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A Grading System For Fruits Maturity Using Neural Networks Approach

Kestina Rai*
Deptt of CSE
NITTTR,
Chandigarh,India
cecm.cse.kr1@gmail.com

Maitreyee Dutta
Deptt of CSE
NITTTR,
Chandigarh,India
d_maitreyee@yahoo.co.in

Sunil Aggarwal
ECE Deptt
UIET
Chandigarh,India
s.agrawal@gmail.com

Abstract: Jatropha Curcas is a non edible oil crop predominantly used to produce bio-diesel. In addition to bio-diesel production, the by-product of Jatropha Curcas' trans-esterification process can be used to make a wide range of products. Traditionally, human experts perform the identification of Jatropha curcas. Its quality depends on type and size of defects as well as skin color and fruit size. Then a Grading System of Jatropha (GSJ) by using color histogram method was developed to distinguish the level of ripeness of the fruits based on the color intensity. Although this automated approach was better than the human expert identification but it only deals with one aspect of the fruit, that is, color. In this paper we propose an artificial neural network approach to build an expert system to measure the ripeness of the fruit based not only on the color intensity but also on other features of the fruit like fruit size, shape of the fruit, texture, etc. because this type of a system can learn from examples like humans and can give better results.

Keywords: Artificial Neural Network, Back Propagation Network, Feedforward ANN, Pattern Recognition, Learning algorithms**.**

I. INTRODAUCTION

Oil & gas prices are escalating. The import cost of oil & natural gas today is over Rs. 120,000 crores. The presently known resources & future exploration of oil & gas may give mixed results. Keeping in mind the changing scenario, research has to be intensified in the areas of alternate sustainable energy sources such as bio-fuel. The country has nearly 63 million hectares of wasteland, out of which 33 million hectares have been allotted for tree plantation. Certain multi-purpose trees such as Jatropha curcas can grow well in wasteland with very little water. Once grown, the crop has fifty years of life. Fruiting can take place in this plant in two years. It yields up to five tons per hectare oil seeds & produces two tons of biodiesel. Presently, the cost of biodiesel through the plant is approximately Rs. 17 to Rs. 19 per litre, which can be substantially reduced through choice of right size of the plant & using high yield variety plantation. Jatropha locally known as Ratanjot belongs to family Euphorbiaceae & shows resemblance with castor. In India about nine species are reported out of which Jatropha curcas has economic value by virtue of oil present in its seed.

As a biological diesel fuel the jatropha curcas is a renewable and environment-friendly fuel, it is a typical green fuel. Therefore, it could accelerate the speed of energy replacement which use oil tung as a biological energy, ease the shortage of energy, and realize the sustainable development of the energy at the same time. They are identified by the nature of little pest, strong anti-drought and wide adaptability.

The global debate on Climate Change/CO2 emissions and domestic concerns on economic, environmental and energy security implications have necessitated alternative energy options and created opportunities for sustainable biofuel enterprise. Jatropha curcas is an uncultivated wild-species plant with great potential for bioenergy development in the country.

II. LITERATURE REVIEW

The training of an ANN is mainly undertaken using the back propagation (BP) based learning algorithm, which is a supervised algorithm. Detail study of Back propagation algorithm is discussed in [1].

In [2], R.P.W. Duin described that the two opposite ways to build a scientific description of the world (Platonic and Aristotelean approaches) may be applied in the area of pattern recognition to both, external examples, as well as to our own internally observed recognition abilities. In [3], Jayanta Kumar Basu discussed that among the various traditional approaches of pattern recognition the statistical approach has been most intensively studied and used in practice. In [4], John Peter Jesan explained that the act of recognition can be divided into two broad categories: recognizing concrete items and recognizing abstract items.

In pattern recognition and in image processing, feature extraction is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant (much data, but not much information) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input.

