Fruit Maturity Detection And Counting Using Image Processing

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Abstract- *As India exports large amount of fruits which greatly improves our economic growth it is essential that we track the quality of the fruits. Automation increases the quality, economic growth and productivity of the country in agriculture science. Sorting of fruits affects the quality evaluation and export market. The crucial characteristic of fruits is appearance that impacts their market value. Although, the sorting on basis of maturity can be done by human but it is inconsistent, time consuming, variable and easily influenced by surrounding. Hence, Convolutional Neural Network (CNN) is used to recognize fruit with high accuracy. This work also focuses on counting the number of fruits to reduce the human labor.*

Keywords*:* Image Processing, Fruit classification, fruit maturity, fruit size, colour index,Maturity level

I. INTRODUCTION

Images are the most basic and common method in physical classification of fruits. Factors affecting fruits can be distinguished visually and they are laborious, expensive and is easily affected by physical factors, including inconsistent evaluation and subjective results. Such inspections determine the market prices and also the ‘‘best-if-used-before date”. The quality inspection is done by trained human investigators by feeling and seeing. This method is significantly inconsistent.Image processing is a rapidly growing research area and is a analyzing technique from pre to post harvesting of crops. Similarly fruits can also be classified on basis of their maturity using image processing. Thus, the objective of this paper is to give survey of computer vision and image processing techniques in the food industry and also to review various segmentation, image features and image descriptors in the literature and quality analysis of fruits on the basis of color, shape, size and texture.

There are so many issues in fruits recognition from images like changes in illumination, camera position also for digitalization process of images etc. The recognition technique may become more complicated if the given images of that fruits are belonging to the same type of fruits. Color feature is used for extracting the information of the objects, which is implementing recognition task. Shape is also another useful feature in object identification. Texture feature is used for distinguish different patterns of images, in which extracting the intensity between pixels and their neighboring pixels.
In this paper we are extracting the features of the fruits from the images of the dataset, at first we are extracting the features like color, shape and texture of the objects from the given images. After that computing similarity between the extracted features of the objects, then finally detecting and classifying fruits based on the maximum features similarity.

Image segmentation is separation or division of the image into areas of similar attributes. In another way, Image segmentation implies pixel classification. The level of difficulty to which the process of image segmentation is to be carried out mostly depends on the particular problem that is beingsolved. It is treated as an important operation for meaningful interpretation and analysis of the acquired images. A very crucial components of pattern recognition and image analysis is image processing and still is considered as most challenging tasks for the image processing and image analysis.

IMAGE PROCESSING: Image processing is form of information processing,inwhich the input is an image, such as photographs or frames ofvideo; the output can also be other than an image, but can be a set of features of the image. The image is treated as a two dimensionalsignal and applying standard signal processing techniques to it is considered asan image processing technique.A pixel can be thought of as a tinydot containing information about the picture. The tiny bits of information are gathered by thecamera's sensor when one snap a picture. The information is stored in a 3 plane ofinformation. Each plane represents three colors that aregreen,red and yellow plane. Each plane has the intensity from 0to 255 or 8-bit of information per plane. These three colorcombination makes up all the color in an RGBimage. Simple calculation of 8-bit information is asfollow: 2n = bit, 28 = 256.

Many techniques of digital picture processing, or digitalimage processing as it was often called, were developed at the Jet Propulsion Laboratory, MIT, Bell Labs,University of Maryland, in the1960s withapplication to satellite imagery, wire photoconversion, videophone, characterrecognition,medical imaging and photo enhancement. Digital processing is mostof the time preferable because of cost issue on top of falling trend of digital services.

II. LITERATURE REVIEW

"Anisha Syal", et.al introduces minimum Euclidean distance based segmentation technique for segmenting the fruit region from the input image.Overlaying of circle is done further on the fruit andlast fruits is counted on the basis of the centroid of the fruit regions. The system is correctly detecting and counting the apples on the test images.

