Segmentation and Classification of Fruit Images Independent of Image Orientation using Height Width Vectors

Akshitha Raj R, Gopika M, Apoorva P, Akshay S

Abstract*: *Detecting fruits automatically through image processing is a bewildering job because of certain properties of several types of fruits. For each image in the database preprocessing removes background and separates the foreground layer.The images are segmented using image threshold method. The classification is done by using a classifier named KNN with the desirable aim of exact and fast classification of fruit.We have considered 170 images examining various cases like single fruit and multiple fruits of same type, different orientation of same type,cut fruit and full fruit images of same type ,different colored fruit images of same type, multiple fruits of different types.. Our system successfully recognizes fruit images with 97.6% accuracy and provides an F- measure of 88%.

Index Terms*: *Image Orientation, Multiple fruits.

I. INTRODUCTION

Image processing made a tremendous association while examining the crofting performance. To get the cost of particular fruit or vegetable bought by the customers, these kind of classification can be very useful for spontaneously identifying the type of fruits. Fruit markets have more duty to give out different types of fruits. Fruit classification has an advantage in market because of different fruits types that are spread across many shops.Time consumption and dividing fruits repeatedly is a very difficult task to do within less number of span. So there should always be a classification system which makes division process easier. New ideas like this will decrement time consumption.

Here in this project, the fruit image is acquired and it is processed to extract the feature of the fruits and classified through KNN. This system is to automatically recognize and classify the fruit image. As we can see there are a lot of fruit identifying system are developed but still few systems are not robust or effective in identifying and classifying the fruits in given datasets.Here, the aim is to divide various kinds of fruit images correctly and effectively by giving importance to orientation of fruits, colored fruits, cut fruit and full fruit images. Hence our system will be helpful in identifying fruits images.

Revised Manuscript Received on July 10, 2019.

Akshitha Raj R, Department of Computer Science, Amrita School of Arts and Sciences, Amrita VishwaVidyapeetham, Mysuru, India.

Gopika M, Department of Computer Science, Amrita School of Arts and Sciences, Amrita VishwaVidyapeetham, Mysuru, India.

Apoorva P, Department of Computer Science, Amrita School of Arts and Sciences, Amrita VishwaVidyapeetham, Mysuru, India.

Akshay S, Department of Computer Science, Amrita School of Arts and Sciences, Amrita VishwaVidyapeetham, Mysuru, India.

II. LITERATURE SURVEY

S.Arivazhagan et.al [1] says that they have classified fruits based on only two features that is, color and texture. Color extraction is done through converting RGB [red, green and blue] into HSV [Hue, Saturation, Value] in order to separate the color information rather than modifying the outcome of the image. The texture extraction is done by GLCM (Gray Level Co-occurrence Matrix) and also they have used Minimum Distance Classifier in which they have found minimum distance between the unknown input data by comparing it with the already existing datasets and classify images of fruits on this basis. In total, they have considered 2633 images of 15 various fruits like plum, kiwi, orange and apple. They have considered only two features (Color and Texture) and hence, in future work other features like shape and size can be considered for increasing productivity and correctness of this system.

Woo Chaw Seng et.al [2] says that they have classified fruits based on color, texture and shape. For enhancing closeness rate compared to the previous system they have tried to get the same values for three features namely color, shape and textures. KNN [K-Nearest Neighbors] algorithm has been made use for identifying image with the trained datasets. The identification is made much easier by displaying the name of the fruit as well as providing the explanation of that particular image. Totally, fifty images were acquired in which thirty six were utilized for training and remaining fourteen fruit images were made use for testing. The accuracy rate is 90%. They have considered lemon, melon, red apple, green apple, banana, strawberry for classification purpose. To increase the performance and adjustability, the system must be in such a way that it will be able to classify more number of different kinds of fruits in future.

Yudong Zhang and Lenanwu [3] have done comparison between the various SVM [Support Vector Machine] namely Winner-Takes-All, Max-Wins-Voting and Directed Acrylic Graph SVMs and found the method which provides better precision. Then by utilizing this method, they have classified fruits. According to this work they have found out that Max-Wins-Voting gives more precision when compared with other methods and hence, they have used MWV SVM to classify fruits of 18 various classes. Altogether, they have considered 1653 images.

In that, 79 features are obtained. In order to decrease the size of the datasets a technique named PCA [Principle Component Analysis] was used which solves the retrieval time. Successfully, this system provides the precision of 88.2%. In future works, it can be enhanced by considering dried, sliced, tinned and canned fruits and also extra attributes can also be considered.

