Volume 3, Issue 11, November 2013 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Fruit Detection with Multiple Features using Fuzzy Logic

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Abstract— Quality needs to be defined firstly in terms of parameters or characteristics, which vary from product to product. In previous years, several types of image analysis techniques are applied to analyze the fruit images for recognition and classification purposes. The proposed method can process, analyze, classify and identify the fruits images, which are selected and sent in to the system based on colour, shape and size and surf features of the fruit. The FCM algorithm is the appropriate and effective classification algorithm to be used in the Fruits Recognition System. The recognition system that has been developed is able to recognize all the test fruit images which are being selected by a user from the fruit selection menu which is based on GUI block in MATLAB on the system.

Keywords - fruit, recognition, computer vision, feature extraction, GUI Block, Image Processing, surf feature.

I INTRODUCTION

Digital image processing analysis and computer visions have exhibited an impressive growth in the past decade in term of theoretical and applications. The fruits recognition system could be applied as an image contents descriptor which is able to describe the low level visual features or contents of the fruit images for the CBIR system. The most popular analysis techniques that have been used for both recognition and classifications of two dimensional (2D) fruit images are colour-based and shape-based analysis methods. However, different fruit images may have similar or identical colour and shape values. Hence, using colour, size and shape features analysis methods are still not robust and effective enough to identify and distinguish fruits images [1].

A. Literature Survey

Some existing systems which are based on fruit recognition and are referred for the proposed topic that analyze fruits using shape-based and colour-based analysis method have been reviewed. The existing systems are: New Method for Fruits Recognition System, Recognition of Fruits in Fruits Salad, and Mango Grading by Using Fuzzy Image Analysis are presented in the following sections. In New method for fruit recognition[1] has analyze, classify and identify the fruits images, which are selected and sent in to the system based on colour, shape and size features of the fruit. The KNN algorithm is the appropriate and effective classification algorithm to be used in the Fruits Recognition System. The proposed method classifies and recognizes fruit images based on obtained feature values by using nearest neighbours classification. Consequently, our system shows the fruit name and a short description to user. The proposed fruit recognition system analysis classifies and identifies fruits successfully good accuracy. In mango grading system [2], mangoes grading by humans in agricultural setting are inefficient, labour intensive and prone to errors. Automated grading system not only speeds up the time of the process but also minimize error. Therefore, there is a need for an efficient mango grading method to be developed. In this study, we proposed and implement methodologies. In Recognition of Fruits in Fruits Salad [3] research paper a methodology for recognition and classification of fruits from image samples of fruit salad. The samples of different fruits like apple, chikku, banana, orange and pineapple are considered. Each sample of fruits are sliced into Pieces and placed on the tray. The RGB colour features extracted from the images from the knowledge base. A K mean classifier is proposed and has the good classification efficiency. An complex level analysis and detection strategy applied to detect the food, and the performance in terms of correct and false detections as well as its sensibility to changes in texture, colour, brightness, contrast, smoothness and other image properties. The performance reported depends on the global strategy chosen and the particular features of each considered application.

B. Main features of proposed Topic

Therefore, a recognition approach for fruit images is proposed, which combines colour-based, shape-based, and size-based methods in order to increase the accuracy of the recognition result with enhancement of surf feature. System recognizes provided 2D query fruit image by extracting features values, including colour, shape and size and computing extracted features values to measure the distance between the computed features values of query image with the stored standard features values of every fruit samples using MATLAB.

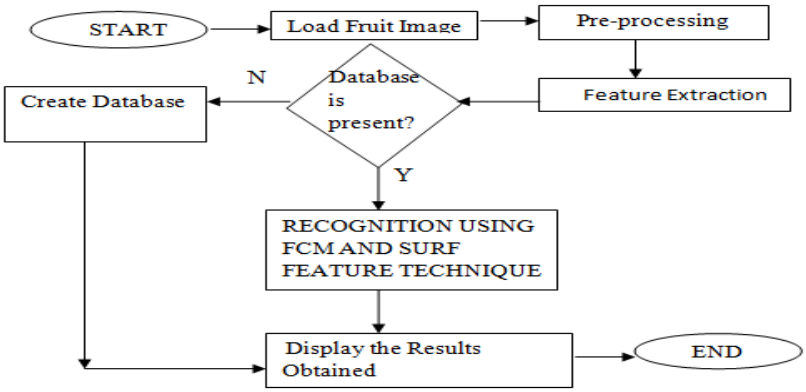

Fig.1 Flow Chart

C. Matlab GUI Block

GUIs (also known as graphical user interfaces or UIs) provide point-and-click control of software applications, eliminating the need to learn a language or type commands in order to run the application. MATLAB apps are self-contained MATLAB programs with GUI front ends that automate a task or calculation. The GUI typically contains controls such as menus, toolbars, buttons, and sliders. Many MATLAB products, such as Curve Fitting Toolbox, Signal Processing Toolbox, and Control System Toolbox, include apps with custom user interfaces. You can also create your own custom apps, including their corresponding UIs, for others to use.

