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Review on Back Propagation Neural Network Application for Grading of Cashew Nuts

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Abstract: ***Recently, methods of quality assessment have gained impetus and substantial efforts have been made to develop systems regarding quality of Cashew nuts. This paper examines latest works of using Back Propagation artificial neural network (ANN) for determining the quality of some Cashew nuts. In this review, the theoretical backgrounds of ANN were analyzed and various application of ANN Intelligent method with respect to cashew nuts was discussed. It is intended that the discussion of evolving method will provide direction for easy future work.***

Keywords: Artificial neural network, Quality, Accuracy, Back propagation neural network, Cashew Nuts

1. Introduction

The long-term aspiration of the neural-network society is to design autonomous machine intelligence but now the present usage of neural networks is in the field of color, size and texture recognition. In the sub-field of data classification, neural network methods have been found to be useful alternatives to statistical techniques such as those which involve regression analysis or probability density estimation. The Potential utility of neural networks in the classification of imagery databases has been recognized for over a decade, and today neural networks are an established tool in the field of fruits and vegetables quality classification. The study of techniques of prediction and diagnosis shows that the most widely used Back Propagation ANN is the three layers which comprises of input, hidden and output layer shown in (Figure 1). The output result relies on the weight used on the data linking the output and hidden layers. During training and learning, weights are the value which back propagation ANN works on to achieve a result that is very close to the required output.

Cashew (*Anacardium occidentale L.*) is of Eastern Brazil was introduced to India by the Portuguese nearly five centuries back. Cashew is the third largest esculent tree nut in the world. India has been the cashew trade and has also pioneered the cashew processing and exports. In addition, India is the largest producer of cashew nuts and the largest area holder of this crop in the world.

Cashew nuts processing India has been a pioneer in cashew processing and has been the first country to hit the world market with cashew nuts. The raw cashew nuts are collected from the growing areas are moved to the factories for processing. It is make secure that the raw nuts are thoroughly cleaned and are free from all foreign matter before they are processed.

Grades Based on the Size, texture, and Color of the cashew nuts are graded into white or scorched wholes, pieces, splits, butts etc. The Government of India Act prescribes 33 different grades of cashew kernels of which only 26 grades are commercially available and exported. W- 320 are the most popular among cashew nuts and also the most available, worldwide. Scorched wholes are another grade of cashew nuts. They are prepared by subjecting the nuts to a longer duration of roasting, whereby they attain a slight brown color. They however have all the other characteristics of white nuts including nutritional qualities. Butts, splits and pieces are priced low and are ideal for cooking, preparation of sweets and savory snacks and etc.

Today, various kinds of cashews are available in the market with different qualities. To determine the quality, grade standard have been designed by considering the color and the size (weight) of the cashew kernel as important characteristic as shown in Table 1. Grading of cashew nuts are based on inspection of physical quality attributes such as color, texture, and size. By using these physical attributes, a trained person determines the cashew kernel of which class (i.e., white wholes). The Table 1 illustrates the Grade designations and definitions of quality of cashew nuts (i.e., white wholes). Reference color slides are available to assist with the assessment of cashew nuts color. Despite the training of the grading personnel and the availability of reference slides, the current method for cashew nuts quality evaluation is time consuming, tedious, and inherently inconsistent.

In this paper working for applications sorting and grading of cashew nuts. In this different classifier and different techniques are used for features extraction. In the cashew nuts grading it required cashew nuts image segmentation after segmentation calculate healthy and infected portion of cashew nut fruit.

Grade	Count per 454 gms	General Characteristics
W-180	170-180	Cashew nuts shall have the characteristics like shape,
W-210	200-210	Shall be white , pale ivory or light ash in color, may
W-240	220-240	be dry and free from damage and black or brown
W-320	300-320	Spots. The nuts should be completely free form tesla.
W-450	400-450	
W-500	450-500	

Figure 1: Cashew Nuts (White Wholes)

2. Artificial Neural Network

"Neural network" redirects here. For networks of living neurons, see Biological neural network. For the journal, see Neural Networks (journal). For the evolutionary concept, see Neutral network (evolution).

In machine learning and cognitive science, artificial neural networks (ANNs) are a family of statistical learning models inspired by biological neural networks (the central nervous systems of animals, in particular the brain) and are used to estimate or approximate functions that can depend on a large number of inputs and are generally unknown. Artificial neural networks are generally presented as systems of interconnected "neurons" which exchange messages between each other. The connections have numeric weights that can be tuned based on experience, making neural nets adaptive to inputs and capable of learning.

