# Quality Detection of Fruits by Using ANN Technique

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# Quality Detection of Fruits by Using ANN Technique

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***Abstract :*** *Grading and classification of fruits is based on observations and through experiences. The system utilizes image-processing techniques to classify and grade quality of fruits. Two dimensional fruit images are classified on shape and colour based analysis methods. However, different fruit images may have similar or identical colour and shape values. Hence, using colour or shape features analysis methods are still not effective enough to identify and distinguish fruits images. Therefore, we used a method to increase the accuracy of the fruit quality detection by using colour, shape, and size based method with combination of artificial neural network (ANN). Proposed method grades and classifies fruit images based on obtained feature values by using cascaded forward network. The proposed system starts the process by capturing the fruit's image. Then, the image is transmitted to the processing level where the fruit features like colour, shape and size of fruit samples are extracted. After that by using artificial neural network fruit images are going through the training and testing. In this proposed paper neural network is used to detect shape, size and colour of fruit and with the combination of these three features the results obtained are very promising.* .

***Keywords:*** *Artificial neural network, Feature extraction, Graphical user interface, Image processing, Quality detection.*

## I. Introduction

Agriculture and Horticulture is one of the largest economic sectors and it plays the major role in economic development of India. Still in India, the traditional inspection of fruits is performed by human experts. A lot of time is wasted in the fields for checking the quality of the crops. In this Paper, an economic and safe way is used to analyze the fruit or vegetable quality which is based on colour, shape and size. Fruits should be tested via non-destructive techniques because these are delicate materials. The most important physical property is fruit size while colour resembles visual property. Hence, classification of fruit is necessary in evaluating agricultural produce, meeting quality standards and increasing market value. It is also helpful in planning, packaging, transportation and marketing operations. If the classification and grading is done through manual techniques, the process will be too slow and sometimes it will be error prone. The labours classify fruits and vegetables based on colour, size, etc. if these quality measures are mapped into automated system by using suitable programming language then the work will be faster and error free. In recent years, computer machine vision and image processing techniques have been found increasingly useful in the fruit industry, especially for applications in quality inspection and shape sorting [1].

Colour and shape characteristics of fruits are decisive for visual inspection. An efficient autonomous system for fruit sorting must be able to adequately identify both parameters. Shape of fruits can easily be obtained from a digital image using classical techniques for image processing. However, colour identification involves many physical and psychological concepts, asking it difficult to properly model and process colour in an image. There are wide varieties of colour systems present for the grading of fruits based on colours. There are some techniques like Fuzzy logic, Neural Network; Based on Colour Histogram, Genetic algorithm etc. [2]. Software development is highly important in this colour classification system.The entire system is designed over matlab software to inspect the colour and size of the fruit. Colour of the fruit is very important in classification but since due to the similarity of colours between some fruits, the size also helps in solving this kind of problems. The colour and size based classification involves extracting the useful information from the fruit surface and classify it to the respective type. Artificial neural network (ANN) is used to detect shape, size and colour of fruit samples.

The paper is organised as follows: Section 2 discusses the work reported in past years in various publications. Section 3 describes the proposed fruit quality detection method. Section 4 presents quality detection experimental results. Finally, conclusion and further recommendations are disscussed in section 5.

## II. Related Work

Nagganaur and Sannanki [1] presented the sorting and grading of fruits using image processing techniques. The system starts the process by capturing the fruit's image. Then the image is transmitted to the matlab for feature extraction,classification and grading.both classification and grading realized by fuzzy logic approach.

Effendi,Ramli and Ghani [3] presented that the quality of fruit depends upon type of defects, skin colour and size of fruit. In there research, they develop an image recognition system to identify the level of maturity of Jatropha curcas fruit and classify it into various categories. The system is divided into two stages: The first stage is a training stage that is to extract the characteristics from the pattern. The second stage is to recognize the pattern by using the characteristics derived from the first task. Back propagation diagnosis model is used to recognition the Jatropha curcas fruits. A back propagation diagnosis model (BPDM) is adopted to recognize the image of the matured fruits. Colour indices associated with image pixels are used as input.

Patel, Jain and Joshi [6] presented the fruit detection using improved multiple features based algorithm. To detect the fruit, an image processing algorithm is trained for efficient feature extraction. The algorithm is designed with the aim of calculating different weights for features like intensity, colour, orientation and edge of the input test image.

Arivazhagan, Shebiah, Nidhyanandhan and Ganesan [7] presented an efficient fusion of color and texture features for fruit recognition. The recognition is done by the minimum distance classifier based upon the statistical and co-occurrence features derived from the wavelet transformed sub-bands.

