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Weed Detection using Image Filtering in Vegetables Crops

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Abstract:. *This paper discuss about system implementation of image processing technique for weed detection and removal. The system presents a machine vision system for weed detection in vegetable crops using outdoor images. The purpose of this paper is to develop a useful algorithm to discriminate weed, using image filtering to extract color and area features, then, a process to label each object in the scene is implemented, finally, a classification based on area is proposed, including sensitivity, specificity, positive and negative predicted values in order to evaluate algorithm performance*

Keywords: *machine vision, weed identification, classical classifier, neuronal networks, unwanted weed, weed in crops*

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I. Introduction

The agricultural sector is focused on establishing environmental requirements that ensure quality and safety of crops production. This approach seeks to make use of technological development to support the processes of soil preparation, planting and weed identification. Nowadays, agricultural workers iremove weeds using herbicides or making a hand labor. Later with the advancement in the technology they started using the herbicides to regulate the growth of the weeds[1]. But to detect the weeds they are still using manual power in many parts of the world. Weeds are the plants growing in a wrong place which compete with crop for water, light, nutrients and space, causing reduction in yield and effective use of machinery and can cause a disturbance in agriculture. Weeds can also host pests and diseases that can spread to cultivated crops. We are using Image processing technique for detecting the weeds and by Image processing, we extract the features that distinguish between crop leaves and weed leaves. The first alternative covers whole crop, causing environmental and economic concerns because it is not a selective treatment. The second way is a painstaking work and given the size of the crop, it may be necessary to sample the population to identify plagues and weed, with a high cost due to time spent on weed removal.

II. Literature Survey

Faisal Ahmed et. Al., have investigated the use of support Vector Machine (SVM) and Bayesian classifier as machine learning algorithms for the effective classification of crops and weeds in digital images. From the performance comparison, it is reported that SVM classifier has outperformed Bayesian classifier. Young plants that did not mutually overlap with other plants are used in the study. Robert Bosch designed a system for weed detection which runs with the help of solar panels for power and uses a camera which is fixed at the bottom for continuous processing of the captured images. This is implemented in the fields of Germany. In the Eastern European countries, students have developed the robot for crushing the weeds as and when detected. Countries like China, Japan are under the process of developing a system which sweeps off all the unwanted materials like weeds, pebbles and stones[2].

The biological morphology is used to predict the biological characteristics of a plant crop. The features include size and shape of the crop. With the help of the predicted size and shape of the plant captured we can easily identify whether the plant is a crop or a weed. Then to distinguish the plantation and soil proper segmentation algorithm is used based on the color of the image the image segmentation is performed. To reduce the noise present in the image proper filtering technique is used. Here median filter is used to remove the noise. By using the segmentation technique and median filtering 72.6% of accuracy is obtained. The preferred shape type is seven shape features to distinguish the crop and the weed and it is used in corn crop and obtained a result of 98.9%. From the biological features it is easy to distinguish the soil and vegetation in an agricultural field[7].

In visual texture system highlights of the photos for entropy, instance, vitality, differentiate, homogeneity, torpidity used for the plant recognizable proof also undesirable harvests. By using the estimation from guaranteeing backing vector Furthermore removing those organization includes got the precision of 93%.

Different research researchers about the weed discovery comes about give the diverse correctness's with different five surface highlights. The PCA with Gabor filter gives the precision accuracy about 91%. The light intensity variation in the captured image used to find the weeds. Edge will be portrayed concerning representation sum from guaranteeing pixels accessible in the point of confinement of the region. The pixels appear in the images vary from zone to zone. Through the convergence of the pixel rate from the captured image at a particular zone is done again and again. It results the similarity of the weeds from the data set.

III. Weed Detection System

The approach of the project is achieving a baseline method for developing a real time weed detection system through binary classification when vegetation is detected, that is, to separate soil and plants, then, to apply a feature extraction for discriminating weed. First, Green plant detection algorithm is implemented to remove soil from image such that image information is reduced. The next steps of algorithm focus only on vegetation, then, median filtering removes noise as "salt and pepper" with advantage of preserving edges. Third, the previous output is converted to binary; at this point, small objects are removed in order to avoid outliers. After, the pixels connected around their neighborhood are labeled, thus, all objects in the image are identified. Finally, area calculation for each object is done. With the values obtained, we set a threshold to differentiate weed from crop, such that the method is a feature extraction criterion based on size. Figure 1 shows the flow chart corresponding to the process described above. The algorithm was performed using MATLAB R2015[4].

