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Design & Development of Intelligent System for Grading of Jatropha Fruit by Its Feature Value Extraction Using Fuzzy Logics

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Abstract— Fruit sorting and grading is done up to some extent on basis of knowledge, experience or some other technique but the efficiency can be improved by upgrading the sorting and grading process. Jatropha has been widely accepted to produce high quantity and quality feedstock for bio energy. In this study the intelligent system is designed using image processing techniques and fuzzy logics. The implementation is done on MATLAB software. The present work is divided in two sections i.e. Training and testing .The sorting and grading is done on basis of extraction of features of Jatropha fruit. The results obtained are accurate and very promising.

Keywords— RGB, Computer vision, mean value, feature extraction, square root

I. INTRODUCTION

Earlier the fruits were categorised and grading was done on experience & vision based .Now the scenario has been changed in the phase of growing technology. The knowledge-based system has been developed to simulate human cognitive and problem solving process. The real example for the knowledge based is an expert system. The accuracy of fuzzy expert system is better than expert system because fuzzy expert system applied fuzzy logic rather than Boolean values. This system is being implemented with the help of Image processing techniques.

II. METHOD

A Computer vision

Computer vision includes the capturing, processing and analysing images, facilitating the objective and non-destructive assessment of visual quality characteristics in food products. Images are acquired with a physical image sensor and dedicated computing hardware and software are used to analyse the images with the objective of performing a predefined visual task. [9]The technology aims to duplicate the effect of human vision by electronically perceiving and understanding an image.

B Fruit Sorting

Quality itself is defined as the sum of all those attributes which can lead to the production of products acceptable to the consumer when they are combined. The basis of quality assessment is often subjective with attributes such as appearance, smell, texture, and flavour, frequently examined by human inspectors.[7] In older days, human depends upon its vision qualities to differentiate between ripe and unripe fruits. But this method had high rate of errors because of illness, distraction and other factors during working hours. This also may effects the working speed of system. So to decrease this failure rate human started to invent new methods. The computer vision strategies used to do sorting and grading of a fruit rely on three basic features which characterize the object: color, shape and size.[8]

C Feature Extraction

Feature extraction is the process of acquiring higher-level information of meaningful object in an image. The feature extraction process is done using the MATLAB image processing toolbox. The extraction process begins with the conversion of the original image to gray image and then to binary image. [10]

D Color, shape & size

Color and shape are the fundamental character of natural images, and plays an important role in visual perception. The process of color classification involves extraction of useful information concerning the spectral properties of object surfaces and discovering the best match from a set of known descriptions or class models to implement the recognition task shape is one of the most active topics in machine intelligence and pattern analysis since the 1950s which tries to discriminate different patterns of images [8]. Size dependant measurements are the descriptors of shape. These descriptors are formed by proper combinations of size measurement. There are different parameters which can be understood and calculated easily for shape and size estimation. Recently, different features of color, size, shape, and texture are combined together for their applications in the food industry. [1].Normally, by increasing the features used, the performance of the methods proposed can be increased.

III . Proposed Work

The fruit selected for the present work is Jatropha fruit. These types of fruits are produced in winter, or there may be several crops during the year if soil moisture is good and temperatures are sufficiently high. Steps for the present work implementation

Training
Testing

Training: The system is trained initially for testing of Jatropha fruit. Training means when the fruit images will be inputted into the system it will extract the features of that images. Feature extraction is done by using Image processing tools and techniques.

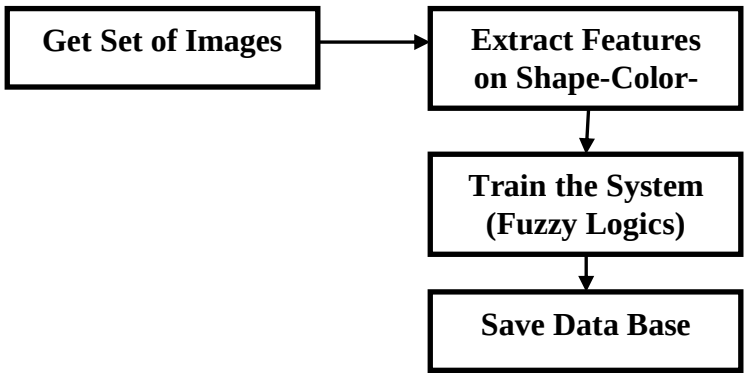


Fig 1: Flow diagram for training

A Steps for the color attribute extraction

1) First of all the inputted image is checked whether it is colored or black and white. If it is colored then only it is processed further else the image is not accepted.
2) Colored image is separated into three different layers (Red layer, green layer and Blue layer).
3) Mean of all three layers is calculated separately.
4) The joint mean value is calculated by the combination of three mean values.