"Bhushan P. Ragit," et al describes processing on yield counting system and health monitoring of citrus fruit is processed. The model in the paper can be worked in any graphical area. The system involves an automatic robot which revolves around. Also the axis of citrus tree and various images from different angle are clicked. Then Image processing algorithm is used to process these images and color based count of fruit is presented asthe output. The system is designed to calculate the yield automatically of citrus group tree accurately and health monitoring in temperature and moisture of tree is also included in system.

"Izadora Binti Mustaffa", et.al focuses on the of mango fruitmaturity identification. Raspberry Pi is a small computer and is powerful enough to run an image processing algorithm. The size of the fruit is determined by this developed image processing algorithm and the K-means clustering is used to determine the fruit color.
"S.Arivazhagan" et al describes computer vision strategies used to recognize a fruit is based on four basic features that characterize the object: intensity, color, shape and texture. This paper proposes an efficient fusion of texture and color features for fruit recognition. The minimum distance classifier is used for recognition based upon the statistical and co-occurrence features derived from the Wavelet transformed sub- bands. Experimental results on a database of about 2635 fruits from 15 different classes confirm the effectiveness of the proposed approach [16].

"Pradeepkumar Choudhary", et.al Fruits should be quickly and correctly differentiated from their surroundings for the fruit harvesting robot. Edge based and color based detection methods are generally used to segment images[17] of fruits. In this work, Digitized images of mango fruits along with its background were selected from the Internet to locate its exact positionby finding a mango in each image. We compared the results of colored based and edge based segmentation results and found that color based segmentation outperforms the edge based segmentationin all aspects. The segmented image result shows the comparisons result. Accordingly, a new mango detection method which is proposed to position the centroid of mangoes.

"AnujaBhargava" et al Presents a detailed overview of various methods i.e. feature extraction, preprocessing, segmentation,classification which addressed fruits and vegetables quality based on size, shape, color, texture and defects. In this paper, a comparison of different algorithm by researchers for quality inspection of fruits and vegetables has been carried out.

"Harpuneet Kaur" et al sheds light on the advancements made in the automated agricultural industry. Digital image processing techniques are now widely used for maturity estimation [18] of fruits and vegetables. This work aimed to study and analyze the various algorithms and feature extraction techniques that are now used for extracting features from the captured digital images. Advantages and disadvantages of various classifiers have been discussed. It was observed that for achieving high accuracy a compromise is to be made with high computational complexity.

"Shubham Tagad.", et.al introduced an assisting application for fruit maturity estimation. The specialty of this system is, it can tell the number of remaining days for ripening of the fruit. One of the three main modules, user will store his information in the system as well as he will click the image of the fruit for its maturity detection. Database will contain the training dataset of fruit. It will also store the user information. Server will pre-process the image given by user and compare its characteristics with characteristics of fruit images stored in database. This system is easy and cost effective technique for maturity detection of fruit. Other fruit maturity detection techniques like use of infrared rays and chemical testing are harmful, it can damage the fruit. This system uses image processing to store the characteristics of fruit. Gaussian blur and sobel edge detection algorithm are used to acquire the characteristics of the fruit.

"Mr. Sumit S. Telang", et al This paper aims at presenting the concept of fruit quality management, automatic vision based technology has become more potential in recent years and more important to many areas including agricultural fields and food industry [19]. The desired system determines the quality of fruit by its colour, size and weight. Sorting of fruits manually is a time consuming process, costly and an inaccurate process and to developed in order to increase the quality of food products made from fruits. The sorting process depends on capturing the image of the fruit and analyzing this image using image processing techniques to discard defected fruits. Colour is most striking feature for identifying disease and maturity of the fruit. The main emphasis is to do the quality check with a short span of time so that maximum number of fruits can be scrutinized for quality in minimum amount of time. The absolute reference point is the way to

perceives and interpret the quality of fruit. The assessment of fruit quality requires new tools for size and colour measurement and capturing the fruit side view image, some fruit characters is extracted by using detecting algorithms [20].

