Rice Leaf Blast Disease Detection Using Multi-Level Colour Image Thresholding

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Abstract—Rice diseases have caused a major production and economic losses in the agricultural industry. To control and minimize the impacts of the attacks, the diseases need to be identified in the early stage. Early detection for estimation of severity effect or incidence of diseases can save the production from quantitative and qualitative losses, reduce the use of pesticide, and increase country’s economic growth. This paper describes an integrated method for detection of diseases on leaves called Rice Leaf Blast (RLB) using image processing technique. It includes the image pre-processing, image segmentation and image analysis where Hue Saturation Value (HSV) colour space is used. To extract the region of interest, image segmentation (the most critical task in image processing) is applied, and pattern recognition based on Multi-Level Thresholding approach is proposed. As a result, the severity of RLB disease is classified into three categories such as infection stage, spreading stage and worst stage.

Index Terms—Rice Leaf Blast (RLB) Disease; Uncontrol Environment; Image Pre-processing; Colour Image Segmentation; Multi-level Image Thresholding.

I. INTRODUCTION

Rice plants can become stressed mainly due to the abiotic and biotic factors. A biotic is the non-living factors such as wind and water, while other living organisms like plants, animals, bacteria and fungi are called the biotic[1]. Rice plants’ stresses are expressed in various ways. For example, plant water stress can slow down photosynthesis, reduce transpiration, and raise leaf surface temperature. Other symptoms can be caused by bacteria, viruses, or fungus which include morphological changes like discoloration of leaves, wilting and plants that do not produce panicles or produce empty panicles.

Rice Leaf Blast (RLB) disease is one of the biotic stresses that contribute to the reduction of rice productivity worldwide. It has become a dominant, threatening disease in Malaysia due to its wide distribution and ability to survive in a wide range of environmental conditions.

The RLB disease is mainly caused by fungus Pyricularia oryzae Cavara[2] that attack rice plants which diminish rice quality. This disease can attack all stages of rice’s growth as early as the seedlings, vegetative and even the harvesting stages. The experts can identify the symptoms of this disease, i.e. by looking at a leaf with lesions usually starts near the leaf tips or leaf boarder or both. These symptoms appear as brown specks and then grow to become spindle-shaped, pointed at both ends. The colour of lesions is usually pale green to greyish green, later turning yellow to grey at the centre of dead spots[3,4].

Several studies have reported that RLB disease is one of the most harmful diseases to rice and had caused yield losses. For instance, in Philippines and Japan, the yield losses were estimated to vary between 50% to 85% and 20% to 100%, respectively[5]. In 2014, [6] has reported that in Malaysia, nearly 10 thousand hectares of MADa crop area was attacked by this disease. This disease is capable of causing yield losses up to 100% which definitely affects farmers’ income and national economy.

Traditionally, the RLB disease inspection is performed by trained human inspectors. However, their observations are highly variable, and their decisions are always inconsistent between inspectors from day to day basis [7]. Therefore, a more reliable technique is necessary to diagnose this diseases instantly and accurately[8].

Thus, an early detection system has been proposed in the literature based on image processing technique[8-10]. Although human eye can identify some of these symptoms, image processing system gives more accuracy and speed[11,12]. This technique will be used to reduce manual inspection and identification of common rice disease[13,14]. Unfortunately, the existing image processing system is focused only on a single leaf and unfeasible for many other aspects such as different sizes, orientations, complex background and light conditions. It is very challenging to detect the target image outdoor since it composed both the structured and unstructured objects [15].

This work presents RLB disease diagnosis system using multi-level colour image thresholding. The system includes image enhancement, image segmentation, and feature extraction. Experimental work was set up at a rice field with considering many rice leaves, different sizes, orientations and light conditions. Details of the proposed system are shown by the flowchart in Figure 1.

II. METHODOLOGY

The experiment was conducted at Rice Research Centre of Malaysian Agricultural Research and Development Institute (MARDI) Seberang Perai, Malaysia. The acquired colour images were captured by using smartphone camera in real-world conditions where the condition of crops’ leaves and the environmental conditions are uncontrolled. Then, all the images will be transferred to a computer for detection of RLB by using image processing technique. The output expected data such as the severity stages of RLB disease can be used