Available online at www.elixirpublishers.com (Elixir International Journal)

Computer Engineering

Elixir Comp. Engg. 96 (2016) 41771-41773

ISSN: 2229-712X

Automated Fruit Grading System using Image Mining

MadhuBala Myneni[1], Seetha Maddala[2] and Akhil Dandamudi[3]
[1]Department of Information Technology, VBIT, Hyderabad, India.
[2]Department of Computer Science and Engineering,GNITS, Hyderabad, India.
[3]ResearchAssistance, Computer Science and Engineering, NU, Neemrana, India.

ARTICLE INFO

Article history:
Received: 1 July 2015;
Received in revised form:
17 July 2016;
Accepted: 23 July 2016;

Keywords
Fruit grading,
Image processing,
Image Mining,
Machine learning,
Feature Extraction.

ABSTRACT
Automated Fruit Grading System is challenging task in ICT in agriculture. This paper presents a new fruit grading system using artificial neural networks (ANN). The classification systems are based on features extracted from fruits obtained from image processing feature extraction methods. Two different types of classifiers as multi-layer perceptions (MLP) with back propagation and radial basis function (RBF) networks. The objective of this study are to define a optimistic set of external quality features of fruits from the primitive features like color, texture and shape of fruits and to examine the effectiveness of the model. In this experiment, the performance of the system achieved 87.5% and 91.1% respectively for MLP with back propagation and RBF.

Introduction

The information and Communication Technology (ICT) is playing a major role in the society to uplift the standards of rural sector with rest of the world. Few of the ICT applications in Agriculture are crop management, fruit quality inspection, sorting and grading, identification of damaged fruits etc. All these applications can implement using image processing Techniques, computer vision and machine learning algorithms. Image Mining Techniques are used to extract the implicit knowledge of the image data. Multi label problems in image classification are discussed in [1].To automate the manual process the machine learning algorithms are used to develop the model. To improve the efficiency of automated system various classification algorithms of data mining are used. The single dataset mango fruit grading by using fuzzy Image analysis has implemented [9]. The comparative analysis on machine learning algorithms has done on selected hybrid features of images have given in [4].

Identify the Headings

Fruit Grading

In present scenario the formers in fruit gardens and fruit markets are following conventional approaches for quality inspection, sorting and decision on grading the agriculture products. This manual approach is time consuming, more laborious task, less efficient, monotonous and inconsistent. Using Image Mining, Image Processing, computer vision and machine learning algorithms this problem can be automated.

Fruit Grading System includes the identification of fruit, quality of fruit, fruit sorting and fruit grading. The Automated strawberry grading system has implemented in based on image processing in [10].

Computer vision based date fruit grading system has designed and implemented in [11].Computer vision systems provide hygienic, economic, consistent assessment. Few difficulties still exist in this area due to relativity, implementation of computer vision technology and processing speeds still slowly to meet modern manufacturing requirements in all agriculture sectors.

A model for grading is proposed in order to overcome drawback of current grading systems which are,

- Current grading systems are not accurate very few parameters like size and color are considered for grading systems
- Still all are under research laboratories
- Most of research and development of automated agriculture product grading has been done outside India
- The sorting of fruits is still performed manually in India
- No grading system is yet available for fruits like chikoo, sugarcane and grapes etc that are exported to other countries from India.

Fruit Quality

Quality is based on a multiple measures like flavor such as sweetness, acidity content in the product, appearance on bases color, size, weight, shape and texture. The recent grading and sorting systems are based on color and size. Quality analysis has done based on color of the fruit has given in [1].

Feature Identification

Identification of the fruit can measured using image processing color, shape and texture features. The combination of three parameters is used to identify the fruit. The identified features are used to build the sorting model. The fruit grading model can be implanted using image classification algorithms. The computer vision applications in image mining have used different algorithms in multi class classification problems. Comparative analysis on feature integration for image sorting has implemented in [6].

