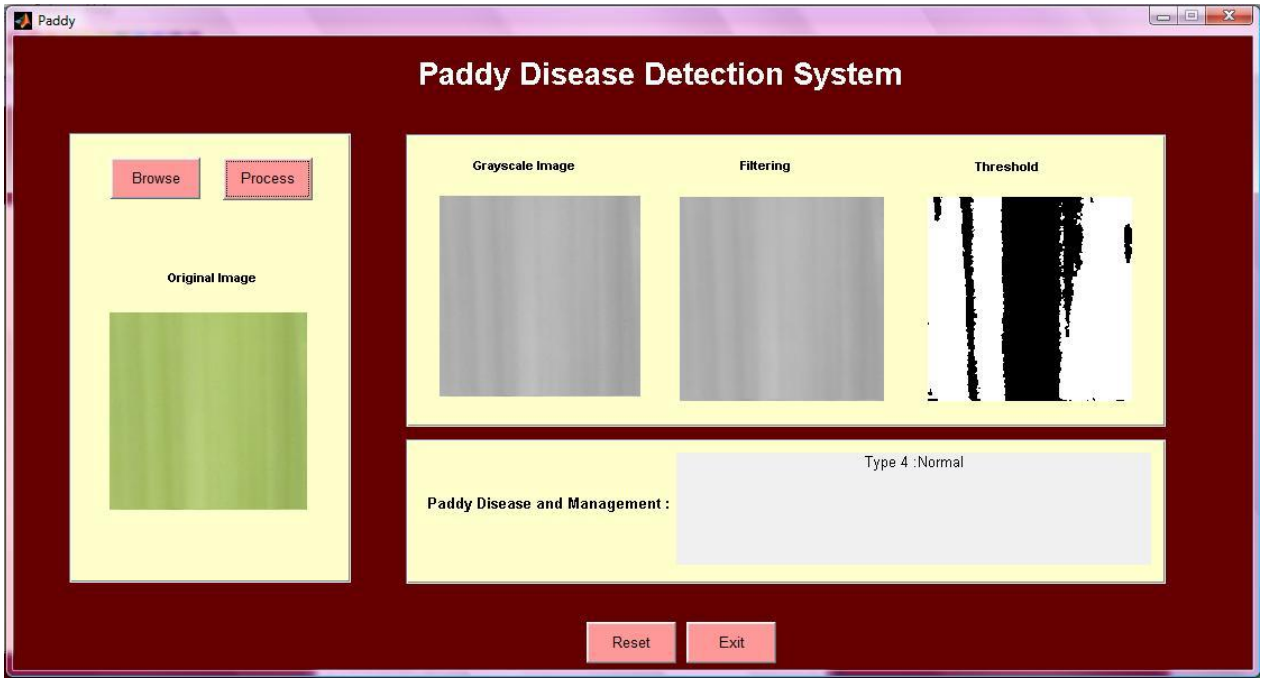
33)



Type of Disease: Normal Paddy

Result : Pass

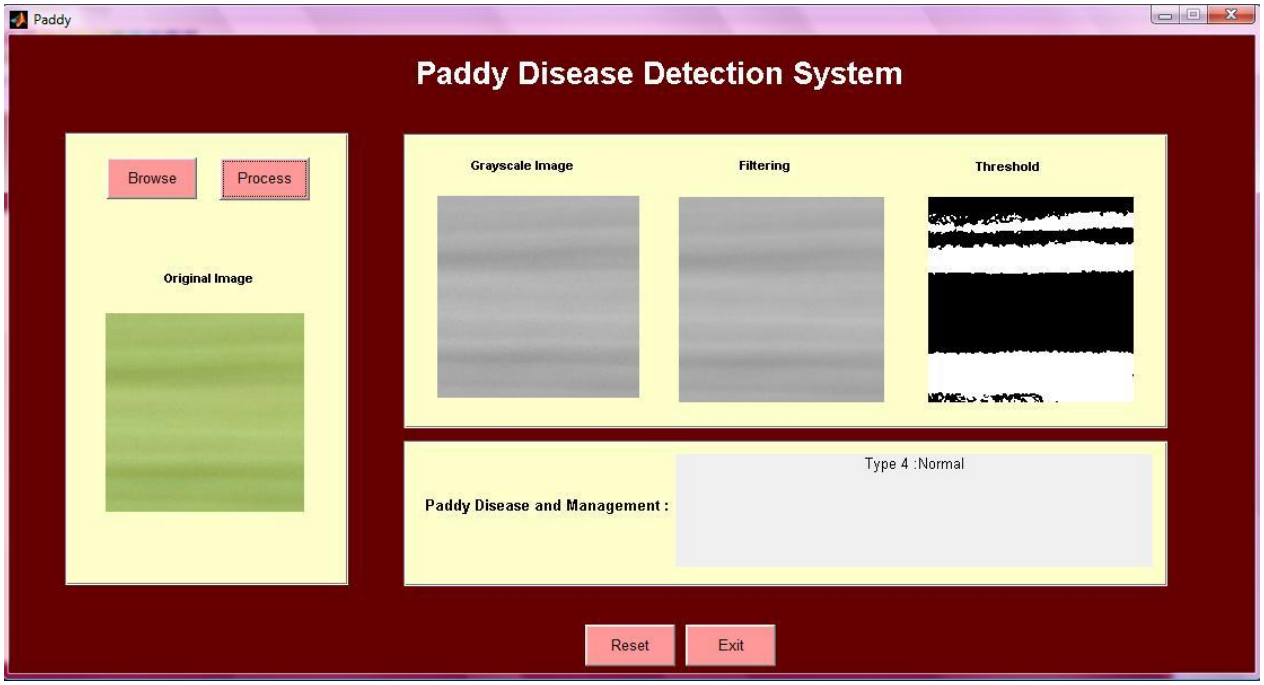
34)



