Segmentation Based Image Mining Algorithms for Productivity of E-Cultivation

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***Abstract*— Image Mining techniques are suggested for agriculture for crop quality-evaluation and defect identification. A review of some of the important segmentation based algorithms and recent trends in image processing techniques which are applicable to crop quality evaluation and defect identification is presented. Image segmentation techniques are used for the detection of diseases. This demonstrates the use of the Agriculture information system, E-Cultivation process for increasing the productivity. Sample Results of some of the image segmentation algorithms used for crop disease identification and productivity measurement in E-Cultivation which are obtained using math lab are presented.**

***Index Terms*—e-cultivation, Image mining, Image segmentation, Agricultural framework, Image Segmentation, Math Lab**

I. INTRODUCTION

Countries like India and Srilanka depends more on agriculture. The communication and information technology is focusing more on supports techniques to channelize the modern technology for improving the agricultural domain. Several domains like Agricultural Information systems and Web based Agriculture can be seen in this context.

Intelligent Process Controlling Models are available to monitor any process in a distributed environment. Using Web based technologies, Web mining, Image Mining web based cultivation is possible. The process of cultivation for optimum yield and quality can be achieved with the support of such techniques. Agricultural field need computer based techniques for crop quality evaluation and defect identification. Image mining is one of such techniques suitable for agricultural applications.

For Agricultural field image processing techniques are useful for identifying the quality and defects by using image segmentation techniques. In case of plant the disease is defined as any impairment of normal physiological function of plants, producing characteristic symptoms. The quality can be achieved by segmenting the image of plant. For example, by counting the number of flowers in an image day by day we can identify the production of a flower plant. The main feature of the Agricultural information system is the availability of agricultural information to various users through the Internet.

Image processing, Image segmentation and image mining can be used in agricultural applications for following purposes:

i) To Identify diseased leaf, stem, fruit.
ii) To measure and monitor productivity of crop.
iii) To measure affected area of disease and to advise.
iv) To identify the intensity of diseases on the productivity.
v) To count the number of fruits and flowers etc on plants and trees.

For example we can identify disease of a plant on its leafs and other parts based on the affected area and symptoms. Consider a mango tree we can identify the fruits productivity like number of fruits, size of and quality. A symptom is considered as a phenomenon and evidence of its existence. Automatic detection of plant disease is an evolving research topic useful for e-cultivation. It benefits in monitoring large fields of crops, automatically detecting the symptoms of disease helps in documentation of Agricultural knowledge based in the form of software code and environment.

Generally diseases of a plant will be observed on leaves or stems of the plant. Monitoring such parts of plants plays a major role in successful cultivation. Diseases cause heavy crop losses amounting to several millions and billion dollars annually. Collecting such information from forms along with other attributes of the cultivation environment raise scope to new research problems in the domain of agriculture.78

The objective is to use Information Technology in agriculture, specifically in cultivation for improving the quality of cultivation and productivity useful for countries like Indian. Sample work is presented to find the flowers productivity in plant image and to identify the crop quality and diseases in plants. This is useful for agricultural information system to automate the process of finding the diseases in uploaded images.

II. IMAGE SEGMENTATION

Partitioning the image into different regions depending on domain requirements and given attributes is considered as Image segmentation in Image Processing.

The segmentation considers measurements of other attributes like grey level, color, texture, depth and motion. The final objective is to cluster pixels of image into salient image regions or segments, such as regions of individual surfaces, objects, or natural parts of objects

etc. Such methods can be used in object recognition, occlusion boundary estimation within motion or stereo systems, image compression, image editing, or image database look-up.

The outcome of this process is a set of regions, clusters or segments that cover the total given image, or a set of contours extracted from the image. In a clustered region each pixel is similar with respect to some characteristic like color, intensity, texture. Other regions and adjacent segments are significantly different. For example in Medical images , the resulting contours after image segmentation can be used to create 3D reconstructions based on interpolation algorithms such as Marching cubes.

