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Analysis of Disease in plant leaves by image segmentation method

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Abstract— A new plant cell image segmentation algorithm is presented in this paper. The difficulty of the segmentation of plant cells lies in the complex shapes of the cells and their overlapping, often present due to recent cellular division. The algorithm presented tries to imitate the human procedure for segmenting overlapping and touching particles. In this context, one of the principal technical challenges remains the faithful detection of cellular contours, principally due to variations in image intensity throughout the tissue. Watershed segmentation methods are especially vulnerable to these variations, generating multiple errors due notably to the incorrect detection of the outer surface of the tissue.

Keywords—Segment, tissue, watershed, cellular.

I. INTRODUCTION

In biology, a common problem is the segmentation of cells for counting and feature extraction purposes Manual work is tedious and yields imprecise and subjective results. Computer assisted assessment has been shown to be a powerful tool due to its automatic, objective and fast measurement. A typical biological image analysis system starts with a digitizer (a video camera, scanner, etc..) followed by an enhancement of the image, segmentation of the cells and feature extraction for classification. . The output provides statistical results concerning the state of the culture that can be interpreted by the biologists.

Image segmentation has been studied by many authors and it has been shown that it is often dependent on the type of elements to segment. A relatively new tool for segmentation is the watershed algorithm [1].

1. It has the ability to perform very accurate segmentations from image markers reducing the problem to a simple marker extraction.
2. In this paper we present a new method to what is already known about the relevant problem.

Samples of Beta vulgarism cells are cultivated in vitro in liquid suspension. . Previous work in this project yielded well enhanced images. Samples of the cells are conveniently diluted in order to have a reasonable spatial distribution. After digitations of the cells [2], the useful zone of the scene was obtained by an adaptive form of the Hough transformation [3] and the images were enhanced by the morphological top hat transformation [4]. The next step in the image analyzing process is the segmentation of the enhanced cells will be discussed in next sections.

II. RELATED WORK

This chapter will begin by outlining the basic problem of segmentation and motivate its importance in many applications. Modern agricultural imaging modalities generate larger and larger images which simply cannot be examined manually. This drives the development of more efficient and robust image analysis methods, tailored to the problems encountered in agriculture images. The aim and motivation of this thesis to resolve the problem of segmenting leaf and pod disease. However, the generality of the problem can lead to potential impacts also in other areas of image analysis in agriculture.

III. METHODOLOGY

1. Segmentation of Plant Cells

The enhanced cells present an even spatial distribution and some of them are touching or overlapping. They do not present a unique geometrical shape that could facilitate the marker extraction (i.e. ultimate erosion yields over segmentation) the grey level is similar for all of them (the gradient information is often useless). Furthermore, the gradient image does not present a unique minimum per cell which could be used for the marker extraction. . It is for all these reasons that classical segmentation algorithms either do not segment the touching cells or lead to over segmentation.

The main idea of the algorithm lies in the imitation of the human procedure in segmenting touching particles. A group of cells is segmented if it presents a shape with two concavities relatively near one to each other with respect to the perimeter of the group.

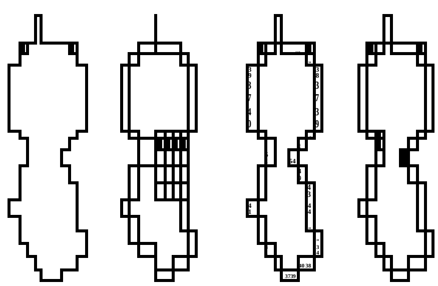
2. Contours and Their Concavities

After the enhancement by the top hat transformation, groups of cells are clearly differentiated from the background The next step is to obtain the contours of the cells in order to study their concavities. This is done by the set difference between the binary image and the unitary erosion. The contours are extracted, labeled and analyzed to obtain the concave points.

3. Concave Points

Dominant points have been widely studied in Pattern Recognition literature, specially in polygonal approximation purposes, object and character recognition but not so much in segmentation [5, 6]. These algorithms are usually recursive and/or computationally demanding. Since the analysis of these points must be for all the cells in the image and the number of cells can be well above several hundreds. the algorithm of concave points has to be simple and robust.

Each point of the contour will have a value of concaveness which is calculated in the following way. In other words, for the jth point of the contour the value of concaveness is calculated as the number of points of a 5x5 mask centered on j that intersect the binary shape. Finally, in order to avoid uncertainties, the values of the two adjacent contour neighbors are added to the present contour value. Thresholding of these values yields the concave points of the shape. . If two adjacent points are selected, the maximum of them is retained. Fig. 1 illustrates the method.



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These points can be due to the speci c shape of the cells or the presence of touching or overlapping cells. In the next section the information of these concavities will be discussed to perform the segmentation.

4. Linking Concave Points for Segmentation

The main idea for segmenting is to cut the shapes by the places where the concave points are present. But the problem is that some concave points may be due to the particular features of the cells and, furthermore, the presence of more than two cells implies several pairs of concave points. The choice of the points for segmentation are based on two main features. The gray level information(atness of the path between points) and spatial information (distance between points compared to the perimeter of the contour).

For each concave point the length and the gradient of the path to the other concave points is calculated. According to these parameters, , each point selects its candidate as a partner. A concave point will choose the partner that minimizes the spatial and gradient parameters. Their description follows.

Spatial Parameter. The spatial parameter is the euclidean distance between two points. In order to prevent from segmenting cells that have concave points in their\real" shape, a condition has to be imposed: The euclidean distance between candidate segmenting points is compared to the perimeter of the shape (number of contour points)) in the following way:

$$\underline{Per}$$

$$d \leq \quad ....(a)$$

where d is the distance between points and per the perimeter. The idea of the condition is to segment only when the distance d is smaller than the diameter of a hypothetic circumference of perimeter per.

