BPNN Approach in Pixel Classification based Precision Segmentation for Agriculture Images

Rajesh S. Sarkate
Dept. of Computer Sci. & IT,
MGM College of CS &IT,
Nanded.

Khanale P.B, Ph.D
Dept. of Computer Science,
DSM College,
Parbhani.

Thorat S. B., Ph.D
Dept. of Computer Science,
ITM College,
Nanded.

ABSTRACT
Segmentation is a main process in the object recognition. Many times success of object recognition process depends on the precision of segmentation. The application of image processing technology, in the agricultural research, has made significant development [1]. With the advance processing capacity, soft computing and computer has attracted it as an alternative to human work [2]. In this paper, application of BPNN is plaid for segmenting gerbera flowers from offline Polyhouse images. Image segmentation is the foundation of many image analysis problems; any segmentation method with precision can positively influence the analysis process. [3]
The agriculture images are subject to more complexes to process as they contain different size; shape objects and suffers from illumination, noise making segmentation more erroneous. The current study uses offline images captured from the natural scene of Polyhouse at arbitrary time. The flowers are segmented using Back propagation neural network. Total 30 images are used in the experiment where 10 images are used as training set and 20 images are used for testing data set. The input vector for the BPNN consist the color feature vector in form of R, G, B values extracted from every pixel, and BPNN classification divides the pixels into non flower pixel or flower pixel regions, giving segmentation.

Keywords
BPNN, Segmentation, Precision, Computer vision, object detection, Gerbera, image processing

1. INTRODUCTION
Use of computer vision is not new to agriculture. Crop disease detection [4][5][6], fruit quality [7][8], flower processing [9][10]**,** Crop area or yield estimation [11][12] are some areas of agriculture that uses computer vision for processing and analyzing related data. Automated harvesting using computer vision has also been tested successfully for the rose flower [13].
Image segmentation is a process of separating objects (foreground) from the background, on the basic of some features. In [14], the feature is defined as one or more quantifiable property of an object that represents some significant characteristics of the object. Color [10] is considered a fundamental physical property of agriculture products and foods in information analysis [15]. Images characterized by color features have many advantages like Robustness, Effectiveness and Computational simplicity. The objects are mostly discriminated on the basis of its color [16]. Variety of methods like color histogram [10]. H component, [17], Otsu method [18], clustering [16], knowledge driven are been used in the color image segmentation[19].
Back propagation neural network is commonly used in the process of classification. The task of classification is to assign the input pattern to one of the predefined classes. Image segmentation caries same process of classifying the input pattern of pixels into two classes; 1-interested and 2- not interested. The process of segmentation appears to be very simple but the accuracy of the segmentation is what matters.

2. PAST RELATED WORK
ANN is often used by researchers for segmentation purpose. ANN was used for segmenting the handwritten text in Assamese with good accuracy [20]. The study for determining the ripeness of a banana, a neural network model was used with help of color information as input [21]. Another study conducted for detection of palm oil leaf disease with image processing and neural network classification on mobile device [22]. ANN was successfully used in Prediction of sweetness and amino acid content in soybean crops from hyper spectral imagery [23].
The successful application of MLP is used in segmenting grey-level images, to segmentation of industrial radiographic images. to classify pixels in a text segmentation application, for detection of tumors in ultrasound medical images [24].

3. MATERIALS AND TOOL
To perform the study, Image acquisition and database collection of this work are done in the Polyhouse near Nanded city. The Polyhouse is built on 5000 square feet with all necessary techniques required for better cultivation of gerbera flowers. The images are taken with the help of digital camera with 10 mega pixels capacity. An image set of 20 images are considered in the experiment.
The image processing and analysis is performed using MATLAB 7.0 software with neural network and image processing toolbox. The computer system, with core 2 duo microprocessor and 2 GB of primary memory, is used to get fast and accurate image processing operations. This high computational power gives the ability, in the initial phase, to process the images captured in the field as is. The neural network output strongly depend on correct input, for that reason in actual experiment, images collected from the Polyhouse are preprocessed with filtering and cropping methods for noise removal and removal of objects that may affect the result. The experiment of detecting flowers is carried out on the sample images taken from the Polyhouse. View of entire Polyhouse is difficult to capture in single image. Also image containing big area of Polyhouse may result in blurring and thereby poor discrimination of the flowers. Therefore, images are taken in parts of the Polyhouse.