Type of Disease: Normal Paddy

Result : Pass

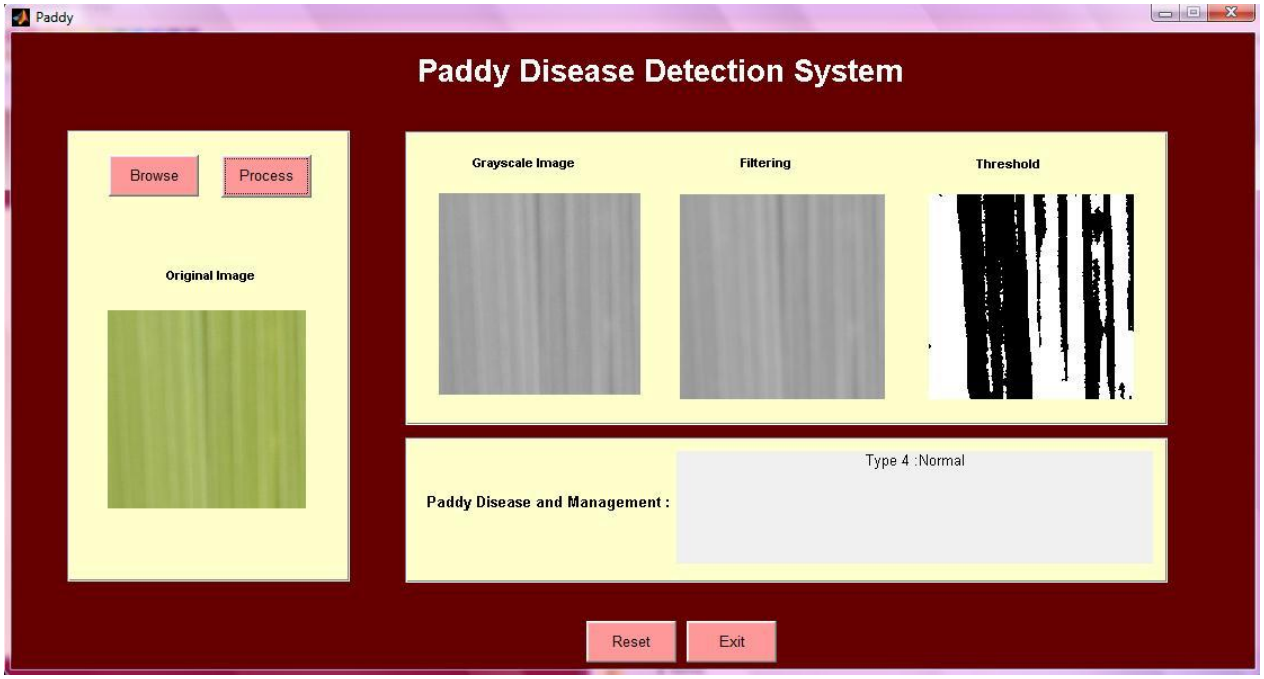
35)



