CLASSIFICATION OF FOOD GRAINS USING CLUSTERING ALGORITHMS

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ABSTRACT

Image processing nowadays plays a vital role in automation in several domains like medical science, remote sensing, agriculture, environmental science, special science etc. In this paper, we present a survey of grading the agricultural products using image processing. A model for the automatic grading of food products is suggested by analyzing their quality. Quality is checked and analyzed using the classification and clustering algorithms. Neural network and image processing algorithms are becoming prominent in the field of agriculture. So we have proposed a model to detect the type of deficiencies in the food products with the help of image processing algorithms. The essential features such as shape, size, color, texture and mass are used to grade the quality of the products.

Keywords: Image Processing, Classification, Grading, Neural Network

INTRODUCTION

A. *Need for grading and standardization*

Grading and standardization is well practiced at all India level for engineering products and consumer goods. It is yet to become popular for rural producer. Efforts are made by standard organization to popularize the standards. Agmark is one of the important step in popularizing quality moment by gradation. There are many advantages of grading. The important one is to obtain fair price to producer and justice to the consumer. [6]

B. *Food Grading*

Grading of food is categorized into different lots, each containing similar characteristics. The characteristics could be one or more of the following types:

- Size – Big, medium, small, long, short, roundish, oblong etc.
- Flavour– which in turn speaks of taste or class
  Ripeness – raw, semi-ripe, ripe in case of fruits, oilseeds, pulses and cereals.
- Length of staple – in case of cotton and jute.
- Location oriented – like Goa Alfanso, Bydagichillies,Baiganpalli mango, and Nagpur orange

- Nasik grapes – having specific tastes, shape, colour etc.[8]

Food grading involves the examination, assessment and sorting of various foods regarding freshness, quality, legal conformity and market value [1][2]. Food grading often occurs by hand, in which foods are assessed and sorted. Machinery is also used to grade foods, and may involve sorting products by size, shape and quality. For example, machinery can be used to remove spoiled foodfrom fresh product. During post harvesting sorting or grading is the most time-consuming process [4][5].

C. *Image processing in grading and standardization*

Image processing remains an important area in the field of computer science and engineering. Image processing takes images as input , process and analyse the images and then produce the output.

First step is to capture or gather images of consideration. Their features are stored as two dimensional array. thecolor of the images are retrieved from each pixel. The pixels are stored in the form of array of binary digits. The second phase is to segment the images. The images are compressed or enhanced as needed and segmented. Then the features are extracted from their segments for analysis. Databases such as testing and training databases are used for analyzation. The last stage is output which is obtained after analyzation.[5][9][10]

The aim of the proposed model is to classify the agricultural products according to their quality. The quality of the products are analysed using the proposed image processing algorithm. The characteristics of the products are selected based on their nature. Image processing techniques and classifiers are used to extract the features of the images, identify their defeciencies, classify and grade them. The proposed model will ease the currently available procedure of food grading.

Section 2 gives the related work and literature review of grading of rice, grains, fruits and vegetables. Section 3 explains the proposed model in detail. It also analyses the characteristics of the products taken for grading and the training database is prepared. Section 4 discusses the conclusions and future works.

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II. RELATED WORK

A. Grading of rice

Several researches had been done in this area. In Archana et al, Classification of four paddy grains is done on shape and their color. In this paper they have used pattern classification algorithms. The algorithm uses a two layer back propagation supervised neural networks with one hidden layer. They produced 98.7% accuracy of granule classification. To grade varieties of rice kernels an algorithm was developed by S.J.Mousavi et al. [13]

Another approach used is focused on providing a better approach for identification of rice quality by using neural network and image processing concepts. Today a great deal of effort is focused on the development of neural networks for applications such as pattern recognition and classification.[15]

This research has been done to pick out the relevant quality category for a given rice sample. It was based on texture and color feature extraction and are used to measure the quality of a rice sample [15].

B. Grading of grains

Grading is the ultimate aim of quality checking. To classify the grains , various standards are adopted for production of grains, breeding and quality checking and finally marketing. Image processing techniques such as neural networks, clustering algorithms and fuzzy logic are involved in the grading process. The trained network was used which identifies the unknown types of grains. It obtains 98% of accuracy[14].

Nandin et al. [15] developed a model to identify grains with 100% accuracy. It uses the image processing along with probabilistic neural network [16][17].

C. Grading of Fruits

Generally, the fruits are graded on the basis of size, weight,gravity, colour, variety, etc. Size grading is predominantly followed in almost all types of fruits on the basis of size. The fruits are graded as a small, medium, large and extra large. Fruits are classified on the basis of their maturity. They are graded into three categories i. immature ii. Properly mature iii. Over mature. Both quality and shelf life can be determined when grading is done on maturity. The mango fruits are graded by this method. They are categorized into three grades i. sp. gravity less than 1.0 ii. Sp. Gravity between 1.0-1.02 and iii. Sp.gravity more than 1.02. For Alphonso and Pairi fruits the second category is about 50%.[6][8]

D. Grading of Vegetables

As far as the vegetables are considered, they are mostly graded on the basis of size and color. The vegetables such as okra, brinjal, bitter guard, green chilli, bell pepper are graded on the basis of size. They are put into three grades i. small ii. Medium iii.Large . Grading on color are done in vegetables like tomato. Potato can be classified based on its

plantlet segments. This is discussed in the paper color machine vision system by Alchanatis et.al.[17][18]