Bindu Tiger and Toran verma [8] presented apple recognition techniques of normal and infected. Proposed method classifies and recognizes apple images based on obtained features values by using two-layer feed-forward network, with sigmoid hidden and output neurons. The toolbox supports feed forward networks, radial basis networks, dynamic networks, self-organizing maps, and other proven network paradigms. This work represents the MATLAB 7.8.0 software and the recognition of generated signals by artificial neural network technique**.**

Sandoval,Prieto and Betancur [9] have proposed a machine vision based classification system to sort coffee fruits (cherries) according their ripeness stage is presented. Eight categories were defined and they include the entire coffee cherry ripeness process, from the initial stage (early green) to over ripe and dry stages. A Bayesian classifier was implemented using a set of nine features which include color,shape and texture computed on an image of the fruit.

## III. Proposed Method For Fruit Quality Detection

This proposed automated system is designed to overcome the problems of manual techniques. The system consists of several steps like feature extraction, sorting and grading. It is designed to combine three processes as shown below in a flow chart. Features like colour of fruit, shape of fruit and size of fruit are extracted. Size features are extracted in height and width. Extracting the size of fruit is called grading. The flow chart of sorting and grading process is given in the following fig. 1.

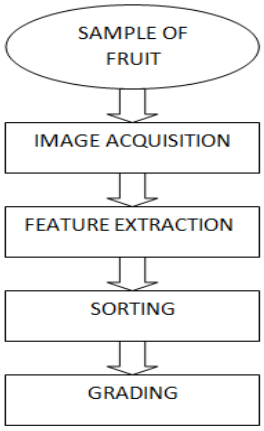


**Fig. 1** Flow chart of sorting and grading process

There are seven Steps for the fruit quality detection in proposed methodology. These steps are as following:
Step 1: Get image of fruit.
Step 2: This image is loaded into the matlab.
Step 3: Extract the features of fruit sample.
Step 4: Train the neural network.

Step 5: Select the fruit sample for testing.
Step 6: Perform testing by using artificial neural network training module button.
Step 7: Artificial neural network based output
The first step is to getting the image of fruit. Image of the fruit samples are captured by using regular digital camera with white background with the help of a stand. Then in the second step the image of the fruit is loaded into the matlab. In third step features of the fruit samples are extracted. Features such as colour, shape and size of the fruit sample are extracted. In fourth step neural network is used for training the data, after that in step fifth fruit sample is selected for testing from database. In step sixth testing is performed by using ANN training module button. Finally, in step seventh ANN based results are obtained. Fig. 2 shows the flow chart of design of proposed system for fruit quality detection by using artificial neural network.

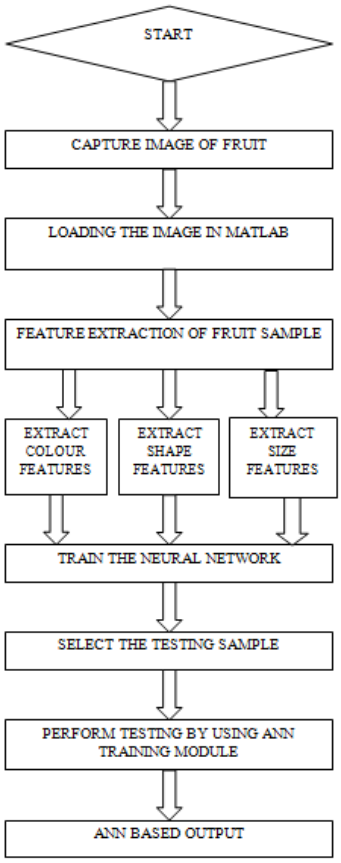


**Fig. 2 Flow chart of design of proposed system for quality detection of fruit by using ANN**

In this process, fruit samples are captured using regular digital camera with white background with the help of a stand. The image is loaded into matlab for processing. The features such as colour content and minor axis are extracted for sorting and parameters such as area and major axis length are extracted for grading the sample image. There are different modules which will perform different operations on the image being loaded. The modules are described as below:

**3.1 Image capture**

An image of the fruit is captured by using any digital camera or any mobile phone camera, an image is captured. This image is loaded into the matlab by using the function "imread". This function reads the image from the specified path. The image is stored in the matrix form of rows and columns. If it is a gray scale image, then it is stored as an M-by-N array. If the file contains a true colour image or RGB image, then it is stored as an M-by-N-by-3 array.

**3.2 Boundary extraction**

As it is a coloured input it needs to be converted to grayscale by function "rgb2gray (image)" and the syntax is:I=rgb2gray(RGB).which converts the true colour image RGB to the gray scale intensity image I, and then the image is converted to binary before it is used for further processing in which image consists of only two colours namely black and white.

