

Chapter 69

Adapted Approach for Fruit Disease Identification using Images

Shiv Ram Dubey
GLA University Mathura, India

Anand Singh Jalal
GLA University Mathura India

ABSTRACT

Diseases in fruit cause devastating problem in economic losses and production in agricultural industry worldwide. In this paper, an adaptive approach for the identification of fruit diseases is proposed and experimentally validated. The image processing based proposed approach is composed of the following main steps; in the first step K-Means clustering technique is used for the defect segmentation, in the second step some state of the art features are extracted from the segmented image, and finally images are classified into one of the classes by using a Multi-class Support Vector Machine. The authors have considered diseases of apple as a test case and evaluated their approach for three types of apple diseases namely apple scab, apple blotch, and apple rot. Their experimental results express that the proposed solution can significantly support accurate detection and automatic identification of fruit diseases. The classification accuracy for the proposed solution is achieved up to 93%.

INTRODUCTION

Monitoring of health and detection of diseases is critical in fruits and trees for sustainable agriculture. To the best of our knowledge, no sensor is available commercially for the real time assessment of trees health conditions. Scouting is the

most widely used method for monitoring stress in trees, but it is expensive, time-consuming and labor-intensive process. Polymerase chain reaction which is a molecular technique used for the identification of fruit diseases but it requires detailed sampling and processing.

The various types of diseases on fruits determine the quality, quantity, and stability of yield. The diseases in fruits not only reduce the yield

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but also deteriorate the variety and its withdrawal from the cultivation. Early detection of disease and crop health can facilitate the control of fruit diseases through proper management approaches such as vector control through fungicide applications, disease-specific chemical applications and pesticide applications; and improved productivity. The classical approach for detection and identification of fruit diseases is based on the naked eye observation by experts. In some of the developing countries, consultation with experts is a time consuming and costly affair due to the distant locations of their availability.

Fruit diseases can cause significant losses in yield and quality appeared in harvesting. For example, soybean rust (a fungal disease in soybeans) has caused a significant economic loss and just by removing 20% of the infection, the farmers may benefit with an approximately 11 million-dollar profit (Roberts et al., 2006). Some fruit diseases also infect other areas of the tree causing diseases of twigs, leaves and branches. An early detection of fruit diseases can aid in decreasing such losses and can stop further spread of diseases.

A lot of work has been done to automate the visual inspection of the fruits by machine vision with respect to size and color. However, detection of defects in the fruits using images is still problematic due to the natural variability of skin color in different types of fruits, high variance of defect types, and presence of stem/calyx. To know what control factors to consider next year to overcome similar losses, it is of great significance to analyze what is being observed.

The approach introduced in this paper can be used for designing automatic systems for agricultural process using images from distant farm fields. Several applications of image processing technology have been developed for the agricultural operations. These applications involve implementation of the camera based hardware systems or color scanners for inputting the images. We have attempted to extend image processing and analysis technology to a broad spectrum of

problems in the field of agriculture. The computer based image processing is undergoing rapid evolution with ever changing computing systems. The dedicated imaging systems available in the market, where user can press a few keys and get the results, are not very versatile and more importantly, they have a high price tag on them. Additionally, it is hard to understand as to how the results are being produced.

Diseases appear as spots on the fruits and if not treated on time, cause severe losses. Excessive uses of pesticide for fruit disease treatment increases the danger of toxic residue level on agricultural products and has been identified as a major contributor to the ground water contamination. Pesticides are also among the highest components in the production cost thus their use must be minimized. Therefore, we have attempted to give an approach which can identify the diseases in the fruits as soon as they produce their symptoms on the growing fruits such that a proper management application can be applied.

Some common diseases of apple fruits are apple scab, apple rot, and apple blotch (Hartman, 2010). Apple scabs are gray or brown corky spots. Apple rot infections produce slightly sunken, circular brown or black spots that may be covered by a red halo. Apple blotch is a fungal disease and appears on the surface of the fruit as dark, irregular or lobed edges.

In this paper, we propose and experimentally evaluate an adaptive approach for the identification of fruit diseases using images. The proposed approach is composed of the following steps; in first step the fruit images are segmented using K-Means clustering technique, in second step, some state-of-the-art features are extracted from the segmented image, and finally, fruit diseases are classified using a Multi-class Support Vector Machine. We show the significance of using clustering technique for the disease segmentation and Multi-class Support Vector Machine as a classifier for the automatic classification of fruit diseases. In order to validate the proposed

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