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ANN based Technique for Vegetable Quality Detection

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Abstract :*Use of image processing technique is increasing day by day in all fields. In agriculture it is also used to check the quality of vegetables and fruits. Shape, colour and size are the image features which help in quality detection of vegetables. In this paper proposed method is used to increase the accuracy of the vegetable quality detection by using colour, shape, and size based method with combination of artificial neural network (ANN). It grades and classifies vegetable images based on obtained feature values by using cascaded forward network. The proposed system starts the process by capturing the vegetable's image. Then, the image is transmitted to the processing level where the vegetable features like colour, shape and size of vegetable samples are extracted. After that by using artificial neural network vegetable images are going through the training and testing. Artificial neural network detect the quality of vegetables by using the shape colour and size features provided at the time of training and also the extracted features of vegetables and provides the result by comparing these features. In this proposed paper neural network is used to detect shape, size and colour of vegetable 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, Vegetable Quality detection.*

I. Introduction

Agriculture and Horticulture plays an important role in economic development of India. Development in agriculture is very slow as compared with development in electronic and automobile sector. Hence, there is need to come up with some new techniques so as to forefront the agriculture sector. Still in India, the traditional inspection of vegetables is performed by human experts. It was very time consuming and laborious task. Grading of vegetables is necessary in evaluating agricultural produce, meeting quality standards and increasing market value. The features that can be extracted from an image of any vegetable are its shape, colour and size. These features help the user to grade the vegetables. In this Paper, an economic and safe way is used to analyze the vegetable quality which is based on colour, shape and size. Vegetables should be tested via non-destructive techniques because these are delicate materials. The most important physical property is vegetable size while colour resembles visual property. 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. Human sorted the fruits and vegetables on the basis of colour, size, shape 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 vegetables are decisive for visual inspection. There are several techniques which can be used to extract the morphological features from an image. An efficient autonomous system for vegetable sorting must be able to adequately identify both parameters. Shape of vegetables 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 vegetables 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 vegetable. Colour of the vegetable is very important in classification but since due to the similarity of colours between some vegetables, the size also helps in solving this kind of problems. The colour and size based classification involves extracting the useful information from the vegetable surface and classify it to the respective type. Artificial neural network (ANN) is used to detect shape, size and colour of vegetable samples.

Neural networks are encouraged from the brain system. Our brain learns from everyday life and use it in future, neural network also works on same code. There are two stages in neural network i.e. training and testing. It is composed of large number of highly interconnected processing elements working in

union. Neural network, like brain, learn by example. We train the system on number of inputs and then use them in real time to test it. Artificial neural network; like other machine learning systems that learn from data have been used to solve a wide variety of tasks that are hard to solve using ordinary rule based techniques [3]. Work in this paper considered on two different vegetables having different features and system can inspect the quality of vegetables according to different attributes such as colour, shape and size.

The paper is organised as follows: Section 2 discusses the work reported in past years in various publications. Section 3 describes the proposed methodology of vegetable 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.

Shahzadpreet, Saurabh, Mohit, Sugam and hari singh [3] presenting appraisal on several procedures in detection and isolating of rotten fruits. Some of methods used are neural networks,fuzzy logic,neuro-fuzzy and support vector machines. Different physiognomies which tell us about apples superiority.

Mandeep kaur and Reecha sharma [4] presented a system in which fruit features like colour,shape and size of fruit samples are extracted.In this paper artificial neural network is used to detect shape,size and colour of fruit.

Bhanu pratap, Navneet, Sunil and Suriti [5] proposedan algorithm for fruit classification based on shape,color and texture. Shape features are calculated by using edge detection.hsi,hsv can be used for color base classification. GLCM is used to calculate texture featuresartificial neural network is used to classifies the fruits by comparing shape,color and texture feature provided at the time of training.

Effendi, Ramli and Ghani [6] 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 [9] 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 [11] 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 [12] 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.

