MACHINE VISION SYSTEM FOR FRUIT SEGREGATION AND PACKAGING

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Abstract - *All industries and stores has workers for fruit segregation but recognizing, categorizing and ranking of fruits are not done correctly. As categorizing is one of the most important industry provocations, a dependable categorizing method is needed so it would be secure to pack automatically. So, it is required to inflict the hardware system in fruit industry. In accordance with the need of hardware segmenting and packaging system for fruits in the supermarket and the limitation of current methods, this project proposes a new segregation method for fruits for packing. Under natural lighting conditions the fruits are segregated. To segment images of fruits we use machine learning techniques. In order to find a fruit in each image and to determine its location twenty digitized images of fruits were randomly selected. We compared the results of both segmentation results and the color based segmentation outperforms the edge based segmentation in all aspects. With the adequate concepts of image processing there is a great scope to provide intelligence for designing on automation system to differentiate the fruits according to its size. This process will lead to developing a product that will segregate all fruit in industries and even in grocery stores. A Microcontroller is used to drive the sorted fruits as per the need to their allotted buckets. Implementation of all segmentation methods on fruit images is applied and a comparative outcome is projected to segregate the fruits.*

Key Words: **Image segmentation, GLCM, MATLAB**

1. INTRODUCTION

1.1 Overview

This overall system is based on the MATLAB software and consists of hardware too. The Image is being processed by using MATLAB software whenever the fruit is detected. Hardware consist of microcontroller and motors. The servo motor pass the fruits and packaging boxes at specified time and these are run by drivers by the command of microcontroller. This system automates the process of fruit sorting and packaging. The fruits are passed one by one which is sensed and image is captured and image processing is done by MATLAB software and thus spot detection is done.

Finally we get the result whether the fruit is accepted or rejected. The fruit is collected in it and if the fruit is rejected then the fruit is moved to the other side with the help of grip. This leads to the ease at meeting the requirement of customer and their satisfaction. Because at the end any industry would aim to meet their customer need and to look after their requirements. In Texture method, when an element or pattern on a surface that is repeated on a regular basis, it is called as Texture. The most crucial attribute is texture in many image analysis and computer vision analysis. The procedures are further divided into constructive approach, design based approach, analytical approach and refine based approach.

1.2 History

Various algorithms for texture feature analysis have been proposed by researchers, such as the Wavelet decomposition method. The extended method is typically based on the co-occurrence matrix to describe the image features with gradient operator. The texture features are extracted according to grey level co-occurrence matrix and grey level run-length matrix. The images obtained from the colour CCD video camera are changed considering different consumer may pack and place in their own way even if under the same illumination condition. So, our algorithm should have good robustness in order to solve the problem. Apart from these, some fruits have extremely similar colour, such as guava and green apples, white pears and white apples.

1.3 Applications

Overall, many problems remain to be solved to enable the automatic weighing and pricing system to recognize fruits precisely. With the unique development of this method with grey-scale images, it has been an extensively efficient form, applicable to colour images. Conventional edge based techniques usually form disjointed borders that calls for post-processing for producing congested regions. The borders of the resultant regions constantly match up to contours appearing in the image as evident contours of objects. The combination of the entire region forms the complete image area. After segmentation the MATLAB output will be sent to the Microcontroller.

Here we have used an Arduino Microcontroller which helps for packing. The fruits packed into three packing buckets. If the recognized fruit is a selected type Microcontroller will send it to second packing bucket. When the recognised fruits are very small in size then it will send the first packing bucket. Or if the segmented fruits are bigger than the selected size then the microcontroller will send it to the third packing bucket. Here, we have used an Arduino microcontroller and stepper motor for the packing process.

2. Existing Method

Manual harvesting may be a traditional and customary method to reap fruits. Even though that's a labour intensive, manual harvesting is quite common for fruits that have huge for optimal maturity or for fruits that are marketed for direct consumption for the people. Historically, manual harvesting has been the well-liked method for achieving high-quality control and minimizing tree damage. Also, manual harvesting is usually administered as a clean-up operation either after the mechanical harvesting or at the top of the harvesting season to select up the fruits that are left behind. the popularity of fruits and packing are done by humans. Fresh produce sold through markets or by direct sales to users or agents would undergo some sorting and packaging. This method involves packing of fruits by hand, using plastic wraps and plastic foam containers etc. Properly trained workers segregate, pack and handle the fruits with minimum damage. The packed fruits are placed in big cardboard boxes of various sizes, depending upon the dimensions of fruit. The labours are expected to wear clean aprons, gloves and head covers. The stamina needed to segregate fruits from the load is typically higher and any less of required stamina may end in diminished packing rates. Manual picking and packing could also be done either by hand or using semi-manual tools that are heavy for prolonged handling. The fruits which will easily be damaged while handling like peaches, cherries, bananas, etc. should be packed by handling the fruit firmly and gently, and punctiliously [6].