**3.3 Geometric features extraction**

This starts with the extracted boundary of the sample. The function used to trace the features is "regionprops". The main features extracted are Area, Major axis and Minor axis.

**3.4 Colour, shape, and size features extraction**

In this red, green and yellow colours are used for classification as there is a difference between the fruit's skin based on these colors. Hence these colours are helpful for sorting out the fruits. The red and green component is calculated by counting pixel values corresponding to the red and green colours and yellow component is calculated by first converting the RGB image to CMY by using the function. Separating one kind of sample from another, classification method is used. In this case, one kind of fruit is separated from the other set of fruits by using neural network. Extracting the size of the fruit is called grading. Size is an important criterion related to the market value of the fruit. Hence grading the fruit is important for the farmers before they sell their products.

**3.5 Method description**

**3.5.1** In this paper, fruit is graded based on the geometric features of the fruit namely area and major axis. In this approach the first step is that to initiate the GUI in which the design is shown as below having the buttons for whole process as shown below in fig. 3.

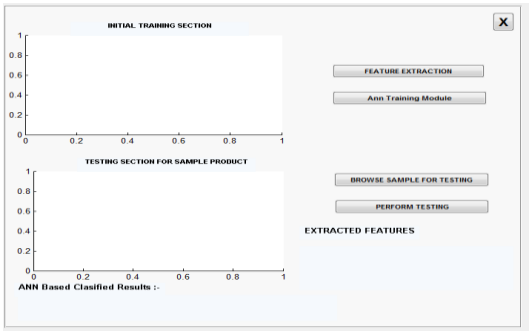


**Fig. 3 Graphical user interface for proposed work**

**3.5.2** The next step is to train the network in which firstly the feature which we have taken for proposed methodology will be extracted. this section demonstrate the feature extraction part of proposed methodology it include the feature extraction of each and every sample in dataset for training of neural network as shown below in fig. 4.

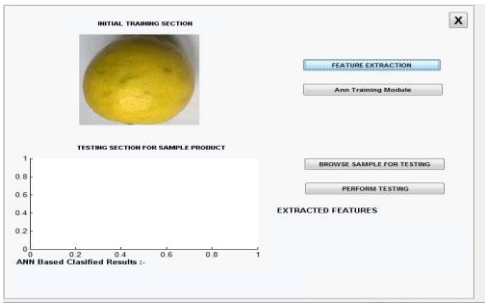


**Fig. 4 Training Section for feature extraction for neural network**

**3.5.3** Final Step of this is testing part in which user has the option to select the sample of fruit which it want to test as shown in fig. 5 and finally want to asses it so in section include the selection of image file from testing samples which will further perform testing and finally asses the selected sample into categories like First i.e. best, Second and third category.

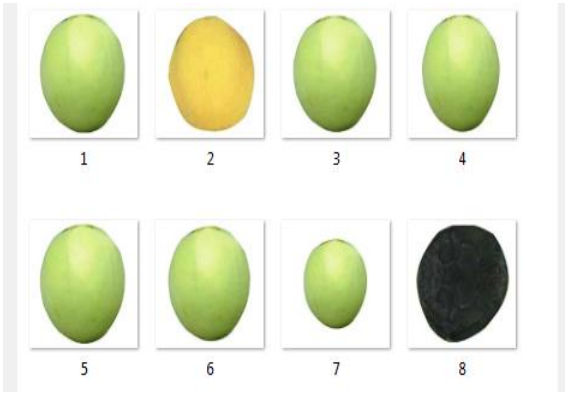


**Fig. 5 Samples of fruit from Database**

This part represent the graphical user interface after selecting the testing sample as shown in fig. 6 by the user next to it when user will click on ANN training module, then it shows neural network training tool. After that click on testing or perform testing this will give results and finally the parameters as values of features of testing sample as shown below in fig. 7.