Amir Alipasandi, Hosein Ghaffari and Saman Zohrabi Alibeyglu [21] introduced a system that is using machine vision algorithm and neural network classifier to classify three varieties of peach fruit. Three cultivatrs, namely, Anjiri peach cultivar and Shalil Nectarine cultivar, varieties of Iran and Elberta peach cultivar variety of United States were randomly handpicked in two stages of growth, immature and mature. An image capturing system was designed to provide an enclosed and uniform light illumination and to obtain standard images from the samples.the images were sent to processing toolboxes of matlab software to visualize, acquire and process the images directly from the computer. Some qualitative information is extracted from the objects to be analyzed in the images. This information was used as inputs to the algorithms for classifying the objects into different categories. In this study feature vector that consider as network input consist of 12 components of colour spaces

and three components of shape features. After network was trained,confusion matrices for mature and immature fruits were obtained.

III. Proposed Methodology

This proposed automated system is designed to overcome the problems of manual techniques. Different vegetables images which are used in this experiment are captured under constant light source. Proposed methodology is as follows firstly the image of vegetable is captured and after that from the captured image various features such as shape, colour and size are extracted. Size features are extracted in height and width. After the features are extracted then artificial neural network is used to detect the quality of vegetables. The system consists of several steps like feature extraction, sorting and grading.

There are seven Steps for the vegetable quality detection in proposed methodology. These steps are as following:

Step 1: Get image of vegetable.
Step 2: This image is loaded into the matlab.
Step 3: Extract the features of vegetable sample.
Step 4: Train the neural network.
Step 5: Select the vegetable 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 vegetable. Image of the vegetable 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 vegetable is loaded into the matlab. In third step features of the vegetable samples are extracted. Features such as colour, shape and size of the vegetable sample are extracted. In fourth step neural network is used for training the data, after that in step fifth vegetable 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 [4].

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 vegetable 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 image preprocessing

image captured from digital camera or any mobile phone camera cannot be used directly because it has lots of noise due to dust and light effect.image processing is done to improve the quality of image.Desired vegetable image is obtained after filtering and this image can be used for features extraction.

3.3 Boundary extraction

Asit 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[4].

3.4 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 [4].

3.5 Colour, shape, and size features extraction

In this red, green and yellow colours are used for classification as there is a difference between the vegetables's skin based on these colors. Hence these colours are helpful for sorting out the vegetables. 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. Shape features are calculatd by thresholding the image and remove noise from image. After that compute the boundaries, perimeter and area of image.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 vegetables by using neural network. Extracting the size of the vegetable is called grading. Size is an important criterion related to the market value of the vegetable. Size features are calculated by converting the colored image into gray and then apply edge detection methods. Hence grading the vegetable is important for the farmers before they sell their products.

3.6 Artificial neural network

Neural network is used to detct the quality of vegetables. A block diagram representation of neural network is shown below in fig. 1. The block diagram shows that neural network consists of three layers which are input layer,hidden layer and output layer. The input layer defines the input given to the neural network which is processed in the middle layer which consists of neurons and this middle layer is known as hidden layer. The hidden layer process the input at the training time to provides the desired output at the testing time. The last layer is the output layer which shows the output result. Artificial neural network perform the inspection of vegetables on shape,colour and size where size A represents height and size B represents width[5].

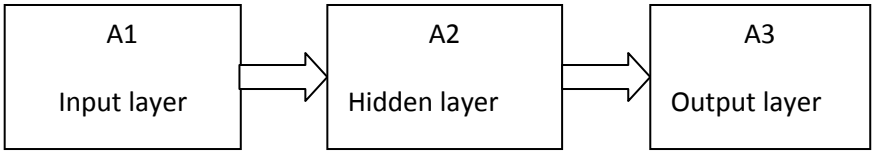

Fig. 1 Block diagram of artificial neural network

3.7 Training and Testing

In training time neural network is trained to detect the quality of vegetable image. The data generated during the training time are stored in the data base of neural network. When a new image is loaded during testing time,features are extracted from the new image which is compared with data stored in neural network. Artificial neural network detects the vegetable quality in suitable shape ,colour and size on basis of its knowledge gained during training time[5]. Training and Testing model of neural network is shown in fig.2. This model consists of input layer, hidden layer and output layer. In the input layer shape, colour and size features are calculated. Hidden layer consists of neurons which generate output. Output layer compares the results of extracted features and results provided at training time and generates the final output.