The Image segmentation is defined as a partitioning of the set F into a set of connected subsets or regions (S1, S2, • • • , Sn) such that [ni=1Si = F with Si \ Sj = _ when i 6= j. The uniformity predicate P(Si) is true for all regions Si and P(Si [Sj) is false when Si is adjacent to Sj.

Where F will be be the set of all pixels and P( ) be a uniformity (homogeneity) predicate defined on groups of connected pixels.

The same definition is used for different types of domains like Medical images, Agricultural images etc. The objective of image segmentation is to locate certain objects of interest which may be depicted in the image. Some tile segmentation can be compares similar to a problem of computer vision.

It can be seen as a process of thresholding a grayscale image with a fixed threshold t where each pixel p will be assigned to one of two classes, P0 or P1, depending on whether I(p) < t or I(p) >= t.

Typical segmentation approaches for intensity images (represented by point-wise intensity levels) are :

i). *Threshold techniques*: Threshold techniques depends on the local pixel information and are effective when the intensity levels of the objects fall squarely outside the range of levels in the background as the spatial information is ignored, but blurred region boundaries can create havoc.

ii). *Edge based methods*: This will work on contour detection and its weakness in connecting together broken contour lines make them, too, prone to failure in the presence of blurring.

iii). *Region-based techniques*: In this method input image is partitioned into connected regions by grouping neighboring pixels of similar intensity levels and adjacent regions are then merged under some criterion involving homogeneity and sharpness of region boundaries.

iv). *Connectivity-preserving relaxation technique:* This is also known as the active contour model.

It will start at initial boundary shape represented in the form of spine curves; it iteratively modifies applying various operations like shrink, expansion as per the some energy function. Coupling it with the maintenance of an "elastic" contour model gives it an interesting new twist; this is a difficult task comparing with other models. Unless handled properly, risk involved in it is more comparing with other models.

Segmentation is classified base on grayscale, texture and motion.

i). Segmentation based on grayscale

ii). Segmentation based on texture

iii). Segmentation based on motion

III. IMAGE SEGMENTATION FOR E-CULTIVATION

Agricultural field need computer based techniques for crop quality evaluation and defect identification. Image mining is one of such techniques suitable for agricultural applications.

Monitoring of the crops for managing the e-cultivation is an important process. Agricultural images are uploaded for monitoring, for e-advisory, for identifying the faulty portions and for measuring the productivity. This will have high impact on the overall productivity of the e-cultivation systems.

The image processing and image mining can be used in agricultural applications for following purposes:

i). Identification of diseased leaf, stem, fruit

ii). Identification and quantification of affected area by disease.

iii). Identification of intensity of diseases and its effect on productivity.

In case of plant the disease is defined as any impairment of normal physiological function of plants, producing characteristic symptoms.

Observing the images of plants, leaves, and stems and finding out the diseases, percentage of the disease plays a key role in successful cultivation of crops. It is helpful in preventing heavy crop losses due to diseases.

E-Cultivation Models

E-Cultivation models are web based agricultural system; Information communications and technology (ICT) are used for agriculture. These models are used for developing new technologies in agriculture field. By using E-Cultivation models agriculture experts can identify the diseases and quality over internet online without visiting the forms physically. This method works on a web based architectural model that creates a agricultural nodal system. Automation of measuring the status of cultivation and collecting requirements are possible through such models. The models used in this work are more suitable for such applications.

IV. DISEASE IDENTIFICATION IN PLANTS USING K-MEANS ALGORITHM

The natural spectral groupings present in a dataset are identified using K-Means clustering. It identifies a fixed number of disjoint, flat or non-hierarchical clusters. It is useful for the globular clusters. The K-Means method is well known for numerical, unsupervised, non-deterministic and iterative.

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Properties of K-Means Algorithm

i) K- Clusters which are all non empty that means at least one item in each cluster are required

ii) The behavior of these clusters will be non-overlapping and non-hierarchical.

iii) All members are closer to its respective cluster.

