Ann Based Fruit Quality Classification with Extended Feature Extraction Methodology

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***Abstract*—** Today grading of fruits and vegetables in the fresh form for quality is essential as the people are becoming quality conscious day by day. The research efforts have been allot to processing and analyzing fruits images to extract meaningful information to detect fruit quality .The existing fruit quality detecting system has the disadvantage of low efficiency, low speed of grading, high cost and complexity. Quality of fruits is not only depends on color and size features but also depends on shape, width and many other features. So we have considered these features together. In this paper a mechanism has used in which multilayer ANN based fruit quality classification is done with extended feature extraction methodology. The Research has proven that by using extended feature extraction methodology and neural network as classification algorithm, the accuracy of fruit grading system has been achieved more than 86%. Final results demonstrate that the approach which is used in this thesis is much better than the traditional ones as it has additional properties of ANN and features extraction as per previous researchers done.

Keywords*—Feature extraction, Multilayer Ann training, Testing, Matlab Software*

I. INTRODUCTION

Customers are the driving force in the fruit market. They have become more health conscious, demanding and willing to pay for the good quality. The customer's trust for fruit industry has been decreased due to fruit scandals thus making it important to improve the safety monitoring. Some unsafe fruit cannot be detected by manual inspection. The fruit quality evaluation has become more important and the need for more comprehensive assessment for all food batches is adequate. Although a lot of research and development work has been done on fruit quality, more needs to be done to find economic ways of monitoring fruit quality .The previous fruit quality detecting system has the disadvantage of low efficiency, low speed of grading, high cost and complexity. To overcome the disadvantages and limitations of the previous methods, new economic, fast, and environment friendly techniques are sought after. As a result, we are purposing an automatic fruit quality system in which various features of fruits will be extracted and extracted features will be train with neural network with multilayer perceptron. In order to improving fruits' quality and production efficiency, reduce labor intensity, it is necessary to research nondestructive automatic detection technology. To extract meaningful information from a fruit, extended feature extraction methodology has proposed. Fruit nondestructive detection is the process of detecting fruits' inside and outside quality without any damage, using some detecting technology to make evaluation according some standard rules. It is the process of generating the features to be used in selection and classification. Color, height and width (shape), and size feature vectors are used for feature extraction. Feature detection, feature extraction, and matching are often combined to solve common computer vision problems such as object detection and recognition. We are using neural network as classification algorithm. The term neural network was traditionally used to refer to a network or circuit of biological neurons. The modern usage of the term often refers to artificial neural networks, which are composed of artificial neurons or nodes. Thus the term may refer to either biological neural networks, made up of real biological neurons, or artificial neural networks, for solving artificial intelligence problems. The connections of the biological neuron are modeled as weights. A positive weight reflects an excitatory connection, while negative values mean inhibitory connections. All inputs are modified by a weight and summed altogether. This activity is referred as a linear combination. Finally, an activation function controls the amplitude of the output. For example, an acceptable range of output is usually between 0 and 1, or it could be -1 and 1.Neural network software is used to simulate, research, develop and apply artificial neural networks, biological neural networks and, in some cases, a wider array of adaptive systems.

II. LITERATURE SURVEY

In [1] Manisha A. Bhange(2015) proposed an image processing technique in which Pomegranate Disease Detection is explained .In the paper, author suggested a solution for the detection of pomegranate fruit disease (bacterial blight) and also the solution for that disease after detection is proposed. Web-based system used to help non experts in identifying fruit diseases, based on the picture representing the symptoms of the fruit. Farmers can take the photo of the fruit disease and upload it to the system. Then system will show to the farmer is the fruit is infected by the bacterial blight or not. Author added new approach of Intent Search in this system that is useful when quality of input image is poor. K-means clustering is used for image segmentation. Clusters are classified in two classes i.e. one class consists diseased fruit images and another class consists non-diseased images. The main purpose of this paper was to improve the efficiency of automatic fruit disease detection system by adding intent search technique.

In [2], Arti N. Rathod (Nov 2013) proposed an Image Processing Techniques for Detection of Leaf Disease The research has conducted the survey of different techniques for leaf disease detection. The research provides various methods used to study of leaf disease detection using image processing. The goal of this research work was to identify the disease affected part of cotton leaf sport by using the image analysis technique. The research wills two techniques for feature extraction and comparison of two techniques i.e. one technique is ostu threshold and other is k-means clustering. This paper describes the segmentation consist in image conversion to HSV color space and fuzzy c-means clustering in hue-saturation space to distinguish several pixel classes. These classes are then merged at the interactive stage into two final classes, where one of them determines the searched disease areas.

