Detection of Number of Fruits in a Tree and Yield Management

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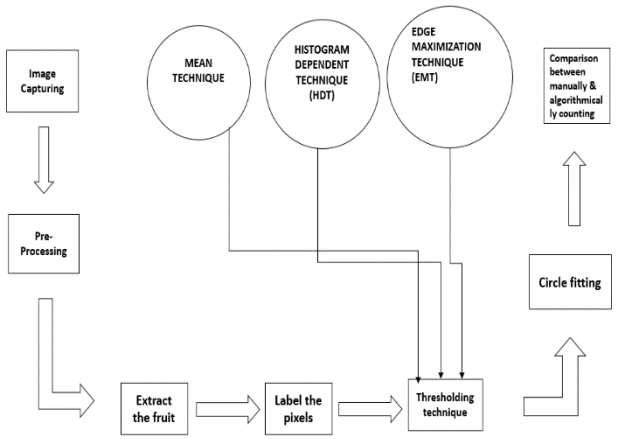
***Abstract*—Computer vision methods are helpful for automatic counting of fruits on trees. In this paper we present automatic detection, counting and yield estimation algorithm for fruits on the basis of colour and shape analysis in the field. Firstly, pre-processing was applied on input fruit tree images and then it was converted from RGB to L*a*b colour space to detect the fruit region from its background. Otsu's method was used to create the image segmentation. Morphological operation was applied on binary images to remove noise. Then fruits were extracted by region labelling. Edge detection technique was applied on the labelled images to detect the edges of fruit region. On this edge detected image, circular fitting algorithm was applied for automatic counting of fruits. We used different types of fruits (apple, Tangerine/orange, pomegranate, lemon, peach, plum) for automatic counting. The simulation outputs show that new counting algorithm is found to be suitable and gives better accuracy than Newton's method [17] for yield estimation. It gives 88.73% accuracy for apple, 93.93% for Tangerine/Orange, 81.36% for pomegranate, 84.43% for Lemon, 83.14% for peach, 70.18% for plum fruits and gives average yield measurement error is 16.3%.**

Keywords - Counting algorithm, Edge detection, L*a*b colour space.

I. INTRODUCTION

Yield prediction of fruit/vegetable through automatic counting in practical environment is one of the hardest and significant tasks to obtain better results in crop management system to achieve more productivity with regard to moderate cost. Yield estimates can provide valuable information for forecasting yields and generating prescription maps for treespecific application. In the present work yield estimation of fruits is a process to find the total number of fruits in a tree automatically. For successful application of effective control methods, the yield information about individual tree is a prerequisite in real time. Morphological operation was applied on images to remove noise. Then fruits were extracted by region labeling. Edge detection technique was applied on the labeled images to detect the edges of fruit region. On this edge detected image, circular fitting algorithm was applied for automatic counting of fruits.

II. BLOCK DIAGRAM



III. IMAGE SEGMENTATION

Segmentation refers to the process of partitioning a digital image into multiple regions (sets of pixels). The goal of segmentation is to simplify or change the representation of an image into something that is more meaningful and easier to analyze.Image segmentation is typically used to locate objects and boundaries in images.Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic.

Some applications of image segmentation in medical field includes:

- Locate tumors and other pathologies,
- Measure tissue volumes,
- Computer-guided surgery

Image segmentation reduces pixel data to region-based information

- segmentation of an image which classifies voxels/pixels into objects or groups
- Form of segmenting the foreground from background
- simpliest case: thresholding gray-scale pixel values

Image Capturing and Pre-processing

We had taken some field images of different fruit tree from internet. Gaussian filter use for noise removes from input image. Then new counting algorithm is applied on these images and compare between manually and algorithmically counting. Test image of plum tree shown in Fig.

Fig 1. Gaussian filtered image Fig 2. Original image of plum tree

Circle fitting

Captured image to RGB Conversion

Filtered input image is converted in RGB colour space for detect fruits from itsbackground. By use of RGB colour space segment the fruit regions with its perceptually uniform property

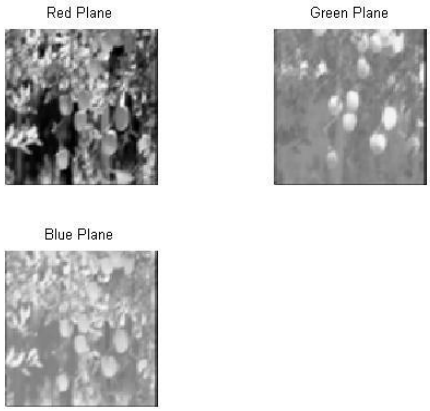


Fig .RGB image

Edge detection

Edge detection technique is detecting the edges of labelled fruit region. Sobel and Canny operator is thebest for the edge detection but canny is expensive than sobel so we use sobel operator for the edge detection this operator calculates the gradient of the image intensity at each point. Edge detection image on figure.

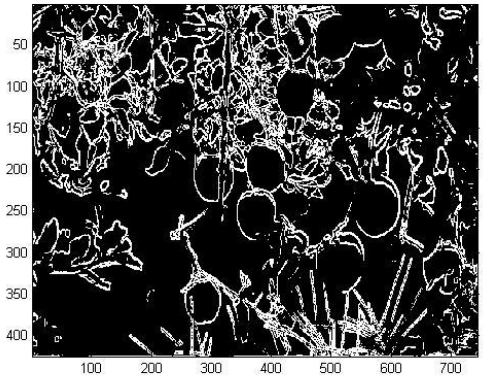
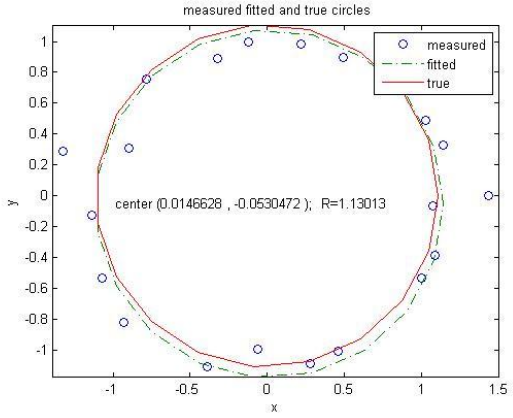


Fig. Edge detected image

Edge detected images are used for circle fitting which is implemented using the following step:

Find the size of edge detected image and labelled each edge pixels.

Detect the boundary points of the fruits. Each boundary point has two values (x co-ordinate and y co-ordinate).



Make a vector XY which stores co-ordinates of the edge pointsFind the number of data points (n). Calculate centroid of the data set by calculating mean of XY vector, which is a two column vector. First column stores the y-co-ordinates and second column stores the x co-ordinates of all the boundary points. XY=[y x].

Fix the distance (a) of each edge points from the centroid.

$$a = \sqrt{[(x1 - x)^2 + (y1 - y)^2]}$$

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