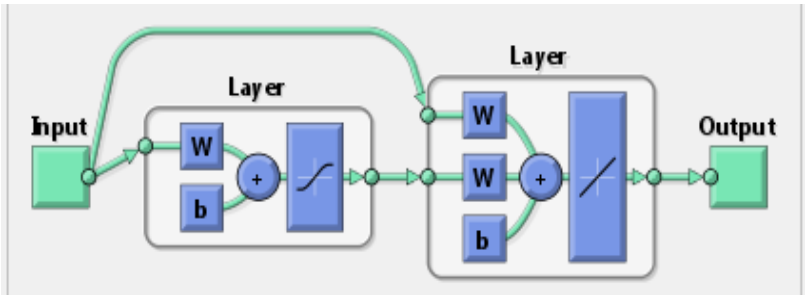

Fig. 2 Training and Testing Model

3.8 Method description

3.8.1 In this paper, vegetable is graded based on the geometric features of the vegetable 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. 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.

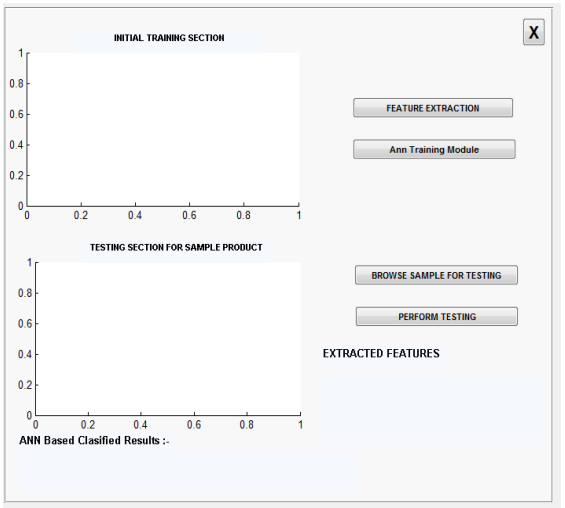

Fig. 3 Graphical user interface for proposed work

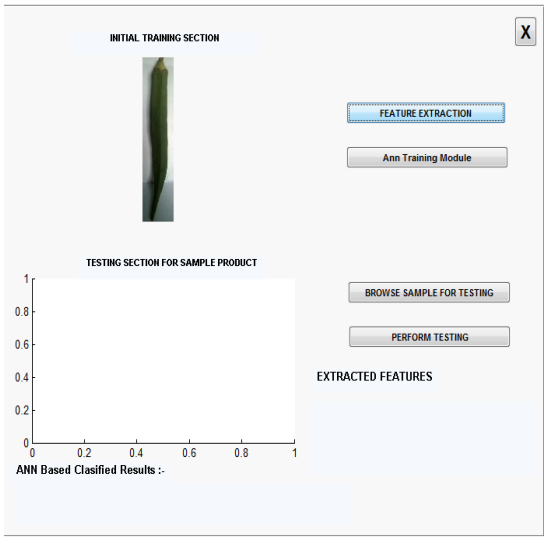

Fig. 4 Training Section for feature extraction for neural network

3.8.2 Final Step of this is testing part in which user has the option to select the sample of vegetable 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. 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. 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. In table 1 first column shows the serial numbers,second column shows the ann based results and last column shows the final results.

Fig. 5 Samples of fruit from Database

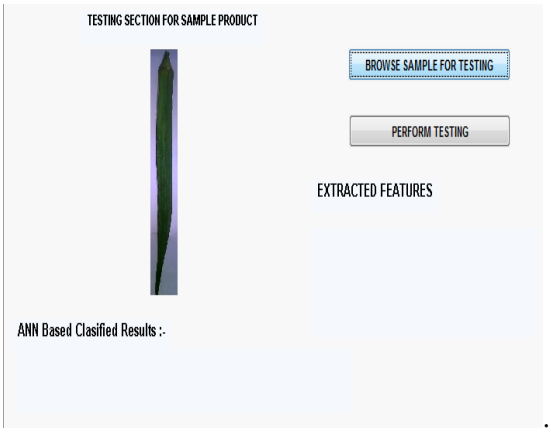

Fig. 6 Testing section for fruit sample

Table 1: Parameters of ANN Results

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

IV. Quality Detection Experimental Results And Discussion

This section presents experiments and quality detection of vegetable samples. In this paper two different types of vegetables 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 vegetable samples are shown below in fig. 7, fig. 8, fig. 9 and in fig. 10 respectively.