Type of Disease: Normal Paddy

Result : Pass

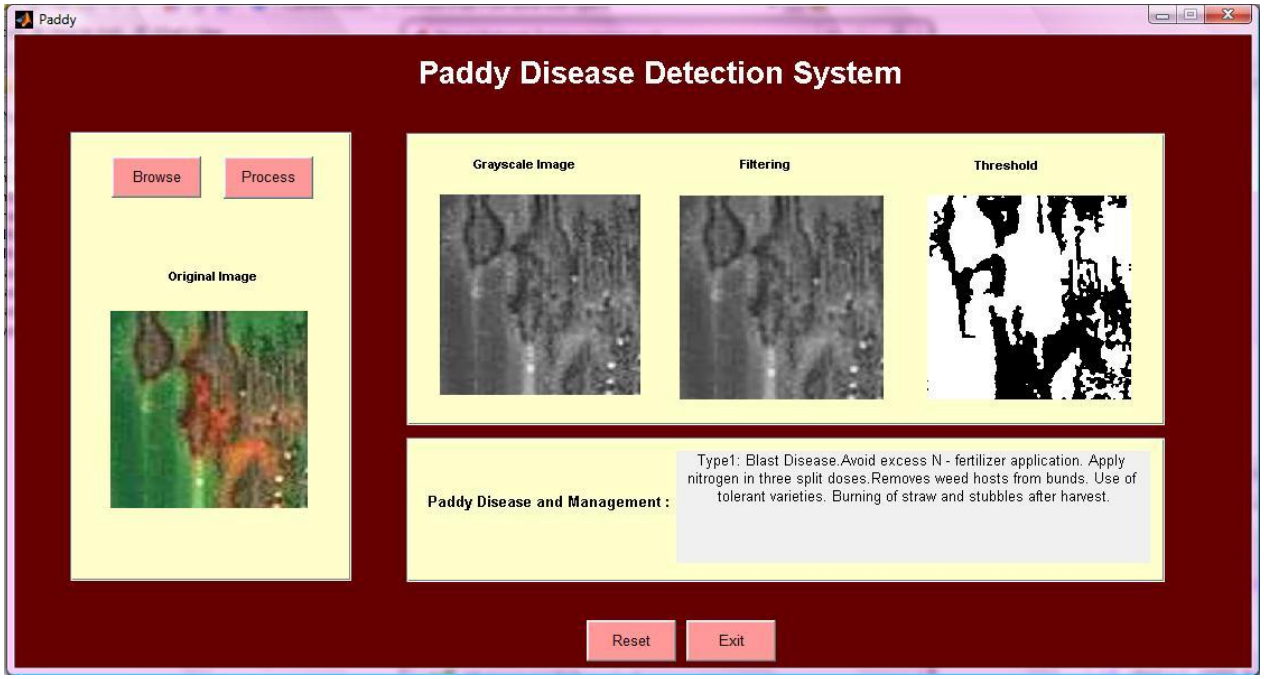
36)



Type of Disease: Normal Paddy

Result : Pass

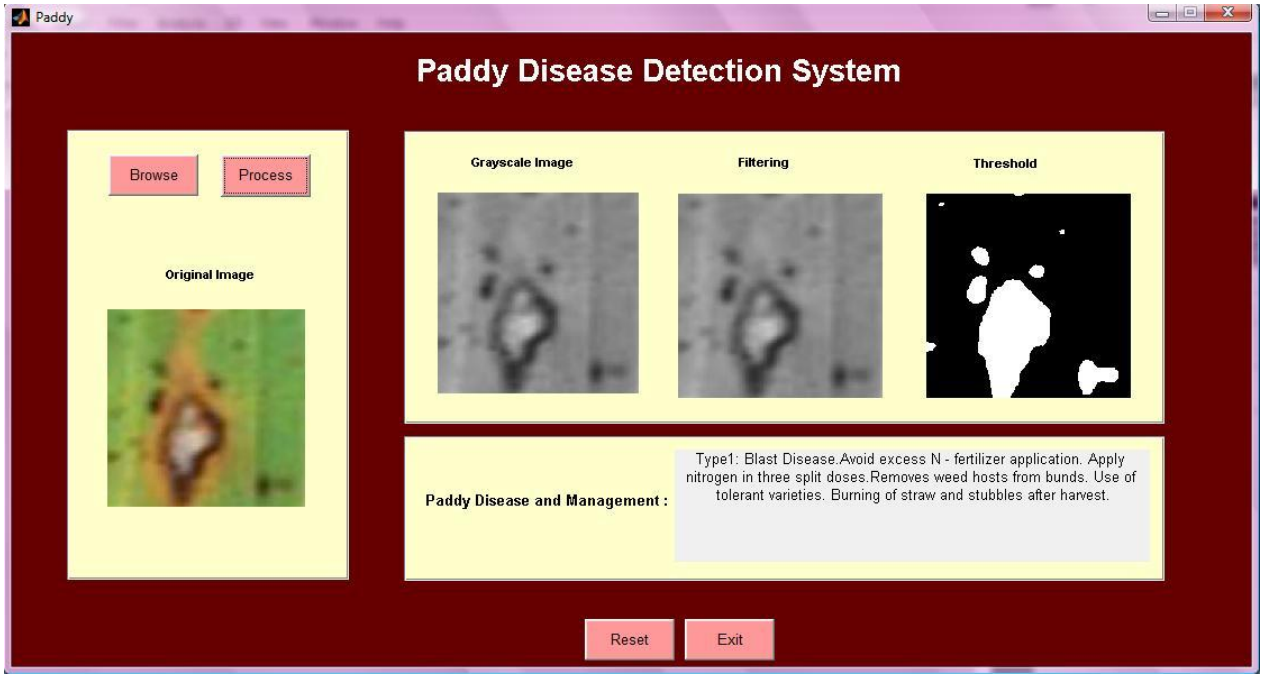
37)