Proposed Fruit Grading System

In the proposed Fruit grading system, the combination of all feature of the fruit image are measured and used for image identification in all perspectives of fruits viz, size, color, weight, appearance etc.

Methodology

The methodology of the proposed system has defined in number of phases. The system needs mechanical set up for moving the image from fruit chamber to end packing system in consistent manner.

Tele:
E-mail address: baladandamudi@gmail.com

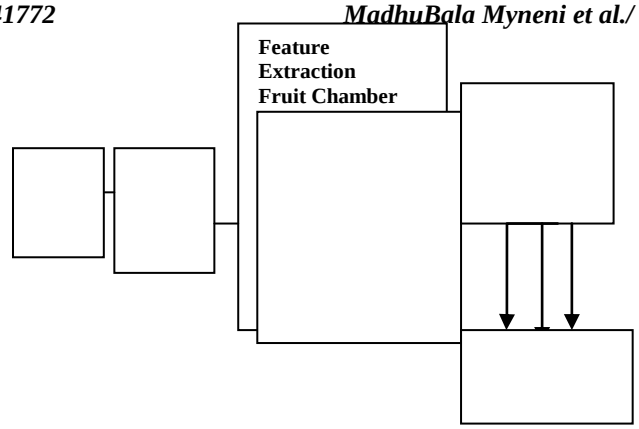

Figure 1: Block Diagram of Fruit Grading System

Figure 1 shows the proposed automated fruit grading system. The process of fruit grading includes the following steps:

Step 1) Fruits are collected in a chamber.

Step 2) The images are captured for each fruit in three directions by using more than one camera. Now the image of each fruit in the chamber is available in monotonous direction.

Step 3) Using feature extraction techniques the identified RGB color mean values, RGB color dominance for quality, histogram threshold value, shape based diameter and perimeter value for size, texture statistical moments for identification of disease or damage fruit are measured using image processing Techniques. These features are measured on each captured image.

Step 4) The identified feature set is used to build the Grading model using machine learning classification algorithm as multi-layer perceptions (MLP) with back propagation and radial basis function (RBF) networks are used.

Based on the decision drawn after the process on the above steps, the fruit is classified into different categories like G1 as BIG, G2 as MEDIUM, G3 as SMALL, ripe/unripe or defectives. Finally automatic packaging system packs the fruit according to the categories provided.

Feature Extraction

Color Features

RGB color mean values and histogram based threshold for dominant color are used.HSV color model is used to find the quality of the fruit based on saturation values.

Texture Features

Histogram based statistical moments like Mean, Contrast, Homogeneity, Energy, Variance,

Correlation, Entropy is used to decide the fruit quality as ripe, raw or damage.

Shape Features

Morphological methods are used to define the shape features as area, perimeter, Minor length and Major length are used to define the grade.

Arificial Neural Network Classifier

Multi Layer Perception (MLP) learning weights by Back propagation algorithm has two phases. First, train the input pattern presented to the input layer. The network propagates the input pattern from layer to layer until output pattern is generated by the output layer. The error is calculated based on the desired output and actual output and then propagated backward through the network from the output layer to the input layer. The weights are modified as the error is propagated. The back propagation training algorithm is an iterative gradient designed to minimize the mean square error between the actual output of multilayer feed forward perception and the desired output.

The RBF neural network has an important phase as training of network. Training RBF neural network consists of two different steps like finding the center and width values for the hidden layer and the weights of the output layer.

The network is trained using a two-phase approach: in the first phase, unsupervised learning occurs, whose main objective is to optimize the value of center and width. In the second phase, the output layer is trained in a supervised mode using the least mean-square (LMS) algorithm to adjust the weight.

The following are the three steps of the hybrid learning method for an RBF neural network:

1) Find the cluster centers of the radial basis function; use the k-means clustering algorithm.

2) Find the width of the radial basis function.

3) Find the weight; use LMS.