In [3], Jagadeesh pujari (2013) used some statistical methods for detecting fruit fungal disease. The fruits chosen for research work are namely pomegranate, mango and grapes. Two phases are used for image preprocessing. In first phase, input image is preprocessed for binarization and noise removal. In second phase image is thinned and bounding box is generated. Block wise feature extraction technique is used for feature extraction. In this technique image is divided in 5*5 blocks. Textual features are extracted using GLCM.

In [4] Shiv Ram Dubey (2012) proposed an image Processing approach has been used for fruit disease identification. The research has conducted for apple Disease namely apple scab, apple rot, apple blotch. K-means clustering technique is used for image segmentation. Feature extraction is done from segmented images. Features considered for feature extraction are color histogram, color coherence vector, local binary patterns and complete local binary patterns. Multiclass support vector machine is used for fruit disease identification.

In [5] Ab Razak Mansor has Proposed a color sensor modal in which color was used as quality factor of mango fruit. In this project, a new model for classifying mango fruit developed using the fuzzy logic RGB sensor color model build in matlab. The objectives of this paper was to define the ripeness index based on intensity of RGB color on mango skin, develop the calibration equation using color values and evaluate the calibration efficiency by classifying the mango ripening index using Fuzzy Logic. Specific objectives implemented to accomplish the overall objective were to use a RGB Fiber optic color sensor to collect RGB data from mango fruits with three categories (i.e., unripe, ripe and over ripe); determine data color features based on the color signal; and develop algorithms for selecting useful color features and classifying the ripeness mango conditions based on the color feature sets using Fuzzy Logic.

Nondestructive quality evaluation of fruits is important and very vital for the food and agricultural industry. A challenging problem is to extend features so that a better fruit quality detection is achieved. The fruits in the market should satisfy the consumer preferences. Many researches were conducted for the fruit quality detection but mostly only the color factor was used as a measure of detection or either the shape of the fruit but these factors were considered individually. Quality of fruit shape, default, color and size and so on cannot evaluate on line by the traditional methods. Sensors were employed that used only one measure as a factor for detecting quality but since fruit quality depends on other factors also like shape, size, ripening factor etc so these needs to be considered too. Firstly, the need is to extend the feature considerations while detecting the fruit quality so that better and efficient results can be produced. Secondly, most work done in the existing techniques is on fuzzy logic. The fuzzy logic uses predefined outputs. At present, most existing fruit quality detecting and grading system have the disadvantage of low efficiency, low speed of grading, high cost and complexity.

III. PROPOSED METHODOLOGY

The proposed automated classification and grading system is designed to combine three processes such as feature extraction, neural network training according to extracted features and grading according to color, size, and height and width values of fruits. Software development is highly important in this classification system and for finding features of a fruit. The entire system is designed over MATLAB software to inspect the color, size, height and width of the fruit. Here grading can be categories into three ways low, medium and best. Work in this paper considered different fruits having different features like in color we have many colors of fruits based on different types of fruits and system can sort and grade the fruits according to different attributes such as color, size and shape. It mainly contains four parts: feature extraction, neural network training, selection of sample for testing and testing. In this paper, we propose and experimentally evaluate an approach for the detection of fruit quality using images.

- First step for this algorithm is feature extraction in which color, roundness, height and width is extracted.
- After that neural network is trained with multilayer perceptron. The reason behind using multilayer is its advantage over single layer perceptron. Here two input layers and one output layer is used.
- After the training process, testing process begins in which one particular testing sample is compared with training samples and if the selected sample matches with one of the training sample, then it accordingly gives the result for color, width, size and roundness features & gives the grades for that sample.
- By using this technique we can improve the quality of fruits. As we know if any fruit is affected by any virus or disease, then their roundness, color, height, width is also affected by that disease and virus.
- By using grading system we give the targets as input and compare these targets with particular sample and produce the results. When we get the results we can easily avoid that fruit or we can set a solution for that disease.
- Fruit quality detection improves the fruit quality, production efficiency and reduces the labor intensity.
- The proposed technique is believed to decrease system cost and complexity and increase system efficiency.

IV. RESULTS AND DISCUSSIONS

The MATLAB v 7.10 tool box is used to implement the developed algorithm. We have considered 9 samples of fruits in which color, size, height and width is different of each fruit. Advantages of using this algorithm are high accuracy of grading, high speed and low cost. Following are the results of different parameters for fruit quality technique using Ann. In first step features are extracted like color, roundness, height and width of samples. When feature extraction process completed, different parameters are extracted, which has shown in plots for width, color, roundness and height features.