Type of Disease: Paddy Blast

Result : Pass

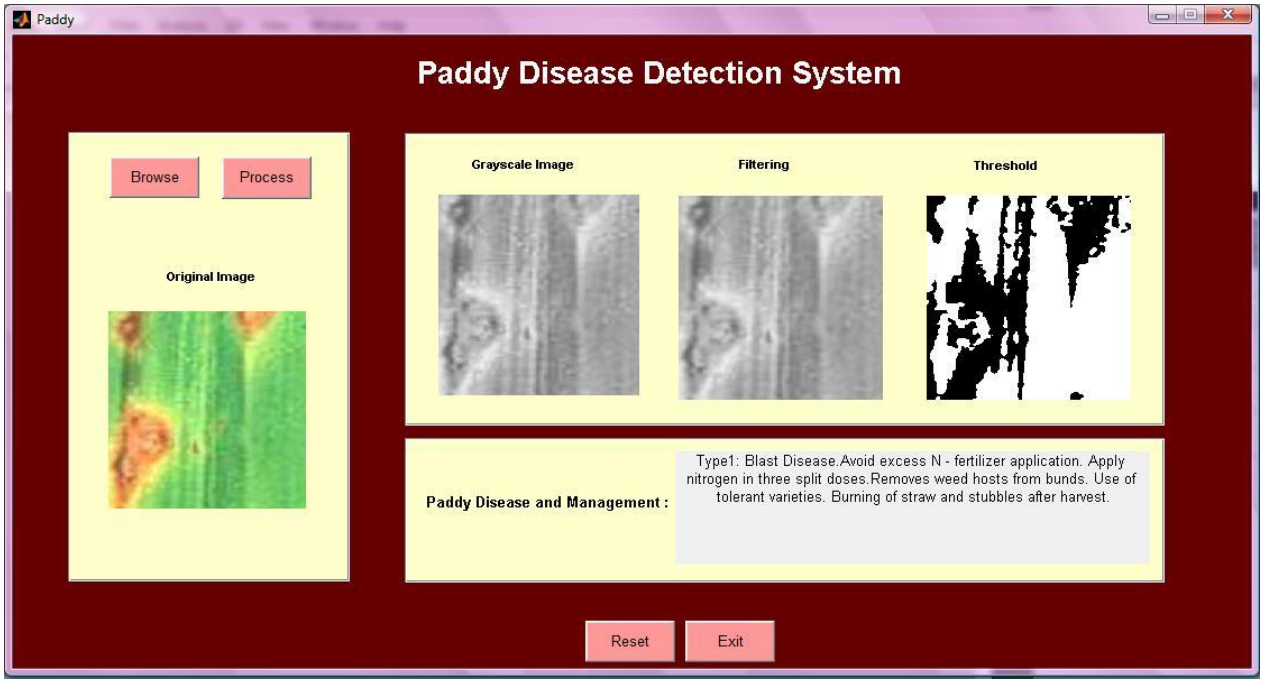
38)