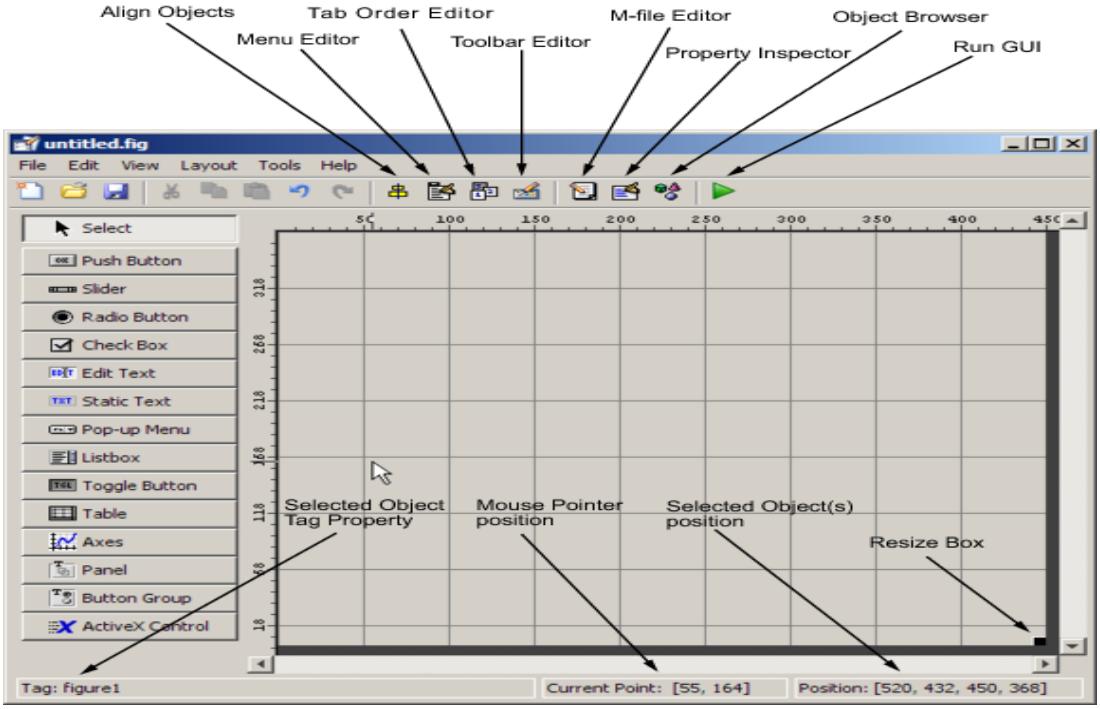

Fig.2 GUI Block Description

D. Feature Extraction

In pattern recognition and in image processing, feature extraction is a special form of reduction. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant (e.g. the same measurement in both feet and meters) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called *feature extraction*. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input.

E. Surf Feature

Fuzzy logic is a form of many-valued logic; it deals with reasoning that is approximate rather than fixed and exact. Compared to traditional binary sets (where variables may take on true or false values) fuzzy logic variables may have a truth value that ranges in degree between 0 and 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false.[1] Furthermore, when linguistic variables are used, these degrees may be managed by specific functions. Irrationality can be described in terms of what is known as

the fuzzjective. Classical logic only permits propositions having a value of truth or falsity. The notion of whether 1+1=2 is absolute, immutable, mathematical truth. However, there exist certain propositions with variable answers, such as asking various people to identify a colour. The notion of truth doesn't fall by the wayside, but rather a means of representing and reasoning over partial knowledge is afforded, by aggregating all possible outcomes into a dimensional spectrum. Both degrees of truth and probabilities range between 0 and 1 and hence may seem similar at first. For example, let a 100 ml glass contain 30 ml of water. Then we may consider two concepts: Empty and Full. The meaning of each of them can be represented by a certain fuzzy set. Then one might define the glass as being 0.7 empty and 0.3 full. Note that the concept of emptiness would be subjective and thus would depend on the observer or designer. Another designer might equally well design a set membership function where the glass would be considered full for all values down to 50 ml. It is essential to realize that fuzzy logic uses truth degrees as a mathematical model of the vagueness phenomenon while probability is a mathematical model of ignorance.