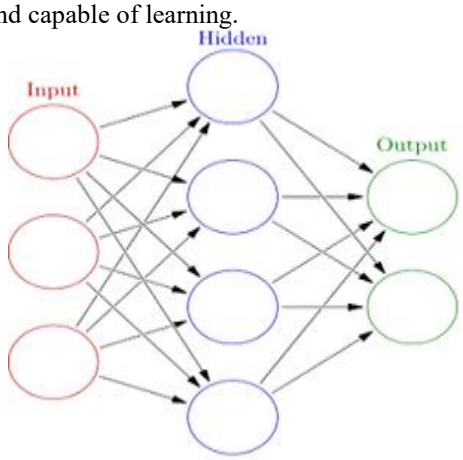

Figure 2: Structure Of Artificial Neural Network

3. Back Propagation neural Network

Back propagation, an abbreviation for "backward propagation of errors", is a common method of training artificial neural networks used in conjunction with an optimization method such as gradient descent. The method calculates the gradient of a loss function with respect to all the weights in the network. The gradient is fed to the optimization method which in turn uses it to update the weights, in an attempt to minimize the loss function.

Back propagation requires a known, desired output for each input value in order to calculate the loss function gradient. It is therefore usually considered to be a supervised learning method, although it is also used in some unsupervised networks such asautoencoders. It is a generalization of the delta rule to multi-layered feed forward networks, made possible by using the chain rule to iteratively compute gradients for each layer. Back propagation requires that the activation function used by the artificial neurons (or "nodes") be differentiable.

The back propagation learning algorithm can be divided into two phases: propagation and weight update.

3.1 Phase 1: Propagation

Each propagation involves the following steps:

1) Forward propagation of a training pattern's input through the neural network in order to generate the propagation's output activations.
2) Backward propagation of the propagation's output activations through the neural network using the training pattern target in order to generate the deltas (the difference between the input and output values) of all output and hidden neurons.

3.2 Phase 2: Weight Update

For each weight-synapse follow the following steps:

1) Multiply its output delta and input activation to get the gradient of the weight.
2) Subtract a ratio (percentage) of the gradient from the weight.

This ratio (percentage) influences the speed and quality of learning; it is called the *learning rate*. The greater the ratio, the faster the neuron trains; the lower the ratio, the more accurate the training is. The sign of the gradient of a weight indicates where the error is increasing, this is why the weight must be updated in the opposite direction. Repeat phase 1 and 2 until the performance of the network is satisfactory.

4. Back Propagation ANN for Fruits Quality Grading

Fruits are growing in attractiveness in daily consumption both developing and developed countries. recognized that autonomous mechanism are now effectively being deployed to determine and evaluate the quality of fruits and vegetables with the combination of digital image processing and ANN. They have successfully applied this combination to identify fungal diseases in cucumber plants by obtaining 3-textural Features from the leaf images namely, energy, entropy and local homogeneity through image processing to actually determine the diseases category. The ANN structure applied was 5-20-2 network Levenberg-Marquardt (LM) back propagation algorithm with 5-input features for energy, entropy, average temperature (AT), maximum temperature difference (MTD) and local homogeneity While the two output are hour post inoculation and diseases detection. Two Hundred and fifty parameters were applied for training with thirty sets used for assessment of the model and twenty data for cross-validation. The Highest accuracy occurred at correlation coefficient (R) Of 0.9

Stefania Matteoli, Marco Diani, Rossano Massai, Giovanni Corsini, and Damiano Remorini[1], lays the foundations for the realization of easy-to-use sustainable automated maturity grading systems. This work has presented an automated non-destructive peach fruit grading approach that makes use of spectroscopy based sensors. Rather than identifying the optimal harvesting window for picking a fruit, here peach fruits are classified within several different maturity categories, ranging from immature to over-ripe fruits. A novel three-step approach is proposed where non-destructive

measurements of peach fruit reflectance are carried out in the first step, fruit flesh firmness is retrieved in the second step by means of multivariate techniques, and the retrieved flesh firmness values are processed with a maturity fuzzy classifier in the third step. The user is provided with ranking of maturity categories and associated reliability levels within the framework of a decision support system that is aimed at assisting the user during the decision-making process. Classification is carried out within a decision-theory-based multiple-hypotheses testing framework and on the basis of decision rules built exploiting that maturity categories can be defined based on suitable ranges of the fruit flesh firmness values. The overall approach has been shown to have great potential in industrial and horticultural applications for the realization of easy-to-use automated maturity grading systems to be employed by non-expert users directly in the orchard or in the warehouse. In the future, the approach will be extended to the use of *imaging* spectroscopic sensors (hyperspectral imaging sensors), in order to improve maturity grading performance by benefiting of the multiple features provided by exploitation of spatial information.