Image Segmentation by clustering

Technique based on clustering like K-Mean can be applied for Image Segmentation. Such techniques are used for clustering the medical and Agricultural images for the identification of defective parts in medical images or required parts in agricultural images. In agricultural images there is a need to identify and measure defective part as well as required regions like fruits and flowers etc.

Color-Based Segmentation

In this model the process is automated to segment colors using the L*a*b* color space. We apply the K-means clustering method for this clustering. The following steps describe this process of clustering:

Step 1: Read and formalize Image
Step 2: Colour Recognition and formatting
Step 3: Image K Means classification
Step 4: Labelling identified section
Step 5: Rebuilding image
Step 6: Finding specified Sections

V. IDENTIFYING THE FLOWERS IN A PLANT

The objective of the work is to detect the flower region and regions of interest (ROIs) from the agricultural image. The process involved in the extraction of flowers region from image is described in the following steps:

i) Original image
ii) Bit plane slicing
iii) Erosion
iv) Median Filter
v) Dilation
vi) Outlining
vii) Flowers Border Extraction
viii) Flood Fill Algorithm
ix) Flowers Extracted Image

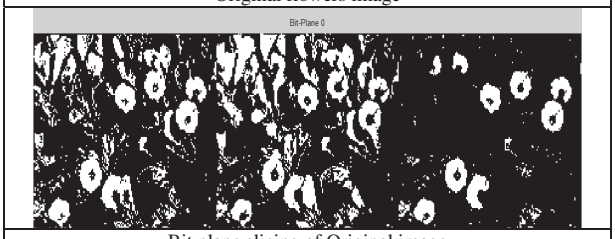
The image processing methodologies used in these models are Bit-Plane Slicing, Erosion, Median Filter, Dilation, Outlining, flower Border Extraction and Flood-Fill algorithms.

The first step is applying bit plane slicing algorithm to the scan image. The different binary slices are resulted from this algorithm. The best suitable slice applied for better accuracy, sharpness and the further enhancement of flower region.

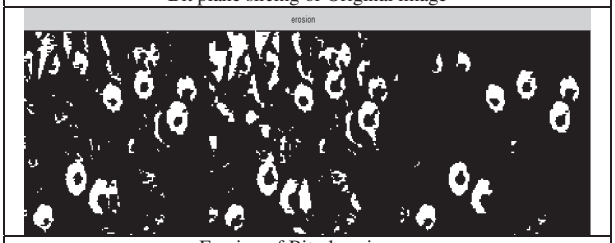
As a next step the Erosion algorithm is applied to enhances on the sliced image for reducing the noise. The dilation and median filters are also used for further improvement for filtering other type of distortion. Outlining algorithm used to find the outline of the regions after obtained noise reduced images. The flower border extraction technique is applied to find the flower border region. Flood fill algorithm is used to fill flower border with the flower region. Finally the flower region will be extracted. This flower region can be used for segmentation for the identification of flowers. Unlike Medical images lot of customization is required on these methods if applied on different types of plants as attributes and requirements change from case to case.

The result obtained is presented as sequences of figures:

Original flowers image

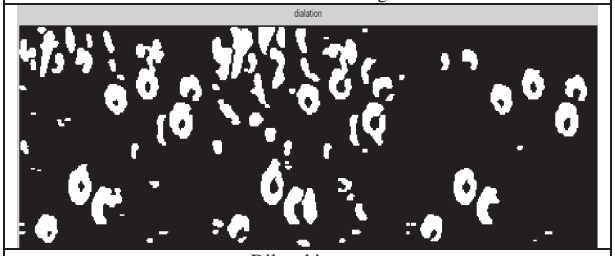


Bit plane slicing of Original image

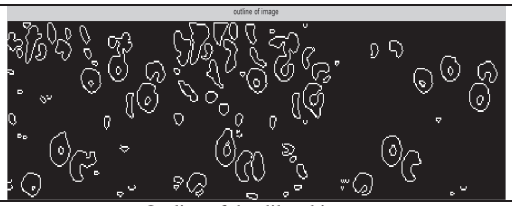


Erosion of Bit plane image

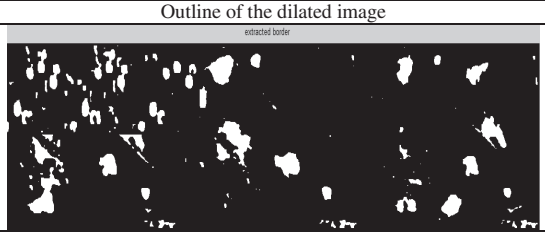
Median filtered image



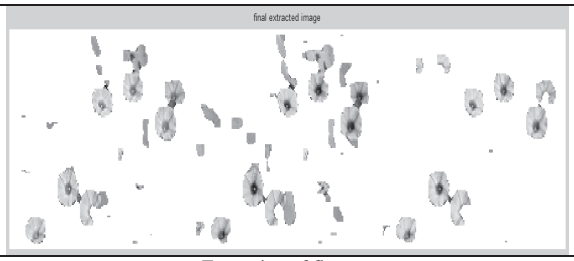
Dilated image



Outline of the dilated image



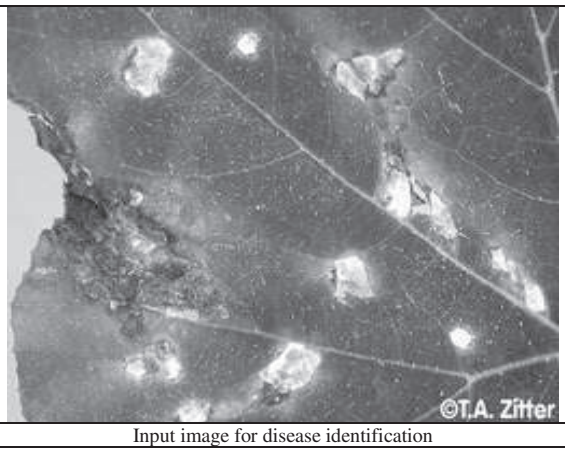
Extraction of border



Extraction of flowers

VI. IDENTIFYING DEFECTIVE SEGMENTS

Identifying the defective segments for measuring the quality and productivity of plant can be obtained in a similar methodology. Result of Mat lab code for the processes is presented in the following figures. Similar things can be applied on quality of vegetables.