In [5], in order to extract useful features of captured images of bulk raisins by image processing technique, an efficient algorithm was developed and implemented in visual

basic language. In [6], Woo Chaw Seng explained that different fruit images may have similar or identical color and shape values. In [7], Zulham presented the development of a Grading System of Jatropha (GSJ) by using color histogram method to distinguish the level of ripeness of the fruits based on the color intensity.

In [8], a face recognition system for personal identification and verification using Genetic algorithm and Back-propagation Neural Network was proposed. In [9], Zulhadi tested different feed forward Artificial Neural Networks (ANN) in which the neuronal signals were processed by a nonlinear hidden layer of units, which used the tan-sigmoid output function that fed into a linear output layer that predicted the position signals. In [10], Atanu Chatterjee introduced a new method for fingerprint identification technology by minutiae feature extraction using back-propagation algorithm.

In [11], Pedro J. Zufiria explained improvements on a neural network structure composed by a multilayer perceptron (MLP) with a preprocessing neural net, in order to perform translation, rotation and scale invariant pattern recognition. In [12], G. Rennick compared five classifiers including the K-means, Fuzzy c-means, K-nearest neighbour, Multi-Layer Perceptron Neural Network and Probabilistic Neural Network classifiers for application to colour grade classification and detection of bruising of apples. In [13], Z. Effendi explained the need and importance of the fruit Jatropha and also explained the usage of Back propagation neural network pattern recognition tasks.

In [14], Shie-Jue Lee and Hsien-Leing Tsai proposed a feature recognition neural network to reduce the network size of Neocognitron by incorporating the idea of fuzzy ARTMAP in the feature recognition neural network.

In [15], H. Fu and Z. Chi proposed an artificial neural network (ANN) classifier to extract leaf veins. In [16], Michael Recce & John Taylor described a novel system for grading oranges into three quality bands, according to their surface characteristics. In [17], Jesús Brezmes had proposed a ripeness evaluation technique so that potential losses to the grower and packer, as well as fast spoilage at the consumer end, could be minimized. In [18], the research developed a back propagation neural networks to identify the Jatropha curcas fruit maturity and grade the fruit into relevant quality category.

III. PROPOSED APPROACH

In the literature survey given above various schemes have been described for recognizing patterns of different images, be it face or fingerprints or fruits or any other static image. It has been observed that introducing artificial neural network for solving the problem always improved performance. So depending on the schemes discussed so far a new method is proposed where an attempt is made to extract certain features of fruits and then use those features to train a back propagation neural network & recognize patterns of these fruits by grading them into different categories. Because this algorithm can learn from examples therefore it results in more accuracy.

This research develops a back propagation neural network to identify the Jatropha curcas fruit maturity and grade the fruit into relevant quality category. 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 for recognition of the Jatropha curcas fruits. This study presents a pattern recognition system of Jatropha curcas using back propagation. The training data set for back propagation has 4 levels of grading i.e., raw, fruit-aged, ripe and over ripe with images of Jatropha curcas fruits. At the end of the training, the neural network achieves its performance function by testing with a selected set of different images.

The grading of Jatropha Curcas depends on a number of factors. In the open literature, previous research papers have taken into consideration variables such as color [7].This study utilizes advantages of such experience and introduces other new important variables such as size, shape and texture. Variables in the input layer are color, size, shape and texture.

A representative schematic diagram of the ANN used is depicted in the figure given below:

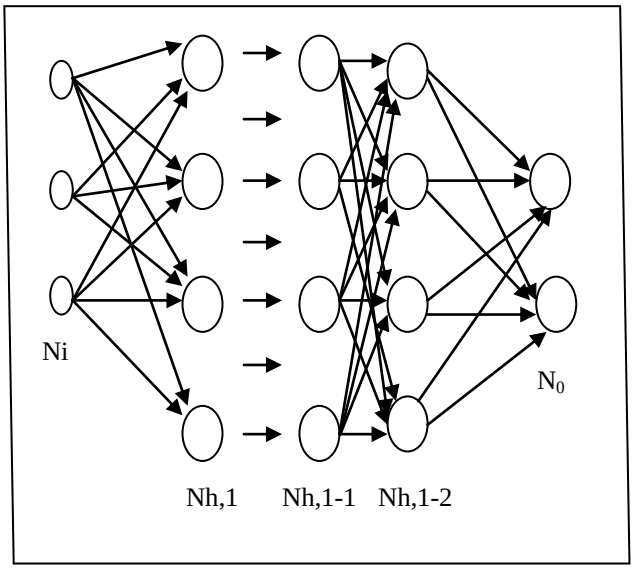


Figure 1. Schematic diagram of ANN

The back propagation neural network is represented as the weighted sum:

$Aj(x',\omega')=\sum_{i=0} xiwji$

Where:

Aj (x',ω') = Back propagation

xi = Input

wji = Weights

IV. EXPERIMENTAL RESULTS

The work done is basically divided into 3 stages.

The first stage basically consists of extracting features from the images of Jatropha curcas fruit. The features being used here are color, size, shape and texture.

In the second stage a neural network is trained using the inputs received from the first stage.

And in the third stage a performance analysis is done on some of the images from the training data.

Color is extracted from Jatropha fruits in the form of RGB values. In this research, a color analyzer is designed which takes as input the images of Jatropha fruit and then extracts color in the form of RGB components.

Initially 6 images of jatropha curcas are used and fed to the analyzer.


Image 1


Image 2

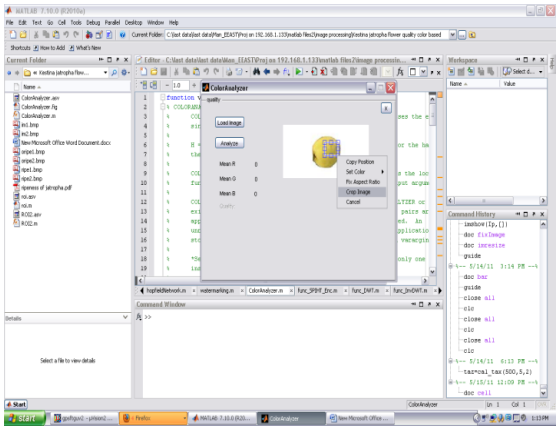

Image 3

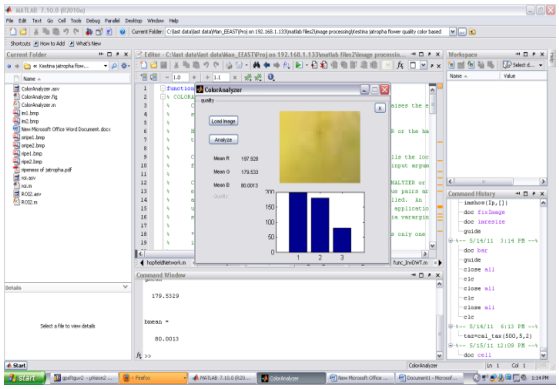

Image 4


Image 5


Image 6

The snapshots of the analyzer which extracts color from the above images are given below:





It is seen in the snapshots that using MATLAB the image is cropped first and then from the region of interest the pixels Red, Green and Blue values are calculated. These RGB values will be used as an input to train the neural network. Other features of interest to be calculated are size, shape and texture.

V. CONCLUSION

Jatropha curcas has the potential to become one of the world's key energy crops. Crude vegetable oil extracted from the seeds of the Jatropha plant, can be refined into high quality biodiesel. Traditional identification of Jatropha curcas fruit is performed by human experts. The Jatropha curcas fruit quality depends on type and size of defects as well as skin color and fruit size. This research develops a back propagation neural network to identify the Jatropha curcas fruit maturity and grade the fruit into relevant quality category.

Color feature is extracted from 6 Jatropha images in the form of RGB values.

Further, in this direction my future work is to extract other features like size, shape and texture from a few more images. Then I would implement a back propagation neural network to classify the fruits into different categories like ripe, over ripe and raw.

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