Wasiu A. Balogun, Momoh-Jimoh E. Salami, Abiodun M. Aibinu,Yasir M. Mustafah, Sadiku Isiaka.B.S [2], have Determination of quality of any food material is actually a complex problem but ANN technique is highly accurate and cost effective due to its computerised and intelligent capability. Medically, The intelligent image processing technique has showed to be useful for human diseases diagnoses and which therefore shown, can easily be adopted for defect detection/prediction of fruits and vegetables quality. This technique Would be very valuable in the inspection of materials of variable shapes usually encountered in the agricultural and food industry. Researcher Must keep focusing on making intelligent systems use easier and lowering the price to make it within the reach of common entrepreneur.

Narendra V.G. And Hareesh K.S. [3], presents a methodology for identification and classification of cashew kernels white wholes. The texture features are extracted using gray level co-occurrence matrix method. The multilayer feed forward neural network is developed to classify cashew kernels white wholes. An analysis of the efficiency of methodology is found 90%.The work gives an efficient model for cashew kernel white wholes identification and classification. The gray level co-occurrence method is found to be an efficient method for texture future extraction. The developed neural network model classifies six different categories of a cashew kernel white wholes with overall 90% accuracy. In this work gray scale images are considered. The classification accuracy was acquired under laboratory setting, so it had some limits. In future work, a large quantity of color features of cashew kernels will be investigated for better classification.

Lalitha Saroja Thota, Dr. Allam Appa Rao, Dr. Suresh Babu Changalasetty Dr. Hanuman Thota, Rambabu Pemula, Y.V.Phani Sankar, Siva Prasad Maroju, Akkisetty Seshagiri, , Ramakanth Medisetty, Ayman Mansour Al-Ahmari, Abdulaziz Mesrie, Abdulrahem Al-Shehri, Abdul Karim Ayed Al- Hanif. [4], have colour features was passed as input to WEKA data mining toolkit to build a classifier model to grade new cashew samples. The classifier model is tested for accuracy and was found as 86%. Unknown cashew samples are taken and their color features are extracted in Lab VIEW and grades are determined with intelligent cashew classifier model. All the cashew samples are graded correctly. The system would not only facilitate cashew grading but also serve as a quality control tool for processing facilities such as elevators, seed cleaning plants, and oil mills. The benefits of the system are reduce the employees and cost effective, make the classification process faster, improve accuracy of classification of cashew and the process will be fully automated with high speed and produce non-destructive cashews. The intelligent model may be enhanced with the texture features like length, width, thickness of cashew inorder to improve grading system.

J.Ramprabhu, and S.Nandhini [5], presents fruit quality detection system. The system design considers some features that includes fruit colors and size, which increases accuracy for detection of fruits pixels. Gaussian Mixture Model (GMM) is used for background removal, for color classification Support Vector Machine (SVM) is used. At present, most existing fruit quality detecting and grading system have the disadvantage of low efficiency, low speed of grading, high cost and complexity. The existing system method for background removal is based on histogram approach which has the disadvantage of fruit pixels being removed if it occurs as a cluster. This drawback is removed in this paper by using a pixel wise classification method called GMM. Image processing offers solution for the automated fruit size grading to provide accurate, reliable, consistent and quantitative information apart from handling large volumes, which may not be achieved by employing the human graders. The hardware prototype also created by using MSP430 ultra low power microcontroller. It will have a good prospect of application in fruit quality detecting and grading areas.

