DuTector: A Durian Leaf Disease Detector Using Image Processing

**Introduction**

Durian is one of the most notable fruits grown in Southeast Asia's tropical regions. While its native range is established in countries such as Malaysia, Indonesia, and Brunei (Lim, 1990), its distribution as an economic crop in the Philippines has been primarily from Mindanao, which is currently the largest producer of this fruit in the Philippines, with around 14,350 hectares devoted to its production (Philippine Statistics Authority, 2016) in 2016. Approximately 8,000 hectares of land in Davao Region have been allocated for durian plantations, with the rest of Mindanao holding more than a few thousand hectares of its land (Philippine Statistics Authority, 2016).

It is one of the most valuable fruit crops, providing smallholder farmers with sustainable incomes and accounting for up to 80% of the industries. Nonetheless, there are still difficulties in cultivating Durian. Plant diseases, such as phytophthora and pythium, are major issues in durian cultivation, causing disease in the roots and stem rots (X. Li, Z. Deng, Z. Chen & Q. Fei, 2011). As a result, plant diseases are responsible for significant economic losses in the global agricultural industry (F. Martinelli et al., 2015). This is one of the primary reasons why advanced disease detection and prevention in crops are critical (Y. Fang & R. P. Ramasamy, 2015). Plant monitoring performed by an expert agriculturist through naked eye observation is important and necessary to control the spread of plant diseases (N. Petrellis, 2015), (V. Singh & A. K. Misra, 2017). However, this method has been shown to be time-consuming, laborious, and costly, particularly when dealing with large fields (S. R. Kamlapurkar, 2016). Researches are already utilizing image processing techniques for fast and more accurate plant disease detection (Sujatha et al., 2017).

The proponents are on the grounds of making the disease detection process fast, convenient and accessible through the use of mobile phone. Through the use of image processing techniques, all the processes are done in the device making leaf disease detection faster, more convenient, and more accessible. It does not require an internet connection or cloud-based transactions to generate the predicted output, allowing it to function as a standalone mobile application.

**Need for this Study**

Agriculture plays a significant role in the Philippine economy. Involving about 40 percent of Filipino workers, it contributes an average of 20 percent to the Gross Domestic Product. This output comes mainly from agribusiness, which in turn accounts for about 70 percent of the total agricultural output (CIDA-LGSP, 2003).

However, crop-damaging diseases reduce crop yield. Plant diseases are the most serious issue faced by farmers. Plant leaves and fruits are primarily affected by bacteria and viruses that cause disease. Technical experts from all over the world are contemplating which method will best assist farmers in detecting diseases. One solution for disease detection is to use image processing techniques. The concept will therefore be intended to help farmers to identify different durian leaf diseases through image processing. It utilizes a large number of images of healthy and infected plant parts like leaves and fruit for processing and then to identify the disease, because the symptoms of almost all diseases first appears on the surface of leaf or fruit of plants.

**Background**

Leaves being the most sensitive part of plants show disease symptoms at the earliest. The crops need to be monitored against diseases from the very first stage of their life-cycle to the time they are ready to be harvested. Initially, the method used to monitor the plants from diseases were the traditional naked eye observation that is a time-consuming technique which requires experts to

manually monitor the crop fields. In the recent years, a number of techniques have been applied to develop automatic and semi-automatic plant disease detection systems and automatic detection of the diseases by just seeing the symptoms on the plant leaves makes it easier as well as cheaper. These systems have so far resulted to be fast, inexpensive and more accurate than the traditional method of manual observation by farmers.

In agriculture and other institutions in India, transfer learning and image processing are being used for disease identification. A study in leaf rot disease detection using image processing was applied. The scheme in capturing the leaf image for input data is through flatbed scanner which is far more advantageous than the traditional way. But this method is chiefly inconvenient because the digital image of the leaf sample captured for input has size restrictions. Adding on, the output after the whole process is mainly displayed in a computer monitor (P. A. Macanhã et al., 2018).

Another study by Sabrol et al., (2015) used different methods before the recognition and classification of plant diseases. They acquired images using digital devices which is similar with the study of Singh, et al. and they conducted image pre-processing techniques such as smoothing, enhancement and filtering. They also conducted color space conversion, image segmentation using color, thresholding and Otsu method. After segmentation, they had extracted the color and texture features of the image. However, there are multiple classification techniques presented in their study.

In the study of Pujari et al., (2014), they detected the disease for analysis at early stage before it damages the whole leaf and eventually the whole plant. As a result of their study, they have found that using neuro-kNN (k-Nearest Neuron) as classifier method reveals a higher accuracy of 91.54% as compared to 84.11% accuracy in using the ANN.

In the Philippines, a study by Maggay (2020) used different steps in the classification of eggplant diseases which were adopted from the study of Sabrol, et al. The first step is image acquisition, followed by pre-processing of acquired images such as cropping, resizing, and augmentation, the third step is feature extraction and the last step is image classification. It was found out that prediction accuracy increases if more augmentation techniques will be performed before feeding the images to the MobileNetV2 framework.

**Objectives**

In general, the capstone project aims to use the concept of image processing in order to give and provide an accurate identification of different durian leaves diseases.

Specific objectives of the capstone project are the following:

1. The system will provide an easy and accessible way to identify various durian diseases in order to produce high-quality durian fruit.

2. The system will assist in determining the durian health status through image processing.

**Proposed Methodology**

The study intends to use the four phases of detecting durian leaf disease. The first phase involves acquisition of images through mobile phone. The second phase segments the image into various numbers of clusters for which different techniques can be applied. Next phase contains feature extraction methods and the last phase is about the classification of diseases.

*Image Acquisition*

In this phase, images of durian leaves are gathered using mobile phone with desired resolution and size. The formation of database of images is completely dependent on the application system developer. The image database is responsible for better efficiency of the classifier in the last phase of the detection system.

*Image Segmentation*

This phase aims at simplifying the representation of an image such that it becomes more meaningful and easier to analyze. As the premise of feature extraction, this phase is also the fundamental approach of image processing. There are various methods using which images can be segmented such as k-means clustering, Otsu’s algorithm and thresholding etc. The k-means clustering classifies objects or pixels 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 their corresponding clusters.

*Feature Extraction*

Hence, in this step the features from this area of interest need to be extracted. These features are needed to determine the meaning of a sample image. Features can be based on color, shape, and texture. recently, most of the researchers are intending to use texture features for detection of plant diseases. There are various methods of feature extraction that can be employed for developing the system such as gray-level co-occurrence matrix (GLCM), color cooccurrence method, spatial grey level dependence matrix, and histogram-based feature extraction.

*Classification*

The classification phase implies to determine if the input image is healthy or diseased. If the image is found to be diseased, some existing works have further classified it into a number of diseases.

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