Feature Extraction (shape identification)

Shape of the fruit is calculated with the help of roundness metric formula. For which Area and perimeter is to be calculated.

B Steps for the shape attribute extraction

1) First of all the RGB image is converted to Grays scale image.
2) Then the threshold value of this gray image is calculated.
3) The gray image is then converted to black and white image so that pixel range of the image will be now 0 to
4) The BW image is then traced for the removal of noise. Noise here refers to the missing of pixels in the boundary. That area is notified with bwareaopen command then that area is filled with imclose command.
5) Then the area and perimeter is calculated. By the inbuilt function.
6) At last the roundness metric is calculated with the formula

Roundness metric= 4π area / 〖perimeter〗 ^2

Feature Extraction (size identification)

For calculating the size of the inputted image Height and width is calculated.

C Steps for the size attribute extraction

1) The image is first of all converted to gray scale if it is colored image.
2) Then the edge detection operation is performed with the help of sobel operator.
3) Height is calculated by tracing the image firstly from top to bottom row wise then from bottom to top .The very first pixel with value 1 is taken from top similarly from bottom and the height is obtained. Height is calculated by Euclidean distance.

Height =sqrt (sum ((x (1)-y (1)). ^2))

4) Then the width of the fruit is calculated. The width can be calculated in both the ways max and min, but here in this work max is considered.

D Preparation of Fuzzy system

For the fuzzy system we want three things (Input variable, Output variable and rule sets)

In this the range of Grades is decided. There are three grades selected A, B, C in this work. Basically the values of all four attribute color, shape, size (height and width) decide the grade of the fruit. So In the rule set preparation range for all attributes is decided.

Testing

In case of testing the images are inputted and the grade of each fruit is notified, as per the decision of fuzzy system.

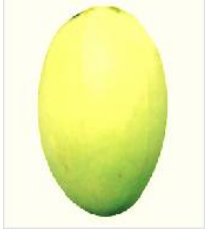
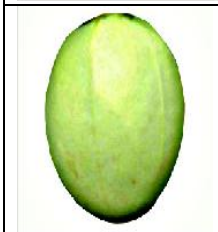
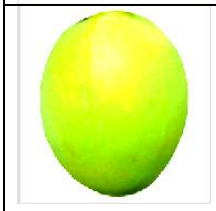
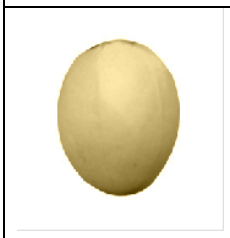
IV. RESULTS

In order to evaluate the performance of the Intelligent system used for sorting of Jatropha fruit, the simulation is done with the help of Image processing tool in MATLAB software. The results of the simulation is showed and discussed here in this chapter. For the display of results GUI is used. First of all the images of Jatropha fruit which are to be sorted are inputted into the system, and features of the fruit are extracted from it. There are three features used for this fruit which are (color, shape, size).Below are the images of 9 samples of Jatropha fruit which are to be tested.

Fig 2: GUI Simulation window

Table- I Result summary of jatropha grading

Sample of Jatropha	Color	shape	Height	Width	Fuzzy result	Grade
	20.875	20.397	23.2	26	2.05	A
	20.995	61.477	22.5	22	3.58	B
	12.72	61.54	22.8	57	7.95	C

	18.74	19.52	22.7	27	5	B
	22.058	69.813	22.8	22	3.61	B
	20.318	63.813	22.8	25	5	B
	19.607	69.813	23.3	20	2.05	A
	20.46	20.309	22.5	25	5	B
	22.579	23.159	17.5	14	4.65	B

V. Conclusion

A fuzzy image analysis method is proposed for the Jatropha grading. There are two parts of this system first is training and other is testing. Under the training part features of jatropha fruit are extracted and then fuzzy set rules are defined. Under the testing section the sorting/grading of jatropha is done as per the fuzzy set rules defined in the training section. The GUI is used for the sorting to make the system more users friendly and the grading is done by using three grades A, B, C.This system will replace the human expert burden for grading of Jatropha and the results obtained show that system is quite stable and accurate.

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