J.Ramprabhu , S.Nandhini [6], paper presents a novel defect segmentation of fruits based on color features with K-means clustering algorithm. The algorithms Gaussian Mixture Model (GMM), Support Vector Machine (SVM) are used for background removal and color classification respectively. Physical recognition of defected fruit is very time overwhelming. These days, most existing fruit superiority detecting and grading system have the drawback of low efficiency, low speed of grading, high cost and complexity. Although the color is not commonly used for defect segmentation, it produces a high discriminative power for different regions of image. This approach thus provides a feasible robust solution for defect segmentation of fruits. Image processing gives solution for the automated fruit size grading to give precise, dependable, unfailing and quantitative information apart from handling large volumes, which may not be achieved by employing the human graders. The hardware model can also be created by using PIC microcontroller. This will have a good aspect of application in fruit quality detecting industries.

Uravashi Solanki, , Udesang K. Jaliya and Darshak G. Thakore [7], conclude different color and texture techniques

for feature extraction. Each and every technique has some merit and demerits. Based on requirement we want to use method for colour and texture. Also give summaries of different classifier with its merits and demerits ANN and SVM give better accuracy then other classifier. Also see different segmentation techniques with its merits and demerits no such segmentation technique applicable in all images so use any of technique which is suitable for our application.

Shivleela R Arlimatti [8], introduces a classification system of one variety of apple fruit with nearest neighbor classifier. The system encompasses preprocessing, dividing the image into windows, features collection, window elimination and classification or decision making step. It discriminates stem end / calyx from defected skin which are natural parts of the apple fruit. Statistical features are extracted from each window and then the fruit is classified by supervised nearest neighbor classifier. Stem end and calyx part of the apple is considered as defect in initial processing. After that this class apple features are fed to the classifier to classify whether apple is defected or whether it contains stem end / calyx. The experimental results show that the proposed technique is effective and efficient than the existing technique.

In this a computer vision based automatic classification system for apple fruit is introduced. The fruit area that is foreground of the image is separated from its background by threshold method, by putting some threshold to the value plane image from HSV plane images. Then the value plane image is divided into several equal parts which are called as windows. The statistical features like mean and standard deviation are calculated. The window which contains only black part that is only background and very small part of foreground is removed from the window list. Then these features are fed to the nearest neighbor (NN) supervised classifier for fruit classification, which is simple but effective in certain tasks. The resultant will be binary classification (defected apple or non-defected apple). The apples which contain stem end / calyx are classified as defects in initial classification. Then these defect class apples are again considered as inputs and procedure is repeated for next classification. These defected apples are again classified as defected apple or stem end / calyx apple which is a natural part of the apple. The experimental results show that the proposed technique is more effective and efficient.

S.Arivazhagan , R.Newlin Shebiah , S.Selva Nidhyanandhan, L.Ganesan [9], have used of computers to analyze images has many potential applications for automated agricultural tasks. But, the variability of the agricultural objects makes it very difficult to adapt the existing industrial algorithms to the agricultural domain. The proposed method can process, analyze and recognize fruits based on color and texture features. In order to improve the functionality and flexibility of the recognition system shape and size features can be combined together with color and texture features. Further, by increasing the number of images in the database the recognition rate can be increased. This algorithm can be used for smart self-service scales.

Harshavardhan G. Naganur , Sanjeev S. Sannakki, , Vijay S Rajpurohit , Arunkumar R [10], have presents a new technique for sorting and grading of fruits. This technique begins with capturing the fruit's image using regular digital camera. The features are efficiently extracted from the query image. The color of the fruit determines its class and fruit's grade is determined by its size. The fuzzy logic technique is used for both classification and grading of fruits, as it also involves decision making by humans. The proposed technique accurately classifies and grades the fruits. The results are good for the five chosen fruits of same color and sizes. This kind of system can be employed in Agriculture Produce Marketing Corporation, etc.

The proposed method has classified fruits with same color and fruits with same sizes. But since there will some kind of fruits with same color as well as same size. For ex. fruits such as tomato and apple will be having same color and size, so there will be misclassification related to those kinds of fruits. Hence one more feature, namely texture need to be considered while classifying such kinds of fruits. The images captured are taken by using white background, hence to make a system more robust, it should be modified to provide correct output for any kind of backgrounds.

5. Conclusions

Determination of quality of any fruits is actually a complex problem but ANN technique is highly accurate and cost effective due to its computerized and intelligent capability. Medically, the intelligent image processing technique has showed to be useful for human diseases diagnoses and which therefore shown, can easily be adopted for defect detection/prediction of fruits quality. This techniques would be very valuable in the inspection of materials of variable shapes usually encountered in the agricultural and food industry. Researcher must keep focusing on making intelligent systems use easier and lowering the price to make it within the reach of common people.

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