3.1 BPNN Architecture
The algorithm used to train the network is the Multi layer feed forward neural network with Backpropagation. In back propagation algorithm, gradient descent is used to update the weights so that the squared error between the network output values and the target output values will be minimized. A

typical BPNN model consists of an input layer, hidden layer(s), and an output layer as shown in Figure 1.
For BPNN modeling, error is back-propagated to the hidden layer each time and subsequently to the input layer with each iteration. Then, the weights connecting the input neurons to the hidden neurons changed randomly to minimize the distance between the desired values and the actual output.
The BPNN model performances are evaluated based on Sum Squared Error (SSE) and Root Mean Square Error (RMSE). The equation for SSE and RMSE is given by

$$SEE = \sum(Tpi - Ypi)^2 \qquad \ldots.(1)$$

$$RMSE = \sqrt{MSE} = \sqrt{SSE/n - p} \qquad \ldots. \quad (2)$$

Where n is the number of observation, p is the number of parameter to be estimated and SSE and MSE are the sum of squared error and the mean square error, respectively

3.2 Network Design

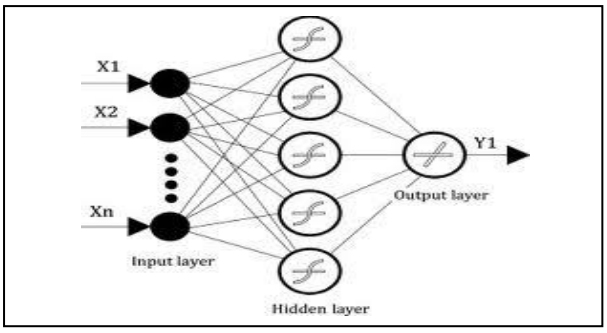

Figure 1: BPNN architecture

In this study, the back propagation neural network is designed with three layers; input, hidden and output. We have used two different neural networks structures for the segmentation purpose. The network has R, G, B values of every pixel as input, forming three neuron input layer. One hidden layer with 20 neurons fabricates the processing part of neural network. BPNN contained only one neuron at output layer, producing the values from 0 to 1.
BPNN approach transformed the image segmentation problem into a pixel classification problem [24]. Using HSV color space and histogram analysis, flower color definition is done [17]. Then by the image segmentation process, flowers are separated from the background & detected in the images. Image set with 20 images are tested with this technique Neural Network

3.3 Network Training

Total 30 images are used in this study, 10 images that are input to be used as training set, are segmented with histogram thresholding method based on the flower color values [17]. Output of thresholding process is the set of 10 binary images containing only flower regions. Remaining 20 images are used for the testing.
The errors are calculated and weights are adjusted accordingly. BPNN is trained for 100 epochs for every training set image. In actual, the network got trained within 6-8 epochs for Gerbera flowers and 10-12 epochs for Marigold flowers. Finally, 20 images from test image set are tested for the segmentation.

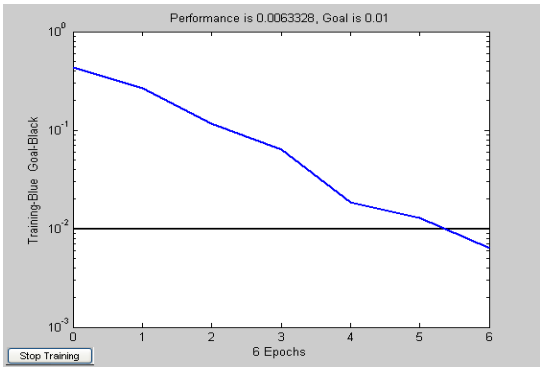

Figure 2: Network Training

4. EXPERIMENT AND RESULT

All experiments are done on core2 duo 2.2 GHz with 2048 RAM under Matlab 7.0 environment. In the experiments, 30 images are employed. The images are taken from two domain i.e. there are 15 gerbera flower images and 15 images of marigold flowers. For these images, all of them are taken by digital camera (Nikon) from various scenes and under different lighting conditions of the real world, varied distances from the flowers. The distance between the camera and the flowers varied from 1 up to 4 meters and the camera is focused in the expected flower regions. The sample results of segmentation are shown in figure 2 and figure 3.