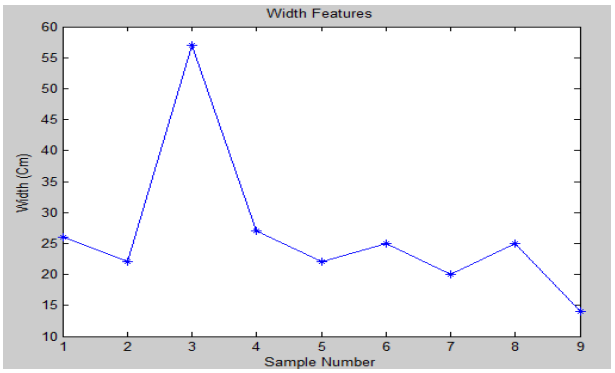

Fig. 1: Width feature results

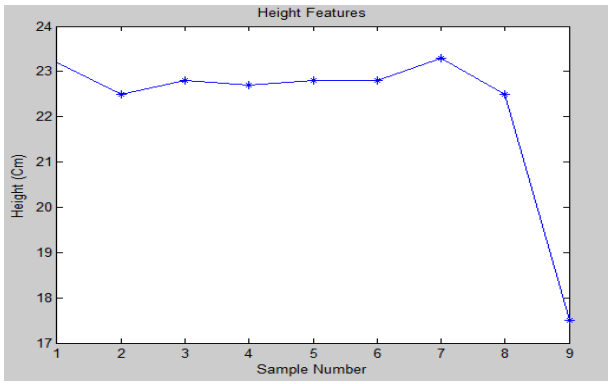

Fig. 2: Height feature result

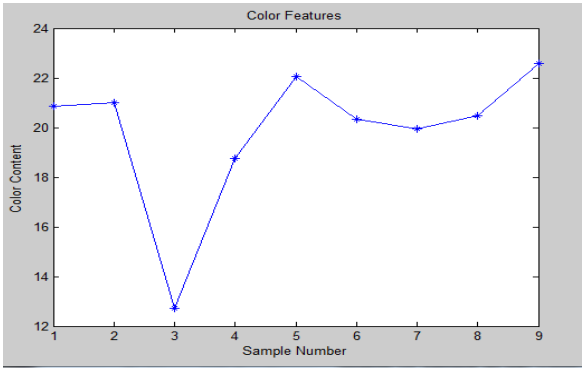

Fig.3: Color feature result

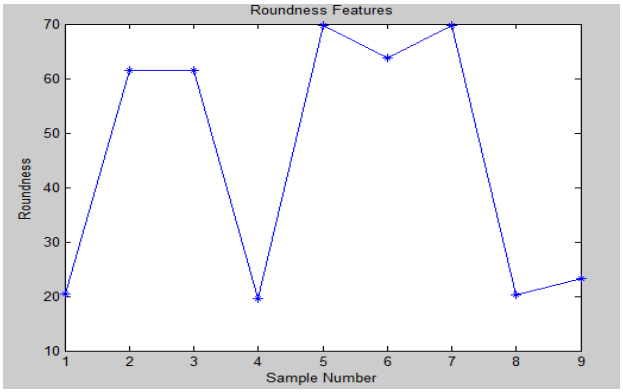

Fig.4: Roundness feature result

Once a network has been structured for a particular application, then network is ready to be trained. To start this process, the initial weights are chosen randomly. Then the training, or learning, begins. The network processes the records in the training data one at a time, using the weights and functions in the hidden layers, and then compares the resulting outputs against the desired outputs. Errors are then propagated back through the system, causing the system to adjust the weights for application to the next record to be processed. This process occurs over and over as the weights are continually tweaked. During the training of a network the same set of data is processed many times as the connection weights are continually refined.

In the testing section extracted features are compared with a particular testing sample features. If sample is matched with trained samples then it gives results for that particular sample and grading on the basis of performance.