F. Fuzzy C-means Algorithm

The Algorithm Fuzzy c-means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. This method (developed by Dunn in 1973 and improved by Bezdek in 1981) is frequently used in pattern recognition. It is based on minimization of the following objective function:

$$J_m = \sum_{i=1}^{N}\sum_{j=1}^{C} u_{ij}^{m} \left\| x_i - c_j \right\|^2 , \quad 1 \le m < \infty$$

where m is any real number greater than 1, u_{ij} is the degree of membership of x_i in the cluster j, x_i is the ith of d-dimensional measured data, c_j is the d-dimension center of the cluster, and ||*|| is any norm expressing the similarity between any measured data and the center.

Fuzzy partitioning is carried out through an iterative optimization of the objective function shown above, with the update of membership u_{ij} and the cluster centers c_j by:

$$u_{ij} = \frac{1}{\sum_{k=1}^{C}\left(\frac{\left\|x_i - c_j\right\|}{\left\|x_i - c_k\right\|}\right)^{\frac{2}{m-1}}} \qquad c_j = \frac{\sum_{i=1}^{N} u_{ij}^{m} \cdot x_i}{\sum_{i=1}^{N} u_{ij}^{m}}$$

This iteration will stop when $\max_{ij}\left\{\left|u_{ij}^{(k+1)} - u_{ij}^{(k)}\right|\right\} < \varepsilon$, where ε is a termination criterion between 0 and 1, whereas k are the iteration steps. This procedure converges to a local minimum or a saddle point of J_m.

The algorithm is composed of the following steps:

1. *Initialize $U=[u_{ij}]$ matrix, $U^{(0)}$*
2. *At k-step: calculate the centers vectors $C^{(k)}=[c_j]$ with $U^{(k)}$*

$$c_j = \frac{\sum_{i=1}^{N} u_{ij}^{m} \cdot x_i}{\sum_{i=1}^{N} u_{ij}^{m}}$$

3. *Update $U^{(k)}$, $U^{(k+1)}$*

$$u_{ij} = \frac{1}{\sum_{k=1}^{C}\left(\frac{\left\|x_i - c_j\right\|}{\left\|x_i - c_k\right\|}\right)^{\frac{2}{m-1}}}$$

4. *If $\| U^{(k+1)} - U^{(k)} \| < \varepsilon$ then STOP; otherwise return to step 2.*

Fig.3 Algorithm of FCM

II Conclusion

Proposed framework is to have a system for fruit quality determination completely on the basis of shape, colour, size, surf. Several fruit recognition techniques are developed based upon colour and shape attributes. Hence, using colour features and shape features analysis methods are still not robust and effective enough to identify and distinguish fruits images. A new fruit quality determination system has been proposed, which combines four features

analysis methods: colour- based, shape-based and size-based and surf based in order to increase accuracy of recognition in a faster way.

The proposed method can also classifies and recognizes fruit images based on obtained feature values by using FCM. The proposed fruit quality determination system analysis classifies and identifies fruits successfully in a most accurate way. This system also serves as a useful tool in a variety of fields such as education, image retrieval and plantation science. As In[1,2,3] research papers the results are concluded and implementations are required further so that system should be improved by extending its functions to process and recognize more variety of fruit images. Accordingly new proposed framework can have extended features with an advanced way of feature extraction and recognition using fuzzy logic. Some Possible Applications of Fruit Recognition are in educational sector, image retrieval and plantation science. These days, in super markets object recognition is frequently coming in use.

Acknowledgement

While bringing out dissertation to its final form, I came across a number of people whose contributions in various ways helped my field of research and they deserve special thanks. It is a pleasure to convey my gratitude to all of them. First and foremost, I would like to express my deep sense of gratitude and Indebtedness to my Guide Ms. Vibhuti Jaiswal for her invaluable encouragement, suggestions and support from an early stage of this research and providing me extraordinary experiences throughout the work. I specially acknowledge her for Guidance, supervision, and the vital contribution as and when required during this Project. Her involvement with originality has triggered and nourished my intellectual maturity that will help me for a long time to come.

I am highly grateful to my co-guide Mr. Amit goyal for their kind support and Guidance for bringing dissertation to its final form.

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