Fig. 7 ANN based results for vegetable sample 1

Fig. 8 ANN based results for vegetable sample 2

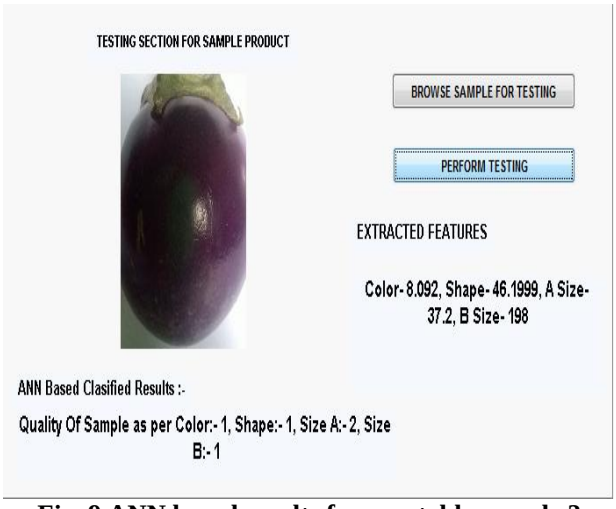

Fig. 9 ANN based results for vegetable sample 3

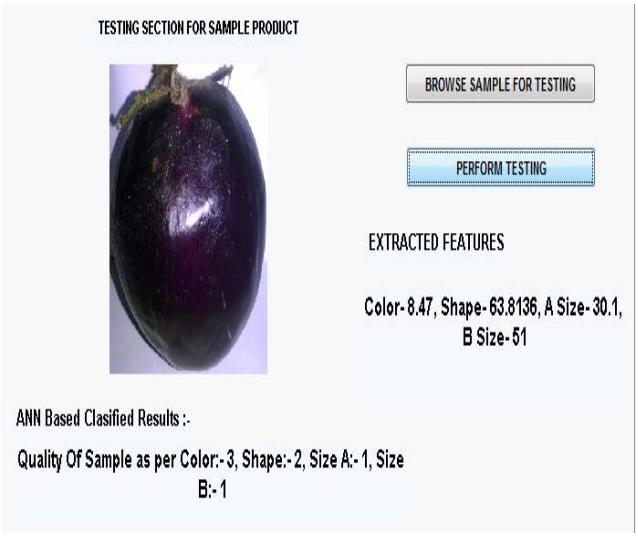

Fig. 10 ANN based results for vegetable sample 4

Table 2 shows the results of vegetable quality detection. First column shows the serial numbers and remaining columns shows number of vegetable samples. ANN based parameters of vegetable samples based on colour, shape and size and category of vegetable quality.

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

S.NO.	NO. OF VEGETABLE SAMPLES	ANN BASED PARAMETERS OF VEGETABLE SAMPLES				CATEGORY OF QUALITY OF VEGETABLE SAMPLES
		COLOUR	SHAPE	SIZE A	SIZE B	
1	Sample 1	1	1	1	1	Best quality vegetable
2	Sample 2	2	1	1	1	Medium quality vegetable
3	Sample 3	1	1	2	1	Best quality vegetable
4	Sample 4	3	2	1	1	Bad quality vegetable

V. Conclusion And Future Scope

The paper proposes a new technique for quality detection of vegetables. The technique is started by capturing the vegetable'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 like colour, shape and size. The ANN technique is used for checking the quality. The quality is determined by using the extracted features of vegetables and the values provided to the neural network during training .The proposed technique accurately detects the quality of vegetables. The results are good for the four chosen vegetable samples 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 and a new parameter can also be added.

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