3. Proposed Method

Fresh fruit harvesting can be done by using the digitized images of fruits that were randomly selected from the Internet and all the images would be of different pixel size. The images will be captured at different lighting conditions with different background colors and different camera positions. All of this images will be sent to the MATLAB as input image. The MATLAB helps recognize the selected image with the help of image segmentation process. In our proposed system the image segmentation is based on colour of the selected fruit and edge based segmentation. The segmented imaged recognized by MATLAB will be sent to the Microcontroller. The Microcontroller Arduino Uno used here help to packing of fruits.

Here we have connected a servo motor with Arduino. When the recognized fruit is ripe Microcontroller will send it to allotted packing bucket. When the recognized fruits are unripe then it will send to unripe packing bucket. Thus this project helps to recognize the fruits size, color and helps for packing.
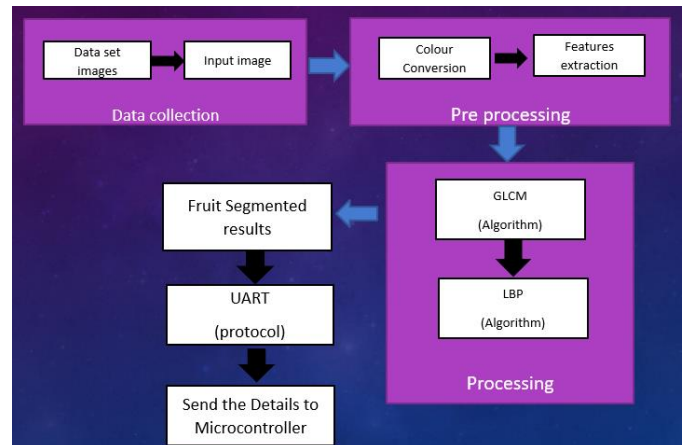

Fig -1: Architecture of the proposed method

We use edge detection method for calculating the edge of the fruit. We can use image segmentation for edge detection process. We will feed the images of fruits for processing the edge and color. By using MATLAB toolbox, Image processing can be done for implementation of the project. We will develop Edge detection for detecting edges of fruits and color detection for detecting color of the fruits. In processing, the image is converted from RGB to grayscale image for further image processing. MATLAB will apply many filtering techniques for image processing.
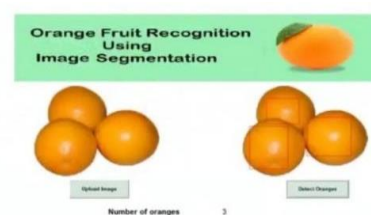

Fig -2: Image Sample

In Image processing, we use the machine learning algorithm for fruit segmentation. The images are varied based on color to identify the ripe and unripe stage. Image processing takes place in the MATLAB where all the algorithms are used to process the image.

3.1 Implementation

3.1.1. Image acquisition

Initial stage of image processing is image acquisition. Digital images of fruits are taken as dataset that are used as input images. The image is stored in RGB and is saved in a folder which can be later accessed for processing of the image. Here we have taken the images of multiple fruits to segment. The fruit images are further processed in MATLAB.

3.1.2. Image Pre-processing

The next stage is a pre-processing stage, the image can be improved by removing unwanted noise and also the contrast of an image. This is very useful for further processing. According to the requirements, the size of the image can be altered. Image Enhancement can be done for processing. As RGB color space is sensitive to conditions such as lighting hence, HSI (Hue, Saturation and Intensity) color space is preferred.

3.1.3. Image Segmentation and Feature Extraction

For acquiring features like shape, color and texture feature Extraction, we have used GLCM feature extraction. This can be done for which to reduce the resources only to the desired large set of data. To implement the GLCM technique, the image is converted from RGB to Binary and then to grayscale and thereafter, features are extracted. GLCM features such as correlation, energy, contrast and homogeneity are used. Diagonal elements in contrast represent the pairs of pixels with no grey-level difference. Correlation calculates how each pixel is correlated to all its neighbours when an whole image is taken into account. Homogeneity measures closeness of the distribution of elements in the GLCM to the GLCM diagonal.

3.1.4. Classification

Classification can be done by acquiring the images which is necessary to compare with the given images. The color features extraction and the contrast are all checked in the classification. As it becomes the ending process of the segregation. From the data extracted and compared from the GLCM extraction, the images can be classified with the LBP that is Local Binary Pattern which are used for comparing the dataset with the features extracted. The GLCM and LBP are combined to give a better performance to classify based on the parameters. The classification of the fruits as ripe or unripe can be given by LBP. Dataset of different types of fruits are taken into account for this classification. Here we have considered multiple fruits for classification. Each Fruit has given identification system for feature extraction. They can easily classify and it has shown precise results of classification.

