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DETECTION AND ANALYSIS OF FRUIT QUALITY USING COMPUTER VISION-REVIEW

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Abstract: In the world where automation and artificial intelligence has become part of human beings, it is necessary to use the technology properly and efficiently. Almost all the industries, factories, supermarkets, malls etc. are using the technologies to reduce time, workload, efforts and money. There are different methods and algorithms available that are used to analyze, classify and detect various fruits and other things within a fraction of seconds. Sometimes it is difficult for the naked eye to spot the differences between good and bad fruits along with its qualities all at once. Hence, this work is basically a survey of different types of fruit and fruit quality detection methods, algorithms', technologies etc. that have been used in the past. This works gives the overview of methods and techniques that are used mostly and the difficulties they have come across.

Keywords: **Python, OpenCV, convolution neural network, image processing, support vector machine.**

I INTRODUCTION

In today's technological era it is necessary to have a good fruit quality for good health of human being, and it is possible by grading the fruits according to size, test, or we can say quality of fruit. But for such grading large man power is required. To overcome this, it is necessary to have an automatic fruit grading system for quality fruit production. Today it is somewhat difficult to detect fruit shape, size, colour because of poor process, but it is now easy to detect correct fruit by using vision detecting technology. At present, most existing fruit quality detecting and grading system have the disadvantage of low efficiency, low speed of grading, high cost and complexity. So, it is significant to develop high speed and low-cost fruit size detecting and grading system [1]. One of the important quality features of fruits is its appearance. Appearance not only influences their market value, the preferences and the choice of the consumer, but also their internal quality to a certain extent. Computer vision and image processing techniques have been found increasingly useful in the fruit industry, especially for applications in quality detection. Research in this area indicates the feasibility of using computer vision systems to improve product quality. The use of computer vision for the inspection of fruits has increased during recent years [2]. The automatic fruit classification system is a process of shorting fruit automation to be implemented in the fruit industry of the farm. There are three important processes in the fruit classification system, namely image pre-processing process, feature extraction and pattern matching. Image pre-processing process is the step for processing the image before it extracted in the feature extraction technique in order of getting the information to be used as input to the patter matching step. There are many steps in the image processing step, such as covert of the color image to gray image, then the edge of the image is calculated from the gray image. The edge image is then extracted in order of getting the information of the image. Features are some quantities, which are extracted from pre-processed fruit image and can be used to represent the fruit image signal [3].

II RELATED WORK

This work summarizes review of previous works that have done on fruit detection and related topics. Following are different methods and techniques used.

Support Vector Machine

H. Patel et al. [4] proposed work for detecting orange quality for which they have used apparatus for size, color and texture estimation. Basically, they used two classifiers was used for classifying the object based on feature and ANN for having any possibility of high degree of non-linearity. They explained four features shape, size, color and texture for feature selection. There work suggested that SVM classification result changes when training/testing ratio changes. Zeehan et al. [5] used computer vision and support vector machine (SVM) for classification purpose. The work was carried out in various stages. Firstly, they resized the image to 256*256 resolution then they created feature space by extracting the color, texture, and shape features. Further principal

component analysis (PCA) is applied to reduce the dimensions of the feature space to overcome the curse of dimensionality. Finally, the SVM is used for training the data.

Color Mapping

T Gayathri Devi et al. [6] proposed an image processing system for automatic segmentation and yield prediction of fruits on the basis of color and shape features. Initially the pre-processing was done on input fruit tree images. Then it was converted from RGB to HSV color space to detect the fruit region from its background. Color thresholding was used to mask the desired colours. Gaussian filter was used to remove noise. The contour of the image is taken. Then those images were processed by image processing algorithm. Color and shape-based counting of fruit is presented at the output. The edge detection and combination of a circular fitting algorithm was applied for the automatic segmentation and automatic counting of fruits in the image. Different types of fruits (orange/tangerine, pomegranate, apple, lemon, mango, cherry) used for automatic counting. Open CV Python software was used to perform the required image processing operations. Segmentation of fruits was achieved using OpenCV python with more than 98% accuracy. In addition, proposed system reduced the cost spend on the manual process of counting the fruits and also reduced the false estimation. G. Moradi et al. [7] proposed an automatic algorithm in order to determine fruits skin color defects. Removing of image background and extraction of fruit shape, exactly, at presence of shadow and complex background considered as an important pre-processing stage. In proposed algorithm at first, background in image was omitted by using active counter model (ACM) algorithm. Finally, the image was segmented using modified FCM (MFCM) algorithm. Experimental results on fruit color images shown that proposed algorithm increased accuracy and speed of fruit skin defect detection, considerably. In proposed method, instead of using all image pixels in segmentation algorithm, only pixels of fruit shape were utilized.

HSV

R. P. Salunkhe et al. [8] proposed two methods for classification of mangos based on changes in their visual features. In RGB method, the ripening stage is detected based on the red, green and blue components of the image pixels whereas in HSV method the hue-saturation-value map was analyzed for the detection implemented using MATLAB software. Results are compared with the manual results and found to be 90.4 and 84.2% accurate in case of RGB and HSV respectively. It is also demonstrated that the proposed methods are insensitive to amount of ambient light, provided that the image is taken in the natural light or under the white light.