PragatiNinawe et.al [4] says that, in order to make the system flexible and efficient, they have considered four features namely color, shape, size and texture in a way that it can provide same values for each attributes of the fruit images. Color features are extracted using RGB color space and texture features are obtained by GLCM. The area and perimeter of each input image was calculated in order to get the shape value. The classification is done through K-Nearest Neighbor algorithm which finds the lowest distance by comparing the unknown input image and already analyzed images. Overall, Thirty six input images were acquired and are divided into training and testing sets. The system can be used for providing knowledge for children and can be used for calculating amount in stores which is an advantage of this proposed system. The precision of 95% was obtained. Incrementing the amount of fruits can pave a way for enlarging the precision of the system.

RuaaAdeebAbdulmunem Al-falluji [5] has proposed a system which basically examines color, shape and texture of each fruit image. Two types of classifiers namely K-Nearest Neighbor and Support Vector Machine are pre-owned for identifying and dividing input images then finally, classifier that provides more correctness was found. GLCM and RGB has been used for the purpose of color and texture feature extraction. KNN classifier classified the image by comparing the trained datasets with test datasets and according to the k value, the input images were classified. SVM classifies the input images by making two classes in order to solve the trouble while sorting the images. The proposed system had tried to bring out same values for all the attributes and it has increased the effectiveness and precision of 100%.

Tzuyang Yu [6] have introduced a paper which provides more information about MATLAB as well Image Processing. Image processing converts the input to digitized image by performing certain operations on it. The paper provides information that starts from basic MATLAB definition to types of operations. The description about the keywords that are used to perform the functions such as open, close, expand, read, write, show, modify and cut is explained in this paper so that the processing, analysis, identification and classification is made much easier using MATLAB.

Y. Song et.al [7] says that they have concentrated more on placing and calculating the pepper fruits. A method named Bags-Of-Model was used to get the single input image of fruits. Color features were obtained by the RGB space. A number of challenges like having more plants in a single picture, expansion of plants and blockage had to be solved in order to make the system more flexible and accurate. Few input images were fully blocked because of the presence of cotyledon. The counting of each fruit is done to check whether same input image has been used in it. They have made use of two classifiers. One is Naive Bayes Classifier in order to find the points present in the image and another one is Support Vector Machine which is very helpful in classifying the high dimensional datasets and this classifier has classified the input images into two different classes in which one class consists of fruits and second class consists of non fruit images. 74.2% of accuracy has been obtained in this proposed system.

RajivkumarMente et.al [8] has given importance to the segmentation process of the fruit images first. Edge and color partition processes were used in order to get the edge and color information of each input images. Edge based detection method helps to find all points present which is useful in identifying the images. 2600 various types of fruits have been used in this system. Color information is extracted by computing l*a*b color and finally recognizing fruit images is made possible through K- means clustering. They have considered only color and edge features to recognize the image. Hence, for attaining more accuracy and efficiency texture features can also be added in the future works.

Naskar S.et.al [9] has introduced a system for identifying fruits in which multiple attributes like color, shape and texture are considered. They have used ANN [Artificial Neural Network]technique in which they have utilized log Gabor filter to recognize the texture .Log Gabor filter is basically an advanced version of Gabor filter. The mean hue value is counted in order to identify the color. Later by calculating perimeter with are pixel shape identification is done. According to this system they have considered totally 150 dataset in which 6 types of fruit with 3 different features are considered that is 6X150 and 3X150.It achieves the accuracy rate more than 90%.The main drawback of this system is that they have considered the fruit images which contain single fruit with white background. Apart from white background this system fails to identify the fruit. Hence images with multiple fruits with different background can be considered while improving the present work for the enhancement of correctness.

According to BhanuPratap et.al [10] image processing method is developing every day in almost all fields and also in agriculture. So they have proposed a method to compare the different features and find out which gives more accuracy level for classification of fruits. They have considered area, major axis, perimeter and also minor axis to calculate shape. This is done by concentrating on segmented image from background using edge based algorithm. To calculate color they have made use of color spaces like HIS, HSV. Coming to texture features they have used GLCM method. All these al done through ANN which consists of 3 layers such as input, hidden and output. According their system they have found out that color and texture feature together gives the accuracy level of 96% compared to shape.

The existing system mainly concentrates on differentiating various kinds of fruits that grow only in south Indian region. They have made use of digitized input images and extracted the foreground of the input image by applying pre-processing technique for fast identification and classification of data. RGB component was used for extracting the color features. The fruit image is transformed to black and white form which

represents the value of pixel with small quantity of luminosity which contains only brightness details. Otsu's method was used for the purpose of changing the digitized image to a grayscale image and classification is done using classifiers named decision table and Naive Bayes method. Features like color, shape and Fourier features were considered for identifying the fruit images. Naive Bayes classifier helps to differentiate the input images using Bayes theorem by assuming the target output between attributes.