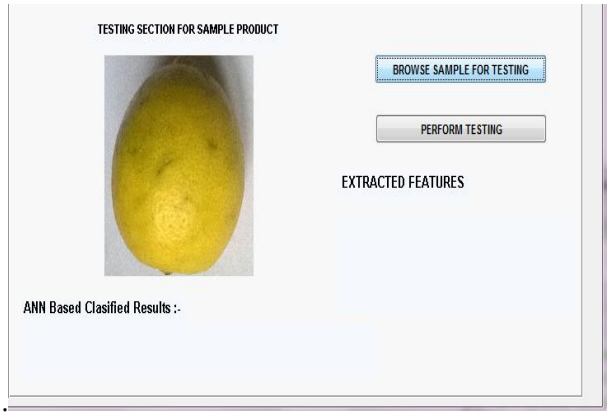


**Fig. 6 testing section for fruit sample**

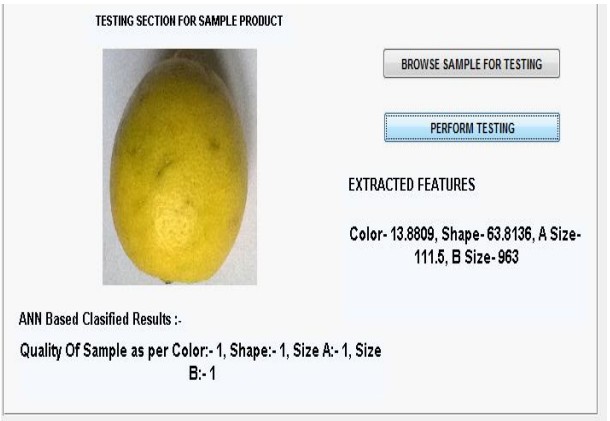


**Fig. 7 Final results of testing sample by using ANN methodology**

The results obtained after perform testing of selected sample into categories like first, second and third.These categories are explained in the table 1 shown below. It shows the result of ANN based technique and also shows the final results.

**Table 1: Parameters of ANN Results**

| S.NO. | ANN BASED RESULTS | FINAL RESULTS |
|---|---|---|
| | 1 | It shows that the given fruit sample is of best quality. |
| | 2 | It shows that the given fruit sample is of medium quality. |
| | 3 | It shows that the given fruit sample is of poor quality. |

## IV. Quality Detection Experimental Results And Discussion

This section presents experiments and quality detection of fruit samples. In this paper three types of lemon fruits are used which are of different colour, shape and size. Results are based on different dimensions like size, shape, height and width where size A represents height and size B represents width. The ANN based results for these three fruit samples are shown below in fig. 8, fig. 9 and in fig. 10 respectively.

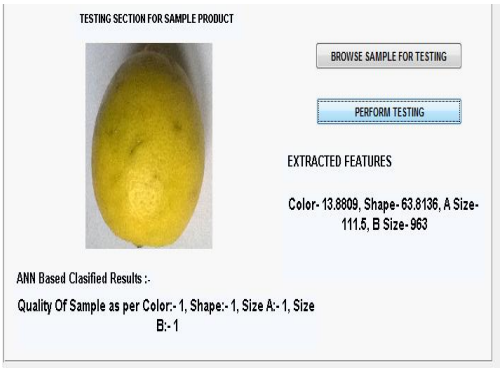


**Fig. 8 ANN based results for fruit sample 1**


**Fig. 9 ANN based results for fruit sample 2**

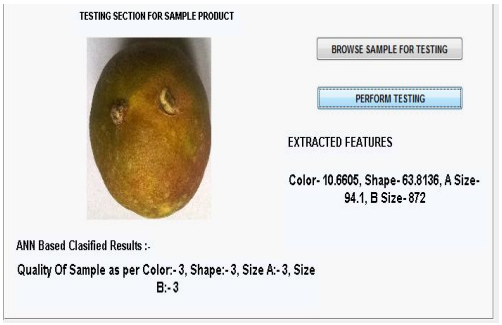


**Fig. 10 ANN based results for fruit sample 3**

Final results for fruit quality detection of given fruit samples are shown below in table 2.

**Table 2: Final results for fruit quality detection of given fruit samples**

| S.NO. | NO. OF FRUIT SAMPLES | ANN BASED PARAMETERS OF FRUIT SAMPLES | | | | CATEGORY OF QUALITY OF FRUIT SAMPLES |
|---|---|---|---|---|---|---|
| | | COLOUR | SHAPE | SIZE A | SIZE B | |
| 1) | Sample 1 | 1 | 1 | 1 | 1 | Best quality fruit |
| 2) | Sample 2 | 2 | 1 | 1 | 3 | Medium quality fruit |
| 3) | Sample 3 | 3 | 3 | 3 | 3 | Poor quality fruit |

## V. Conclusion And Future Scope

The paper presents a new technique for quality detection of fruits. The technique is started by capturing the fruit's image using regular digital camera or any mobile phone camera. The features are efficiently extracted from the sampled image. The extracted features are based on the parameters colour, shape and size. The ANN technique is used for checking the quality. The quality is determined by using fruit features obtained with the help of ANN. The proposed technique accurately detects the quality of fruits. The results are good for the three chosen lemon fruits of different colour, shape and size. This kind of system can be employed in juice plants, fruit and vegetable farms, packaging etc. In future the quality detection based on ANN should be compared with other mechanical and automated techniques.

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