Type of Disease: Paddy Blast

Result : Pass

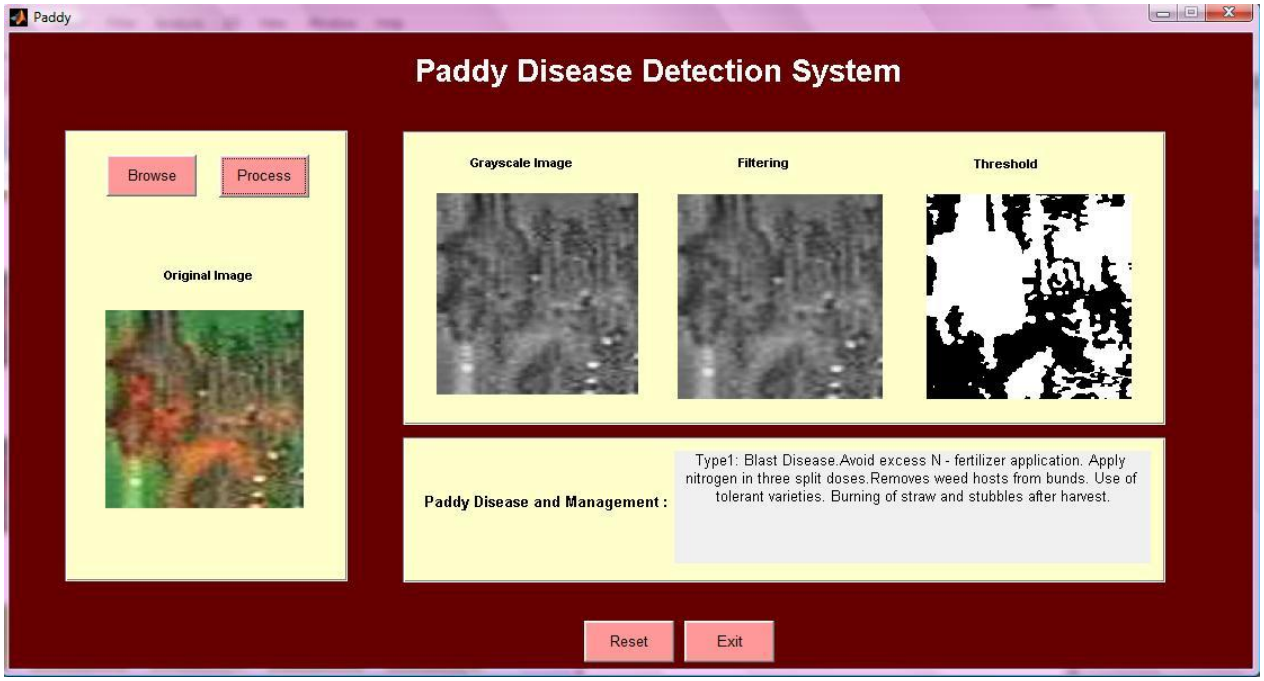
39)



Type of Disease: Paddy Blast

Result : Pass

40)



Type of Disease: Paddy Blast

Result : Pass

D Calculation of RGB for Normal paddy

Sample 1

	RGB	Min value	Max value
	Red	93	123
	Green	142	171
	Blue	89	124

Table 5.2: RGB calculation of Sample 1

Sample 2

	RGB	Min value	Max value
	Red	102	141
	Green	143	184
	Blue	111	155

Table 5.3: RGB calculation of Sample 2

Sample 3

	RGB	Min value	Max value
	Red	147	172
	Green	169	191
	Blue	69	89

Table 5.4: RGB calculation of Sample 3

Sample 4

	RGB	Min value	Max value
	Red	157	187
	Green	179	209
	Blue	95	126

Table 5.5: RGB calculation of Sample 4

Sample 5

	RGB	Min value	Max value
	Red	102	141
	Green	143	184
	Blue	111	155

Table 5.6: RGB calculation of Sample 5

Sample 6

	RGB	Min value	Max value
	Red	144	188
	Green	168	210
	Blue	80	136

Table 5.7: RGB calculation of Sample 6

Sample 7

	RGB	Min value	Max value
	Red	148	204
	Green	167	205
	Blue	74	122

Table 5.8: RGB calculation of Sample 7

Sample 8

	RGB	Min value	Max value
	Red	150	188
	Green	173	210
	Blue	83	132

Table 5.9: RGB calculation of Sample 8

Sample 9

	RGB	Min value	Max value
	Red	145	185
	Green	168	209
	Blue	80	125

Table 5.10: RGB calculation of Sample 9

Sample 10

	RGB	Min value	Max value
	Red	136	181
	Green	151	199
	Blue	64	117

Table 5.11: RGB calculation of Sample 10

Total range RGB of 10 samples are:

Red : 93 - 204

Green : 142 - 210

Blue : 64 - 155