Overall 140 input images have been made used for the experimental purpose and are divided into preparation set and evaluation set. The main advantage is that the extraction of Fourier feature for fast accuracy. They have only considered fruit images that have undergone technique like pre-processing and feature extraction and are classified using Naïve Bayes classifier even though it provides 88.08% accuracy they are still not considered to be robust or efficient because they have considered only south Indian fruits [12]. Hence we have proposed a system that is helpful for recognizing fruits with any angle [orientation] which provides more accuracy compared to other proposed system.

III. PROPOSED SYSTEM

According to the extensive survey carried out, many observers presented dissimilar mechanisms for proper examination as well as classification of fruits. But still, it is not considered to be robust because, existing systems doesn't concentrate much on orientation and group of fruit images for classification. Hence, we have come up with a unique and efficient fruit recognition system using KNN algorithm in which we have considered 170 datasets that contains fruit images with different orientation and group of fruit images.

In our proposed system, we have made use of KNN classifier in which first we input the fruit image and then remove the background and concentrate more on foreground image in order to recognize the object of that particular image. After this preprocessing step, each image is segmented pixel by pixel for the extortion of attributes like color, texture, shape, size. The comparison between features of unknown image and trained datasets is done. After that, K value is obtained and finally, it will display the fruit name on the original image.

IV. ALGORITHM

Step 1: Image acquisition:

Image acquisition basically refers to collecting images. Here in our system we have collected 170 fruit images of 4 different fruits in different angles from internet. Images also contain group of fruits. We have considered four fruits apple, banana, orange, grape.

Step 2: Input image

Images collected from various sources of internet is provided to our system using GUI from the specific location which can be of any format. For example, png, jpg, jpeg and tiff.

Step 3: Threshold

It's a form of partitioning the input image into forepart and backdrop for identifying the holes and fill them using 'imclose' function and then perform 'imfill' to fill extra holes.

Step 4: HSV

To differentiate the brightness of the image from color data, we are converting RGB to HSV color space. Here, this conversion model helps to describe the color exactly similar to how individuals see.

Step 5: Connected component threshold image

The fruit image is viewed by giving importance to each constituents to get the elements related to it.. It is the binary form with different measures of connectivity. Here, white part considered to be the object and black part in the image indicates false. After the completion of scanning, the equally labelled pairs are sorted into their respective classes and a unique label is assigned to it.

Step 6: Individual fruit that was extracted

Extraction of individual fruit is done by measuring the attributes such as area, perimeter, bounding box, eccentricity, centroid and filled image. This will be stored in an array called 'Stats' that contains a structure for all the input image. After measuring the properties, crop out the sub image and sent it to KNN and feature extraction.

Step 7: Segmented out RGB with white background

After extracting the individual fruit from the image, the threshold of unnecessary parts in the RGB is done and is set equal to white.

Step 8:Segmented out RGB

When threshold of unnecessary parts of RGB is done then each channel of RGB is separated.

Step 9: display the name

KNN algorithm is the simplest and easiest algorithm where an image is classifies into two classes. In our system name of the fruit on the original image is displayed. In KNN positive and negative values are taken. Positive value if the feature is matched and negative value if it doesn't match. Altogether the total number of positive and negative values are taken in count and finally the fruit is classified.

V. RESULTS

170 fruit images with different orientation were collected from internet in which 102 images were used for training purpose and remaining 68 were utilized for testing purpose.

VI. CONCLUSION

The paper is emphasized more on image processing in the field of fruit recognition. Attributes like color, texture, shape and size are analyzed for the purpose of identifying input images. The project mainly concentrates on recognizing the fruit Images and display the name according to its content wherein which it can be helpful for the society.

Table I representing the output for various fruits.

Input image	*Threshold image*	*HSV image*	*Connect component threshold image*	*Individual fruit that was extracted*	*Segmented out RGB with white background*	*Segmented out RGB*	*Fruit name displayed*	*Name*
								*Apple*
								*Banana*
								*Orange*
								*Grape*
								*Banana*
								Banana
								Grape
								Orange
								Orange
								Apple
								Apple

Table II Representing output for different input cases

Case1									*Grape*
									*Orange*
Case 2									*Banana*
									*Banana*
Case 3									*Orange*
									Orange
Case4									*Orange*
									Orange
Case 5									*Banana*
									Banana
Case 6									*Apple, grape, banana ,orange*
									Apple, grape, banana ,orange

The system that we have proposed successfully detects the fruits with the cases examined such as single fruit and multiple fruits of same type, different orientation of same type, cut fruit and full fruit of same type, combination of cut fruit and full fruit of same type, different color fruit images of same type and multiple fruits of different types. By evaluating all these, our system successfully identifies fruits up to 97.6% accuracy

Case1: Single fruit and multiple fruits of same type.
Case 2: Different orientation of same type.
Case 3: Cut fruit and full fruit of same type.
Case 4: Combination of cut fruit and full fruit of same type.
Case 5: Different color fruit images of same type.
Case 6: Multiple fruits of different types.