The MATLAB helps recognize the selected image size with the help of image segmentation process. In our proposed system the image segmentation is based on colour of the selected fruit and edge based segmentation. The segmented imaged recognized by MATLAB will be send to the Microcontroller. The Microcontroller Arduino Uno used here is helped for packing of fruits. Here we have to connect a servo motor with Arduino. When the fruit is recognized a color of the fruit Microcontroller will send it to allotted packing bucket. When the recognized fruits are unripe then it will send to unripe packing bucket. Thus this project helps to recognize the fruits size, colour and helps for packing.
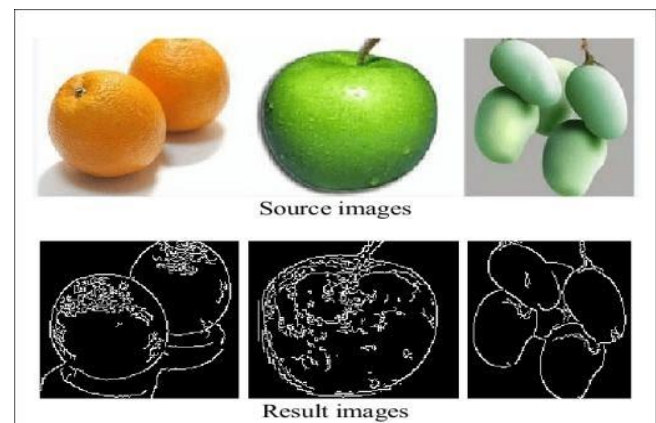

Fig -3: Binary Pattern

The process will result in masking binary images where the fruit surface would be represented as white region and the background would be represented with the black color. We have given a fruit image in this picture but in some other images there may be unwanted objects at the background and any other unwanted things. These unwanted region are removed by eliminating tiny objects in the binary image. Finally we can achieve the required fruit regions by filling binary image regions and holes.

4. Results and Discussion

4.1 Simulation output for Image processing

The processed image is displayed in gray scale pattern and the condition of the fruit is indicated whether ripe or unripe in condition. The results are taken by means of simulation that shows two parameters for segregation. It displays the fruit color to indicate its ripe and unripe condition. By this the fruits can be classified in an easy way. We have used Arduino Uno which is connected to a virtual terminal two servo motors
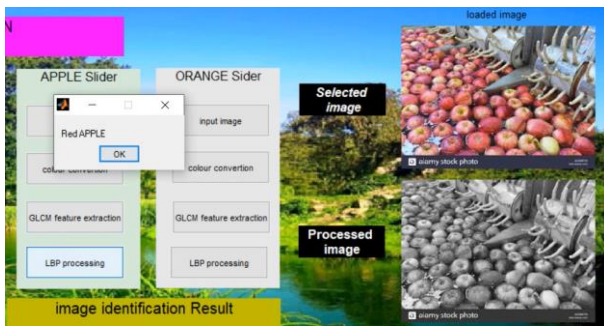
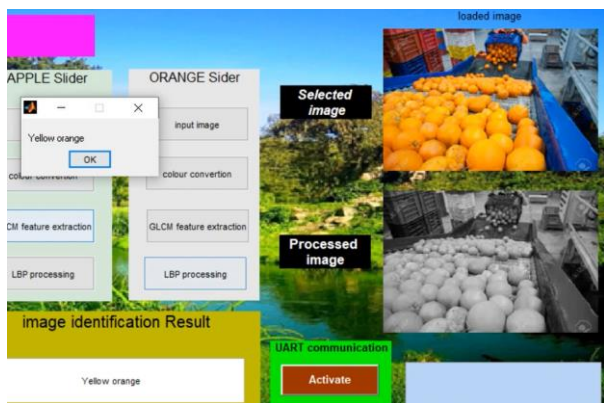**Fig -4:** Image acquisition and processing for apple

Fig -5: Image acquisition and processing for orange

4.3 Future work

For image segmentation, the efficient approach for splitting and merging an image is to employ the global and local characteristics for color intensities of an image. This method subdivides a picture into disjoint regions and a group of arbitrary regions by a quick over segmentation algorithm where parts of objects are produced as region of interest. Then, those regions are iteratively merged until satisfying the homogeneous condition or when further merging is impossible. An important characteristic of graph-based method as stated in its ability to preserve detail in low-variability image regions while ignoring detail in high-variability regions which can be used for multiple detection. Because of noise and high variation in the original image, the obtained image after applying the k-means algorithm may include many small regions that will be merged with nearby regions to speed-up the merge procedure. So we will filter out these small regions using a threshold of region size. In this algorithm, small regions or regions with size smaller than a pre-defined constant will be merged to the biggest nearby region.

5. CONCLUSIONS

The performance of the system has been demonstrated, we used a dataset of fruits or vegetables obtained from a finance place like supermarkets. The dataset contains images of fruits under different lighting conditions with varying numbers of elements. The software and the simulation has been done. Each image of the fruit is taken for segregation and the size is compared for segregation. Moreover it also detect the object based recognition and the microcontroller drives the fruit to their allotted packages. The experiment results prove that this method is effective for fruit segregation. Many Industries and grocery stores will find this product very useful that will help increase their production by a large margin. . It is also time efficient and help the shop to deliver cost-effectively. Hence, from the above results we can say that this way of segregating fruits is best in comparing with the other methods for fruit industries and grocery stores.

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