III. PROPOSED WORK

Fruit recognition is an area belonging to major research area of object recognition from images. It can be considered as one of the specific case of object recognition research. Fruit recognition based on computer vision is still considered as a complicated task due to various properties of numerous types of fruits. Looking to usability, many researchers have contributed a lot in computer based fruit recognition but most of these attempts have fused mainly color and texture feature or color and shape features or shape and texture. Recently attempts have started exploiting shape, color and texture features. In this system features such color, shape, texture and size are used to determine maturity and to count number of fruits. This proposed system uses watershed algorithm to count the number of fruits.The watershed from a regular neural network is taking into account the structure of the images while processing them.

Training and Testing Dataset: Here we use 80% of data set for the training purpose and remaining 20%dataset for testing is a classical algorithm used for segmentation, for separation of different objects in an image. Starting from user-defined markers, the watershed algorithm treats pixel values as a local topography (elevation). The algorithm floods basins from the markers. In many cases, Basins are flooded as markers are chosen as local minima of the image.

CNN Algorithm: CNN algorithm is used to detect the maturity of the fruit.The CNN algorithm is used for data classification. Convolutional neural networks (CNN) are part of the deep learning technologies. Such networks are composed of convolutional layers, pooling layers, ReLU layers, fully connected layers and loss layers. In a typical CNN architecture, each convolutional layer is followed by a Rectied Linear Unit (ReLU) layer, then a Pooling layer followed by one or more convolutional layer and finally one or more than one fully connected layer. A characteristic that sets apart the CNN from regular neural network is taking into the images while processing them.

Traditional feature learning methods are relied on semantic labels of images as supervision. They usually assume that the tags are evenly exclusive and thus do not pointing out towards the complication of labels. The learned features endow explicit semantic relations with words. CNN also develop a novel cross-model feature that can both represent visual and textual contents. As part of deep learningCNN is a technique of classifyingimages. In which we apply single neural network to the full image.

1. Accepts a volume of sizeW1×H1×D1

2. Requires four hyper parameters:
   Number of filters K
   Their spatial extent F
   The stride S
   The amount of zero padding P

3. Produces a volume of size W2×H2×D2 where:
   i. W2=(W1−F+2P)/S+1
   ii. H2=(H1−F+2P)/S+1(i.e. width and height ar e computed equally by symmetry).
   iii. D2=K.

4. With parameter sharing, it introduces F*F*D1 weights per filter, for a total of (F*F*D1)*K weights and K biases.

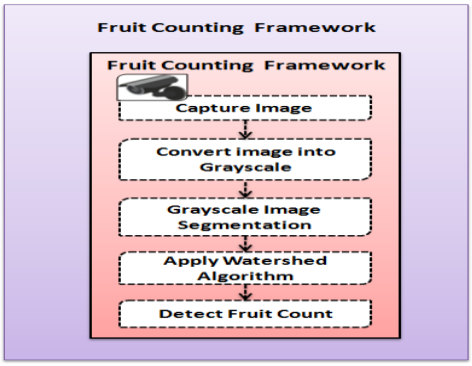
In the output volume, the d-th depth slice (of size W2×H2) is the result of performing a valid convolution of the d-th filter over the input volume with a stride of S, and then offset by d-th bias.

5. A common setting of the hyper parameters is F=3,S=1,P=1

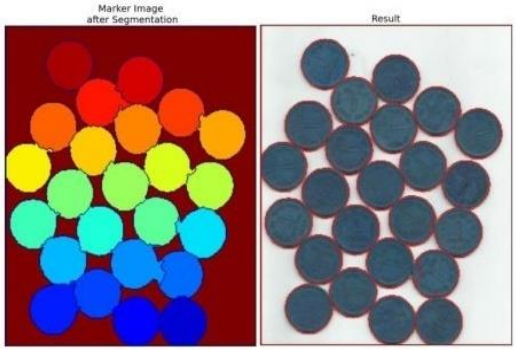
However, there are common conventions and rules of thumb that motivate these hyper parameters.