VII. FUTURE WORK

Divergent color spaces are used for taking out the color feature yet, many other color space can be used for refining the performance. In future works, more number of fruit images can be comprised so that the system can be region-bias fee. It can be also worked on grouping and findingfault present in more number of fruits.

REFERENCES

1. Arivazhagan, S., Shebiah, R. N., Nidhyanandhan, S. S., &Ganesan, L. (2010). Fruit recognition using color and texture features. Journal of Emerging Trends in Computing and Information Sciences, 1(2), 90-94.
2. Seng, W. C., &Mirisaee, S. H. (2009, August). A new method for fruits recognition system. In Electrical Engineering and Informatics, 2009. ICEEI'09. International Conference on (Vol. 1, pp. 130-134). IEEE.
3. Zhang, Y., & Wu, L. (2012). Classification of fruits using computer vision and a multiclass support vector machine. sensors, 12(9), 12489-12505.
4. Ninawe, P., &Pandey, S. (2014). A completion on fruit recognition system using k-nearest neighbors algorithm. International Journal of Advanced Research in Computer Engineering & Technology, 3(7).
5. Al-falluji, R. A. A. (2016). Color, shape and texture based fruit recognition system. Int. J. Adv. Res. Comput. Eng. Technol, 5(7), 2108-2112.
6. Yu, T. (2014). Image Processing using Matlab.
7. Arefi, A. M. Motlagh, K. Mollazade and R. F. Teimourlou, Recognition and localization of ripen tomato based on machine vision, Asian J. Crop Sci. 5 (2011), 1144–1149.
8. B. S. Bennedsen and D. L. Peterson, Performance of a system for apple surface defect identification in near-infrared images, Biosyst. Eng. 90 (2005), 419–431.
9. Naskar, S., & Bhattacharya, T. (2015). A fruit recognition technique using multiple features and artificial neural network. International Journal of Computer Applications, 116(20).
10. Pratap, B., Agarwal, N., Joshi, S., & Gupta, S. (2014). Development of ANN based efficient fruit recognition technique. Global Journal of Computer Science and Technology.
11. Sahana, M., & Anita, H. B. (2017). Automatic Classification of South Indian Regional Fruits using Image Processing. Indian Journal of Science and Technology, 10(13).
12. Thendral, R., Suhasini, A., &Senthil, N. (2014, April). A comparative analysis of edge and color based segmentation for orange fruit recognition. In Communications and Signal Processing (ICCSP), 2014 International Conference on (pp. 463-466). IEEE.
13. Semary, N. A., Tharwat, A., Elhariri, E., &Hassanien, A. E. (2015). Fruit-based tomato grading system using features fusion and support vector machine. In Intelligent Systems' 2014 (pp. 401-410). Springer, Cham.
14. Savakar, D. (2012). Identification and classification of bulk fruits images using artificial neural networks. International Journal of Engineering and Innovative Technology (IJEIT), 1(3), 35-40.
15. Holalad, H., Warrier, P., &Sabarad, A. (2012). An FPGA based efficient fruit recognition system using minimum distance classifier. Journal of Information Engineering and Applications, 2(6).
16. AkshayS,"Single Moving Object Detection and Tracking UsingHornSchunck Optical Flow Method", International Journal of AppliedEngineering Research, Vol:10, No:11, 2015.
17. Akshay S, ApoorvaP,"Segmentation and classification of FMM compressed retinal images using watershed and Canny Segmentation and Support Vector Machine",2017 International Conference on Communicationand Signal Processing(ICCSP), 2018.

VIII. AUTHORS PROFILE

Pooja U B, Pursuing BCA in Amrita School of Arts and Sciences, Mysuru, Amrita VishwaVidyapeetam.

Shreya R Joshi, Pursuing BCA in Amrita School of Arts and Sciences, Mysuru, Amrita VishwaVidyapeetam

Apoorva P received M.Sc. degree in Computer Science from University of Mysore in 2011. From 2011 she is working as an Assistant Professor in Department of Computer Science, Amrita Vishwa Vidyapeetham, Mysore Campus. Her areas of interests are Pattern Recognition, Digital Signal Processing, Computer networks and network security.

AKSHAY S received M.S. degree in Computer Science from University of Mysore in 2012 and he is currently Pursuing his PhD. From 2012 he is working as an Assistant Professor in Department of Computer Science, Amrita VishwaVidyapeetham, Mysore Campus. His areas of interests are Pattern recognition, Digital Signal Processing, Image Processing, Algorithms and Data structures.