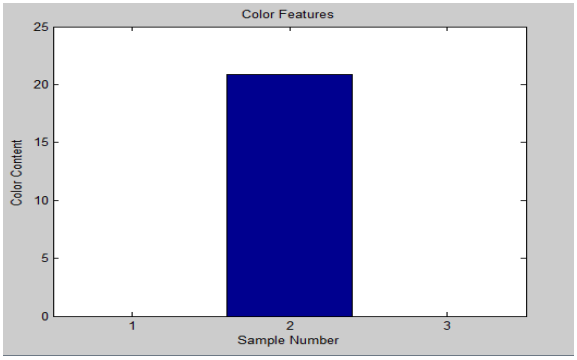

Fig. 5: Color feature result after testing

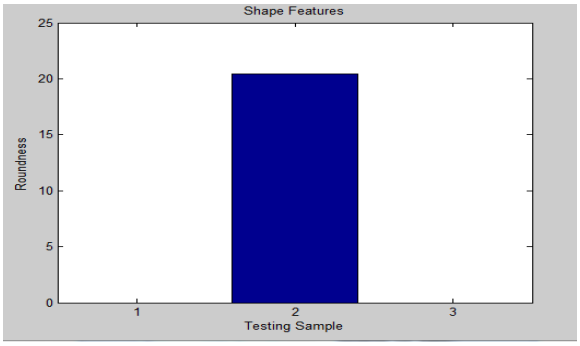

Fig. 6: Shape feature result after testing

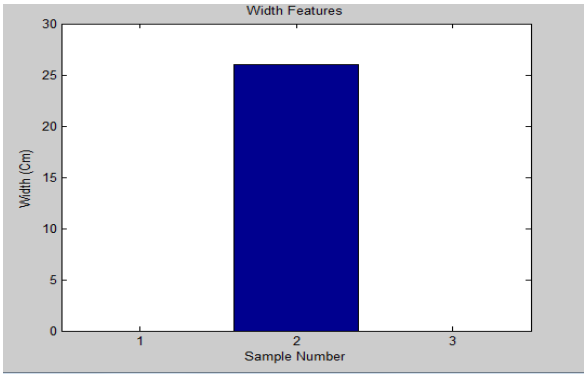

Fig. 7: Width feature results after testing

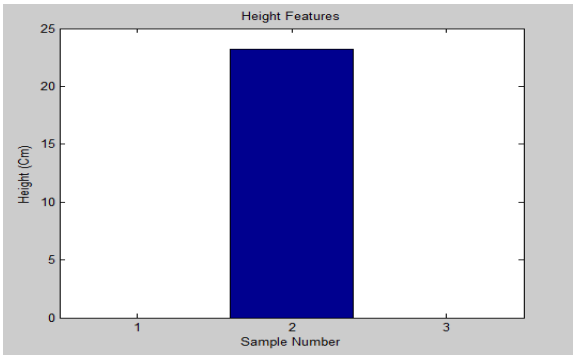

Fig. 8: Height feature results after testing

Using table 1, we will find accuracy of fruit quality system in terms of perfectly matched samples or total number of samples. Let's take an example. We are taking First sample for testing purpose. By clicking on testing button; it shows the different results for each feature. Here, it gives 22.5796 for color feature which is graded with low quality and same for size, roundness and so on. Percentage accuracy is defined as the ratio of correctly matched images to the total no of test images.

$$\text{Percentage accuracy} = \frac{\text{correctly matched samples}}{\text{Total number of samples}} * 100$$

It gives 87.5% accuracy.

V. CONCLUSION

The Research has proven that by using extended feature extraction and neural network as classification algorithm, the accuracy of fruit grading is more than 86%. This paper presents the novel work on the automatic fruit quality system for classification and quality assessment of fruits. This paper has presented a new approach which gives betters fruit quality detection with extended feature methodology. We have proposed a technique in which all the quality factors are considered together and the quality of the fruit depends on all the factors. The equipment cost of the system is reduced by using camera images. This technique provides decrement in system cost, complexity and increase system efficiency. It reduces labor intensity and improves production efficiency. The result shows that extended feature extraction with neural network can be used accurately as data acquisition and can be applied to other classification fruits. As a future scope the further enhancement can be done by using clustering approaches ex. k-means clustering, c -mean clustering or any other along with swarm Intelligence to train the present classifier.

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VI. REFERENCES

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TABLE I. QUALITY ASSESMENT USING MULTILAYER ANN

Features result after training					**Grading**			
Sample no	***Color***	***Roundness***	***Height***	***Width***	***Color quality***	***Roundness quality***	***Height quality***	***Width quality***
1	22.5796	23.1595	17.5	14	Low	Best	Low	Medium
2	20.9959	61.4772	22.5	22	Best	Medium	Best	Best
3	12.727	61.4772	22.8	57	Low	Low	Best	Best
4	18.741	61.545	22.7	27	Medium	Best	Best	Best
5	22.0582	19.5262	22.8	22	Best	Best	Best	Low
6	20.3182	69.8136	22.8	25	Medium	Best	Best	Low
7	19.9607	63.8132	23.3	20	Best	Best	Best	Best
8	20.4605	69.8132	22.5	25	Medium	Best	Best	Medium
9	13.8763	14.7642	24.8	122	Low	Low	Low	Low