Watershed Algorithm: The watershed is a classical algorithm used for segmentation for separating different objects in an image.The watershed algorithmtreatspixels values as a local topography (elevation). The algorithm floods basins from the markerstill basinsattributed to different markers meet on watershed lines. In many cases, basins are flooded since markers are chosen as local minima of the image.

A. Flow Diagram for Fruit Counting

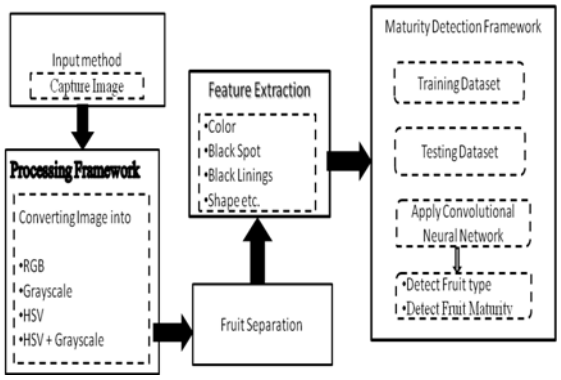


1) Capture Image: The system can capture the fruit plate image. The fruit plate contains apply, orange etc. fruits.
2) Convert Image into Grayscale: In this phase, the input image is converted into grayscale.
3)Image Segmentation: The segmentation is applied on the grayscale image.
4) Counting the Fruits: For the fruit counting we use watershed algorithm. Blobs or contours having more than a threshold size are counted. The output of the algorithm may be similar to following,



In the above image the one color consider as a one fruit and then total number of fruits are counted.

IV. SYSTEM ARCHITECTURE



First we are capturing the image which is given as a input. After that the given input will go under processing framework.

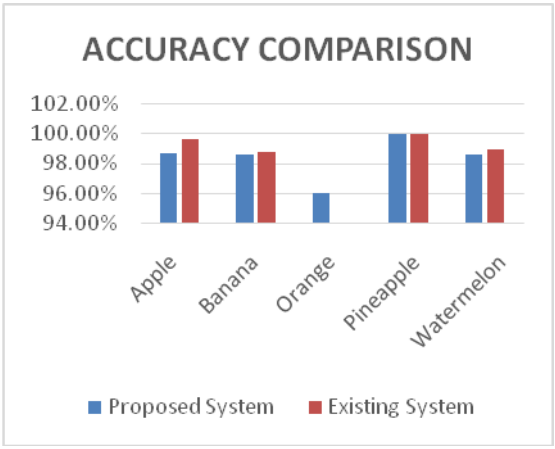
1. **Processing Framework:**In this framework input images are converted from RGB images to Grayscale, after that keeping that images in the RGB color-space, then converting the input from RGB images to HSV color-space, and then merging the converted input images (i.e. from RGB images to the HSV color-space and to the Grayscale)
2. **Fruit Separation:**The process of cutting of background, add and extract common feature analysis ofimage focused at separating an input image into area that has strong relation with objects orareas of interest has called as Image segmentation. In image segmentation, removed data aremostly depend on the exactness of the operation. If objects in image are not distributedaccurately, it is difficult to understand for object detection, measurement and classification.Hence the image is interpreted and understood.
3. **Feature Extraction:**Feature extraction is an initialization from the measured data that derives the features of the images. In here the different features are extracted from the fruits. This section gives an idea ofdifferent features used for the operation. Mainly used featuresare,

1. Shape.
2. Size.
3. Texture.
4. Color.

Maturity Detection Framework:RGB, grayscale and S channels values are used for finddifferent between maturity stages. The length and aspect ratiois doing not to affect the ripeness of fruits. In here the fruitclassified into three based on maturity they are unripe, ripe and overripe.

V. RESULT

The graph below shows the comparison between proposed system and existing system.



VI. CONCLUSION

This work analyzes how fruit counting andfruit maturity detection is essential factor in agriculture sector. The Image processing technique is used for fruit maturitydetection on captured digital image of different fruits. Variousalgorithms and feature extraction techniques are

usedfor extracting features from the captured digital images.Various classifiers have been discussed. Hence, the extensionof this work will review all above mentioned techniques and methods.

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