Calculation of Centers

To calculate the centers of the radial basis function (RBF) uses the k-means clustering algorithm. K-means clustering algorithm is used to find a set of clustered centers and a partition of training data into subclasses. The center of each cluster is initialized to a randomly chosen input data. Then each training data is assigned to the cluster that is nearest to center. After training data have been assigned to a new cluster unit, the new center of a cluster represents the average of the training data associated with that cluster unit. After all the new centers have been calculated, the process is repeated until it converges.

Width Calculation

After the RBF centers have been found, the width is calculated. The width represents a measure of the range of data associated with each node. Calculation of the width is usually done using the P-nearest neighbor algorithm. Any number P is chosen and for each center, the P nearest centers is found. The root-mean squared distance between the current cluster and its P nearest neighbors is calculated, and this is the value chosen.

Learning in the outer layer is performed after calculation of the centers and widths of the RBF in the hidden layer has been completed. The objective is to minimize the error between the observed output and desired one. It is commonly trained using the LMS algorithm.

Results and Discussions

Based on these rules the grading model has trained with six data sets. The model tested with test data of size 50 in each category.

Table1 has given the accuracy of model while testing with teat data considering color& size features, color, size and shape features of fruits. The highest accuracy of 98% achieved in fuzzy system.

Table 1. Accuracy with different datasets

Data set	*Parameters considered*	*Accuracy (%)*
Mango	Size and Color	80
	Size,Color and Shape	88.2
Banana	Size and Color	88
	Size,Color and Shape	92
Tomoto	Size and Color	88
	Size,Color and Shape	95
Straw berry	Size , Color and Shape	88.8
Orange	Size and Color	86
	Size,Color and Shape	90
Lemon	Size and Color	94
	Size,Color and Shape	96

Conclusion and Future Direction

Automated fruit grading is speedy, inexpensive, safe and accurate. Proposed model is generalized and it is considering far more feature parameters than available grading systems. Currently, research in the automated fruit grading has been conducted by experimenting them in laboratories only. No implemented model is available. So a properly focused research and a detailed review on this research area need to be carried out.

References

1. Guangming Xiong, "Rapid Color Grading for Fruit Quality Evaluation Using Direct Color Mapping," IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING, vol. 8, no. 2, pp. 292-302,November 2011.
2. I.S. Jacobs and C.P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.
3. J. Clerk Maxwell, "A Treatise on Electricity and Magnetism", 3rd ed., vol. 2. Oxford: Clarendon, pp.68-73, 1892.
4. Madhubala M and Seetha M, "Comparative analysis on scene image classification using selected hybrid features",in IJCA, vol.63,no.2,Feb 2013.
5. Madhubala M and Seetha M, "Feature extraction for image retrieval using image mining techniques",in Research Inventy,vol.1,no.8,pp.18-24,2012.
6. Madhubala M and Seetha M, "Feature integration for image information retrieval using image mining techniques",in IJCET,vol.3,no.3,Dec 2012.
7. Madhubala M and Seetha M, "Hybrid feature Extraction and selection using Bayesian classifier",in AEMDS proceedings in Elsevier science and technology,2013.
8. Mahendran R, Jayashree GC,Alagusundaram K, "Application of Computer Vision Technique on Sorting and Grading of Fruits and Vegetables", Abd El-Salam et al., J Food Process Technol 2011.
9. Tajul Rosli Bin Razak et.al. "Mango Grading By UsingFuzzy Image Analysis," In proceedings of International Conference on Agricultural, Environment and Biological Sciences, Phuket, 2012.
10. Xu Liming and Zhao Yanchao,"Automated strawberry grading system based on image processing," Computers and Electronics in Agriculture, vol. 71, no.Supplement 1, pp. S32-S39, April 2010.
11. Yousef Al Ohali, "Computer vision based date fruit grading system: Design and implementation," Journal of King Saud University - Computer and Information Sciences, vol23, no. 1, pp. 29-39,January 2011.