III. PROPOSED GRADING MODEL USING IMAGE PROCESSING

The proposed model is developed to grade the essential agricultural food products. The products taken for grading are fruits, rice and grains and vegetables. Each product have their own features for testing their quality. The features such as shape, size, color , texture and density are taken for testing in this model. The common features for each fruit or vegetable is collected from the agricultural database and stored in the training database. The image of the product is captured by an optical scanner or a digital camera. They are digitized and compressed and enhanced for preprocessing. The RGB image as captured is then converted into HSI (Hue, saturation, intensity) image. From this HIS image each pixel is extracted and stored in the pixel matrix. The pixel matrix stores the color at each pixel of the image. The image is segmented and features are extracted and classified from the pixel matrix. These features are compared with testing database and the products are graded accordingly[10].

The training database for sample fruits is given in Table 1. The training database for rice and grains is shown in Table 2.

Table 3 shows the training database for sample vegetables.

The framework of the proposed model is shown in Fig1.

Table 1: Training database for sample fruits [5][8][11]

Food Products (Fruits)	Features	Parameters to be tested	Classification method
Apple	Color, Texture , Wavelet	Broken skin, surface discoloration, spots, scars	Statistical and Syntactical classifiers
Orange	Color, Texture, intensity	Stem end, scars, density	K-means clustering
Dates	Physical , color	Flabbiness, size, shape, intensity	Feed forward MLP
Water Melon	Shape, size, mass	Mass, volume, dimensions, density	Shape based classification
Lemon	Color, size	Volume, shape, density	ANN classification

Table 2: Training database for rice and grains [4][9][11]

Food Products (Rice and Grains)	Features	Parameters to be tested	Classification method
Rice and Grains	Shape, Size, Texture	Length of grains, density, skin decay	Naïve Bayes classifier & ANN

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Table 3: Training database for sample vegetables [6][8][11]

Food Products (Vegetables)	Features	Parameters to be tested	Classification method
Tomato	Shape, color, thickness	Firmness, defects, dirt, decay	Decision tree classifier
Mango	Size,color, maturity	Skin breaks, surface discoloration, overripe	ANN classifiers
Potato	Shape, firmness	Freezing injury, bacterial ring rot, loose sprouts	FMM neural networks

Figure 1.Grading Methodology using image processing classifiers

IV. CONCLUSION AND FUTURE SCOPE

This paper proposes an effective model for grading the quality of food products. It uses image processing applications which have been proved effective for various agricultural domains. The analysis of the parameters have proved to be accurate and less time consuming when compared to traditional methods. There are still some more features to be considered in each food product so that the grading can be done more effectively. This model can be improved by considering more combinations of features for better classification rather than identifying from one category of features. The proposed system consists of preprocessing, feature extraction, segmentation , training and classification and finally grading. This paper proposes a valuable approach which supports the accurate detection of deficiencies and lack of quality in food products and hence this model achieves efficient grading of food.

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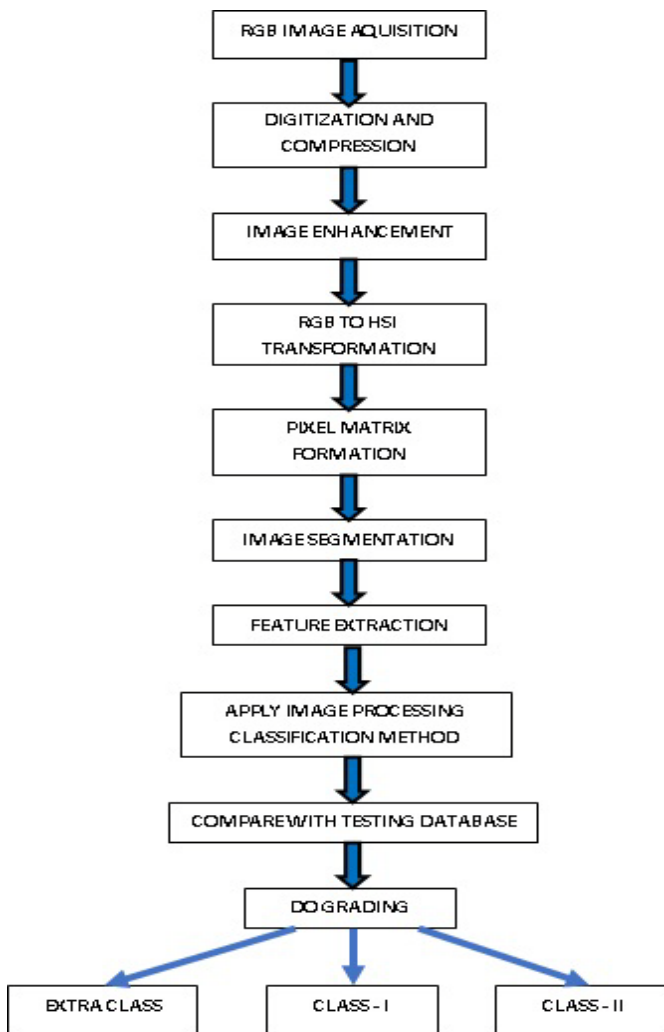[18] L.A.I. Pabamalie, H.L.Premaratne "A Grain Quality Classification System" IEEE 2010. Sep 2011