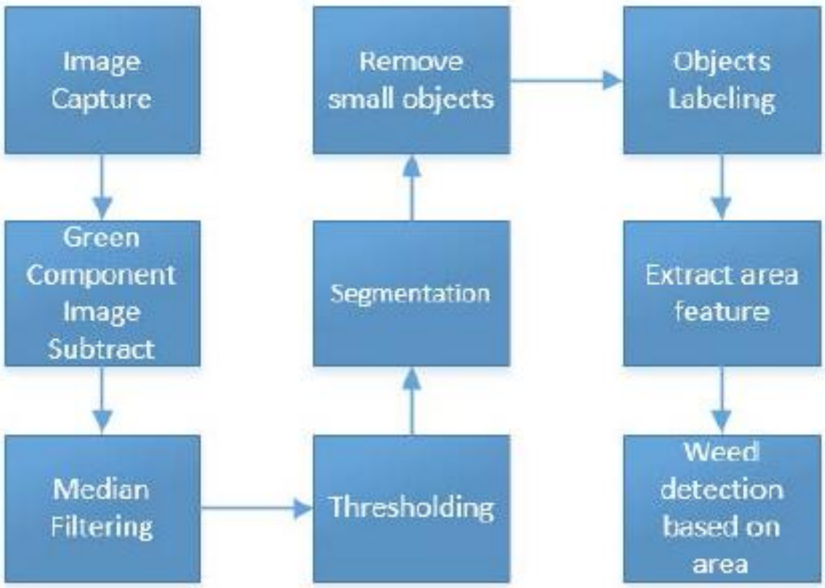

Figure 3.1: Vision System Flow chart

Image acquisition

The digital images were captured in outdoor light conditions with perspective projection over crop (See Figure 2). Captures have 8MP resolution in RGB color space with JPG extension. The main idea of crop images acquisition is to avoid lighting and sharpness problems, therefore, color changes about vegetation are reduced. In this way, the accuracy of the first step of the plant classification algorithm increases provided that green color over objects is kept.

Green plant detection algorithm

A method for the segmentation of green plants and separation from the background is to use green component of RGB color model to get an image only with vegetation information. Previous studies have based their criteria for selection on an Index that stands out green component of source image; Excess Green Index and Normalized Difference Vegetation Index are some methods that use this approach, however, they are aimed to perform on different sunlight and background conditions. In this project, the module for the weed remover robot will have a camera obscura and lamps in order to maintain uniform illumination. Then, it results appropriate to subtract green component from the original image.

Median filtering Median filtering

It is used for noise suppression in images subtracted, preserving edges whereby the relevant image information is conserved and tends to produce regions of constant or nearly constant intensity [12]. This filtering works using pixel values around 3-by-3 neighborhood mask. This window is moved over the points of an image, then, the value at the mask center is replaced with the calculation of the median from source image values within the window.

Segmentation

A sequence of morphological treatments [4] was prepared in order to ready the image to extract the regions of interest which will later be identified and classified. The software used for this was OpenCV in Python using WEKA. The images were analyzed in RGB and HSV so which of the six channels giving more information to perform the segmentation process. After analyzing, saturation and green channel offered greater definition of regions.

High levels of noise present in the segmented image can generate more confusion when performing the extraction of plant of the crop. So we proceeded to analyze the image in the channel color saturation (see Figure 5), in which the plant part given the colorimetric purity that is present in the image is highlighted. Subsequently the same procedure as with the previous image in the G channel, automatic segmentation is performed in order to extract only the regions that are of interest to detect the presence of plant component, resulting in a much cleaner extraction.

Fill image holes

Because of feature extraction based on area, it is appropriate to fill in the holes in the image. Thus, evaluation in the next step is enhanced since compact objects are obtained. For this purpose, an algorithm based on morphological C. This method uses 4 or 8 connected neighborhood pixels to evaluate the resulting image [6]. The algorithm calculates a marked image stemming from source image borders using :

Labeling

Identifying objects in the scene, requires to label each element as a plant, getting a region description in order to extract features in the next step. Therefore, an algorithm based on connected components is used [7]. The region labeling stage evaluates each pixel with a 4 neighbor-connectivity, using a heuristic stated on pixel values according to predecessor labels at north and west position.

Classification based on area

Once objects on the scene are labeled, the next step is to extract area features from each element to discriminate weed and crop. The algorithm presented, defines an area counting the number of pixels in the object region; then, the value is stored for all items. The elements are sorted according to the area values in descending order. When a difference with the next object evaluation is greater than 50%, the average of the previous elements is calculated. This value is the threshold for weed detection

IV. Conclusion

The algorithm of weed detection system was tested using photos taken perpendicularly to crop lines, avoiding illumination disturbances in spinach and chard crops of Horticulture Technology. The images were labeled manually based on random behavior of weed and the expertise of crops manager, in order to compare and evaluate the performance of the proposed approach to weed detection.

This paper has shown a practical way for weed detection using an area-based feature to discriminate from crop. This study was limited to periodical weed removal tasks, whereby weed size is smaller than the crop size to carry out the approach reported, achieving a high sensitivity, specificity, PPV and NPV values. The use of low level features as color and area results appropriate in periodical treatment conditions in contrast to use texture or shape features that could have similitude between weed and crop. The algorithm presented in this paper leads on unsupervised learning, hence, additional computational cost is reduced compared to the algorithms that require training to identify weed with these descriptors. Then, color and area approaches result effective to recognize weed, avoiding a large database processing to discriminate crop. Additionally, the obtained results are focused on crop size; therefore, weed features are not relevant, which provide versatility for the application in the identification of different vegetable crops. This feature is important due to wide variety of weed plants. At color detection stage, the histogram serves as a basis to validate binary segmentation, bearing out a way to separate plants from soil using green component, which is the main objective in image acquisition the plant colors preservation. It is also remarkable that environment light controlled proposed like a camera obscura in a weed remover robot will help in the elimination of significant changes to parameterize green plants from image source because of variation in illumination. Thereby, other algorithms to try outdoor conditions images are not necessary and the computational cost is also reduced.

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