Fuzzy logic

Y. P. Huang et al. [9] proposed a fuzzy Mask R-CNN model to automatically identify the ripeness levels of cherry tomatoes. First, to annotate the images automatically, a fuzzy c-means model was used to maintain the spatial information of various foreground and background elements of the image. Then, a Hough transform method was applied to locate the specific geometric edge positions of the tomatoes. Each data point of the image space was annotated to a JavaScript Object Notation file. Second, annotated images were trained with Mask R-CNN to identify each tomato precisely. Finally, to prevent preharvest abscission of tomatoes, a hue-saturation-value color model and fuzzy inference rules were used to predict the ripeness of the tomatoes. N. B. Bhagat et al. [10] The proposed system is implemented for potato grading by combining different parameters like shape, size, percentage of deficiency and weight. The proposed system is real-time image processing. Potato image is properly captured by a camera and processed by image processing chamber. The system gives 1-D image parameter detection for grading of potatoes. Shape, size, percentage of deficiency and weight are calculated. Knowledge base fuzzy rules are designed. By using computer vision and fuzzy logic better results are achieved.

Neural Network

P. Constante et al. [11] applied artificial vision techniques for detection of features for strawberries used in the food industry. For this purpose, a computer vision system based in artificial neural networks is used, organized as a deep architecture and trained with noise compensated learning. This combination originates a strong network - object relations which makes possible the recognition of complex strawberry features under changing conditions of lightning, size and orientation. The programming uses OpenCV libraries and fruits databases captured with a webcam. The images used to train the Artificial Neural Network are defined with canny edge detection and a moving region of interest (ROI). After training, the network recognizes important features such as shape, color and anomalies. R. K. Megalingam et al. [12] paper presents the novel idea for detecting food spoilage using image classification with machine learning algorithms and artificial intelligence technology. Food spoilage is detected by using artificial intelligence, deep convolutional neural networks, and computer vision and machine learning algorithms like k clusters algorithm for color classifications in images and its HSV values for spoilage detection. This project was done using the jupyter notebook platform through anaconda prompt. In this project, photos of food or fruits will be taken which have to be tested and then it will be processed through computer which will then perform image classification and machine learning algorithms for getting the colors in the image and spoilage is detected by HSV (Hue Saturation Value) values and percentages of each color which we have got by using the k cluster algorithms in Jupyter notebook. L. Wu, H. Zhang et al. [13] this paper proposes a method of fruit automatic recognition and classification based on convolutional neural network. First, they had obtained two color fruit image data set (public data set and self-made data set). The public data sets were composed of fruit images with simple background, while the fruit images in the self-made data set are taken in a complex environment. Then, on the basis of convolutional neural network, conducted several research experiments through parameter adjustment, and achieved the highest average classification accuracy of 99.8% on the public data set. In the self-made data set, the classification accuracy is 90.2%. Finally improved the classification accuracy of the self-made data set from the original 90.2% to 98.9% by adopting appropriate data enhancement techniques.

V. Kukreja and P. Dhiman [14] This study aims to use the dense CNN algorithm to detect and provide an effective method for detecting the apparent defects of citrus fruit. Citrus fruit images are collected and put in two classes of good and damaged ones, to recognize and categorize the image dataset. Firstly, a dense CNN model was used without doing preprocessing and data augmentation on 150 images and achieved an accuracy of 67 percent but the proposed model has used data augmentation and pre-processing to enhance the CNN performance and have used 1200 images. Further, the proposed model is compared with the dense model where data augmentation and pre-processing techniques have not been used. The overall accuracy of the proposed model is 89.1%. The results show that techniques of data augmentation and preprocessing have delivered promising insights to estimate citrus fruits. M. Nie et al. [15] an apple classification method based on BP neural network is proposed in this paper. The image of the Red Fuji apple is detected during the transmission process, and machine vision technology is used for classification research. Firstly, through morphological operations and hole filling, and median filtering to remove noise, the target area of the fruit is extracted. Then, the binary image is obtained by Canny algorithm. The apple fruit shape, fruit diameter, color and defect characteristics are respectively extracted. Finally, the genetic algorithm is used to optimize the BP neural network, establish and train the network structure to determine the type of test sample. The experimental results show that the BP neural network optimized by genetic algorithm is used in the classification of Red Fuji apple, and the accuracy rate is 91.67%. In this paper, features such as color, fruit shape, fruit diameter and surface defects are extracted. The external quality characteristics of the apple's color, fruit shape, fruit diameter, and defects are extracted separately. Q. Liang et al. [16] In this paper, an advanced target detection framework, single shot multi-box detector (SSD), is used to detect apples in the orchard. The environment of the apple orchard is complex, and there is often occlusion between fruits. So, it is a difficult task to identify apple. SSD algorithm uses Convolution Neural Network to extract the apple characteristics of orchard automatically, this method has a higher recognition accuracy than the traditional artificial feature recognition method, which meets the real-time requirements. In the SSD network, the convolution layer and the full connection layer are converted into the complete convolution layer, which improves the speed of fruit detection. A. Awate et al. [17] In the proposed work, OpenCV library is applied for implementation. K-means clustering method is applied for image segmentation, the images are catalogue and mapped to their respective disease categories on basis of four feature vectors color, morphology, texture and structure of hole on the fruit. The system uses two image databases, one for implementation of query images and the other for training of already stored disease images. Artificial Neural Network (ANN) concept is used for pattern matching and classification of diseases.

CONCLUSION

In this paper, we can say that each algorithm can have advantages or disadvantages over one another. Some have more accuracy but are time taking, similarly some are fast but lacks accuracy. Then there are some that are accurate and fast. From analysis we can say that for fruit detection extracted features of fruits are important and according to our requirement we can use algorithm, techniques or any other methods.

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