Input image for disease identification

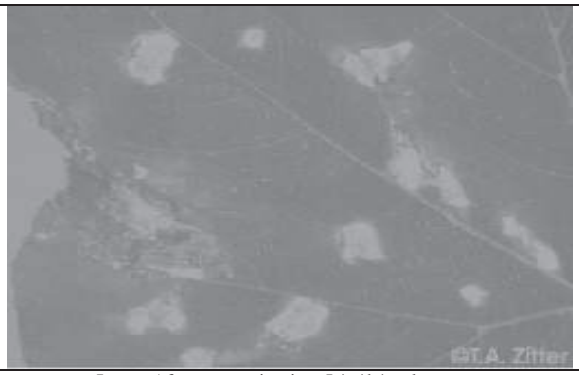


Image After converting into L*a*b* color space

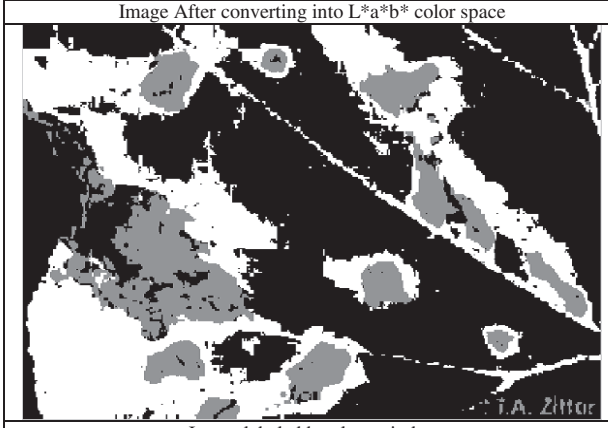
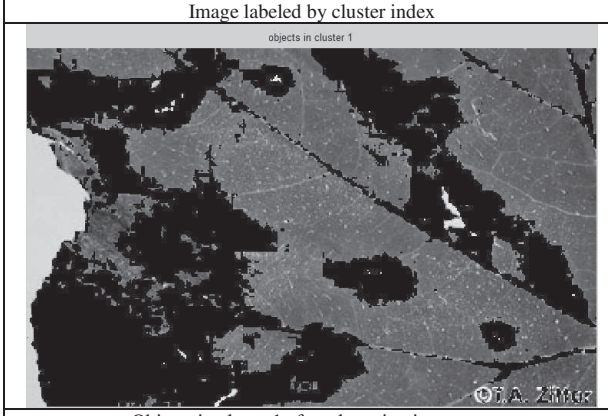
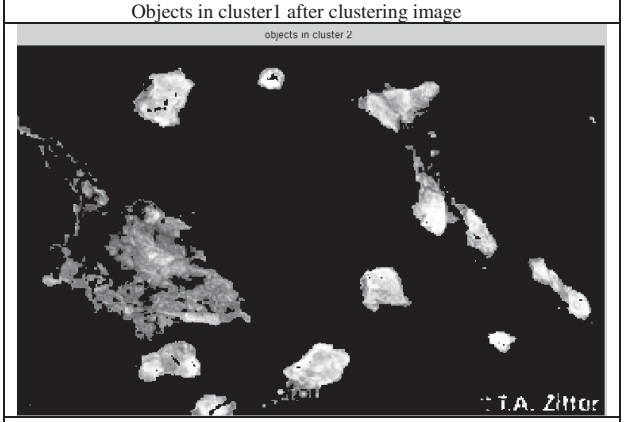


Image labeled by cluster index



Objects in cluster1 after clustering image



Objects in cluster2 after clustering image

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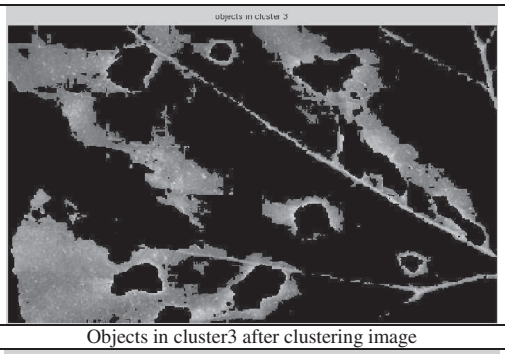
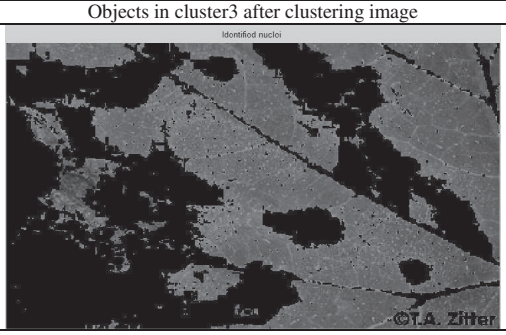


Objects in cluster3 after clustering image



Identified specified nuclei in image

CONCLUSIONS

The main objective of the paper is to use different image mining techniques like K-means Clustering algorithm in image segmentation techniques for e-cultivation requirements. Unlike medical images e-Cultivation raises several different types of challenges as the type of requirements and attributes change from case to case. A lot of customization of image segmentation and other algorithms are required for each case. This will raise scope for lot of research in this domain.

The model presented as sample in this paper can be extended to problems like count the number of flowers in images. Such techniques can be applied on satellite images also to monitor the cultivation process in spatial domain. The model presented is objected to small image samples of e-cultivation nodal system for evaluation of crop quality and productivity useful for e-cultivation advisory models.

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