

Chapter 50

Automated System for Crops Recognition and Classification

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ABSTRACT

Marketing profit optimization and preventing the crops' infections are a critical issue. This requires crops recognition and classification based on their characteristics and different features. The current work proposed a recognition/classification system that applied to differentiate between fresh (healthy) from rotten crops as well as to identify each crop from the other based on their common feature vectors. Consequently, image processing is employed to perform the statistical measurements of each crop. ImageJ software was employed to analyze the desired crops to extract their features. These extracted features are used for further crops recognition and classification using the Least Mean Square Error (LMSE) algorithm in Matlab. Another classification method based on Bag of Features (BoF) technique is employed to classify crops into classes, namely healthy and rotten. The experimental results are applied of databases for orange, mango, tomato and potatoes. The achieved recognition (classification) rate by using the LMSE for all datasets (healthy and rotten) has 100%. However, after adding 10%, 20%, and 30% Gaussian noise, the obtained the average recognition rates were 85%, 70%, and 25%; respectively. Moreover, the classification (healthy and rotten) using BoF achieved accuracies of 100%, 88%, 94%, and 75% for potatoes, mango, orange, and tomato; respectively. Furthermore, the classification for all the healthy datasets achieved accuracy of 88%.

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INTRODUCTION

Agricultural crops such as cotton, fruits and vegetables are important raw materials for many industries. However, these crops can be damaged by insects, soil pollution, weather and other many factors. Insects and diseases cause vegetables and fruit devastating problem, which results in economic losses and affect the production in agricultural industry worldwide. Now days, with growing the population, it is required to categorize and to distinguish good and bad crops. Moreover, the agriculture sector is interested with several aspects, such as product's quality and the crops status measurements based on the farmers' point of view. However, the availability of experts and their services may consume time and efforts. Previously, the use of traditional methods led to waste time and to inaccurate results. Thus, to overcome these drawbacks automated image processing techniques are conducted to analyze the crops and to classify them into healthy and rotten classes in a shorter time, with less effort and more accurately. In addition, image processing along with communication network availability facilities the communication with experts within less time consuming and at affordable cost compared to the traditional methods.

Currently, computer vision systems are used for automatic inspection of vegetables/fruits based on various methods that are equipped to detect defects on the crops' surface. Recognition system is a 'grand challenge' for the computer vision to achieve near human levels of recognition. The fruits and vegetables classification is useful in the super markets to classify them, and then assign prices automatically. Fruits and vegetables classification can also be used in computer vision for the automatic sorting of fruits from a set, consisting of different kinds of fruit (Song *et al.*, 2014).

Consequently, the current work proposed an automated approach to analyze, recognize, and classify crops including fruits and vegetables by using image processing techniques. The proposed approach is used to measure the characteristics of the crop under concern as well as to identify the rotten parts based on the crop's image using digital camera. The extracted features such as the area, standard deviation, and the perimeter are then used in the identification and classification of the crops. The datasets used in the proposed work were manually obtained by capture images for different crops (fruits/vegetables), including tomato, potatoes, orange, and mango. The recognition/classification results using the LMSE approach is compared to the classification using the BoF model.

RELATED WORK

Researchers are interested with applying various image processing techniques in the agriculture applications due to its accuracy. Various studies were conducted that use image processing to analyze one type of crops by extracting certain feature such as the color, size or texture. Jiménez *et al.* (1999) introduced a review of various vision systems to recognize fruits for automated harvesting. The survey concluded that under difficult conditions there is a feasibility of practical implementations of computer vision systems for the analysis of agricultural scenes to locate natural objects. The authors discussed the basic considerations about the distributions and characteristics of the fruits in natural orange crops.

Zhao *et al.* (2005) introduced a vision based algorithm to locate apples in a single image as a prelude to the use of stereo vision to correctly locate apples in an orchard. The authors considered on-tree situations of contrasting red and green apples as well as green apples in the orchard with poor contrast. The results depicted that redness in both cases of red and green apples can be used to distinguish apples from the rest of the orchard. In addition, texture based edge detection measurements were conducted as well

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