Gradient Parameter. If the concave points are real segmenting points, a rela-tively \ at path" must exist between them. The following parameter is obtained between each concave point:

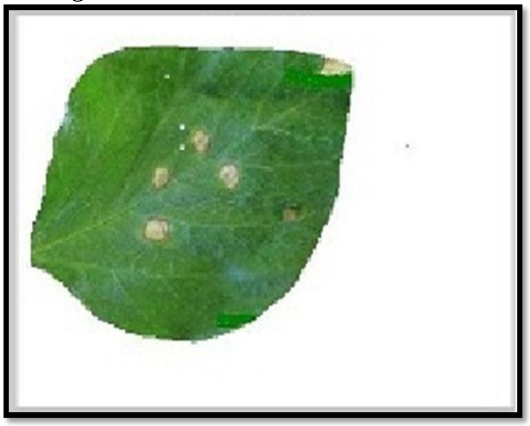
$$\overset{i}{\underset{N+1}{Grad = X_{jYn}, Y_{nj}}} \quad ....(b)$$

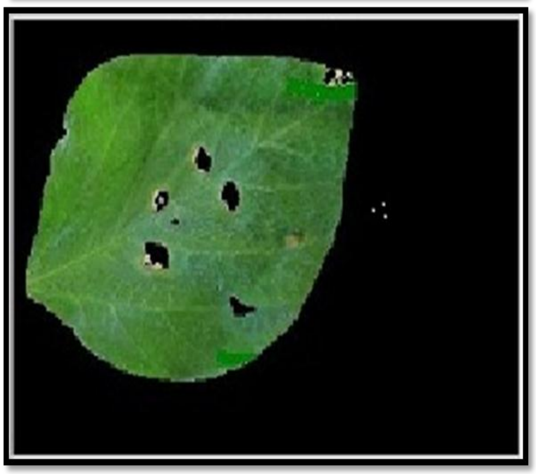
where i is the number of points in the line that joins two concave points and Yn the gray level information in the point n. The point that minimizes this factor is chosen as a candidate. The obtained value must not exceed 2 N(N being the number of total grey levels) , which has been found to be a reasonable threshold of atness.

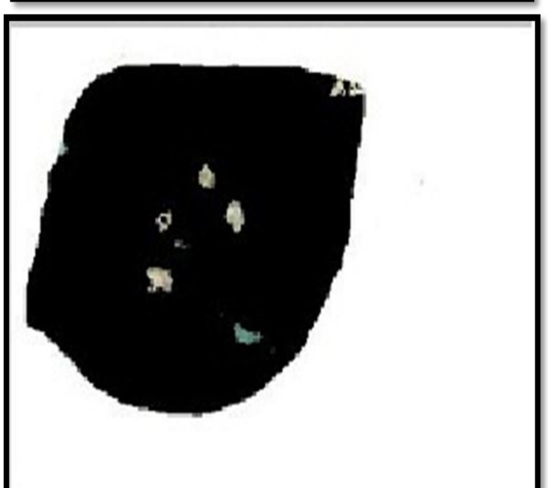
The calculation of these parameters is done for all points and each point makes its choice. Finally, the selected points are compared, when the points select one to each other the cell is decided to be segmented by drawing a line between points. This line is dilated in order to let the watershed algorithm to nd a more accurate segmentation line.

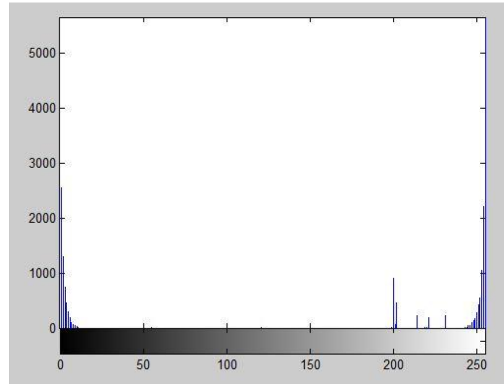
IV. RESULTS AND DISCUSSION

For testing the performance of the algorithm, a collage image was built containing groups of cells Different stages of the algorithm are shown, contour image with concave points, segmenting lines and nal segmented image after the watershed algorithm.









V. CONCLUSION AND FUTURE SCOPE

In the present scenario it is very important to have an established approach for grading the defects on the plant leaves automatically. For automatically detecting the leaf plant as well as for leaf disease detection, Machine Vision Technology is of great use. These systems are going to be very helpful for agriculturist since it is efficient than the manual method. The proposed system uses Euclidean distance technique and K- means clustering technique for segmentation of image to segment the leaf area, disease area and background area of the input leaf image in order to calculate the percentage infection of the disease in the leaf and to grade them into various classes.

Effective grading of leaf disease can be very helpful in reducing the damage of the crop plants. Computer vision technology and digital image processing is of great use for automatically detecting leaf as well as pod disease. This system is very useful in the field of agriculture since it is efficient than manual procedure.

segmentation is one of the most important image processing methodologies which are used in this project to separate the disease regions of the leaf from healthy area. In this proposed work we have used Region Based segmentation methods to find out the disease regions. Out of the three basic Region based segmentation methods such as Region Growing, Region Merging and Region Splitting we have derived methodologies how to select the best one. The best Region based segmentation is Region Growing, a detail of which is explained in the work. A large number of segmentation methods are coming up from researchers. The future deductions of research are to use different kinds of segmentation and different Quality Metric parameters to find which the best is.

In the present work the K-Means Clustering is been used. A large number of clustering methods under Data Mining Techniques like Agglomerative, CURE, OPTICS, Chameleon etc. are available in the literature. A future research work would be using various Data Mining Techniques.

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