Figure 2: Segmentation results for Gerbera flowers

Figure 3: Segmentation results for Marigold flowers

5. CONCLUSION

The study has shown the successful implementation of Backpropagation neural network for purpose of segmentation. In this research, the system is able to fulfill the research objective by separating flowers in the image. The system has used 20 images in the experiment. The designed network performance found to be impressive in detecting flowers

present in the images. The quality of images used for training plays important role in network performance.

6. FUTURE WORK

The study focuses on use of Backpropagation neural network for the purpose of image segmentation. It is been observed that BPNN is a strong alternative to other segmentation methods like thresholding, clustering etc. In future, the efficiency of this approach needs to be compared with other methods.

7. REFERENCES

[1] A Processing in Agriculture : A Survey," vol. 52, no. 2, pp.. Vibhute and S. K. Bodhe, "Applications of Image 34–40, 2012.

[2] F. Mendoza, P. Dejmek, and J. M. Aguilera, "Predicting Ripening Stages of Bananas (Musa cavendish) by Computer Vision," no. 1, 1997.

[3] A. A. Ahmed, M. Vias, N. G. Iyer, C. Caldas, and J. D. Brenton, "Microarray segmentation methods significantly influence data precision.," *Nucleic Acids Res.*, vol. 32, no. 5, p. e50, Jan. 2004.

[4] S. Weizheng, W. Yachun, C. Zhanliang, and W. Hongda, "Grading Method of Leaf Spot Disease Based on Image Processing," *2008 Int. Conf. Comput. Sci. Softw. Eng.*, pp. 491–494, 2008.

[5] I. S. Ahmad, J. F. Reid, M. R. Paulsen, and J. B. Sinclair, "Color Classifier for Symptomatic Soybean Seeds Using Image Processing," *Plant Dis.*, vol. 83, no. 4, pp. 320–327, Apr. 1999.

[6] G. Anthonys and N. Wickramarachchf, "An Image Recognition System for Crop Disease Identification of Paddy fields in Sri Lanka," pp. 403–407, 2009.

[7] H. Saad, A. P. Ismaie, N. Othman, M. H. Jusohl, N. A. Ahmad, and K. P. Pinang, "Recognizing The Ripeness Of Bananas Using Artificial Neural," pp. 536–541, 2009.

[8] S. Cubero, E. Moltó, N. Aleixos, A. Gutiérrez, F. Juste, and J. Blasco, "Machine Vision System for the In-line Inspection of Fruit on a Mobile Harvesting Platform in Field Conditions," no. August 2010, pp. 26–27.

[9] F. J. Adamsen, T. A. Coffelt, J. M. Nelson, E. M. Barnes, and R. C. Rice, "Crop Ecology , Management & Quality Method for Using Images from a Color Digital Camera to Estimate Flower Number," pp. 704–709, 1997.

[10] A.-X. Hong, G. Chen, J.-L. Li, Z.-R. Chi, and D. Zhang, "A flower image retrieval method based on ROI feature.," *J. Zhejiang Univ. Sci.*, vol. 5, no. 7, pp. 764–72, Jul. 2004.

[11] M. Soltani and M. Omid, "A New Mathematical Modeling of Banana Fruit and Comparison with Actual Values of Dimensional Properties," vol. 4, no. 8, pp. 104–113, 2010.

[12] F. Cointault and P. Gouton, "Texture or Color Analysis in Agronomic Images for Wheat Ear Counting," *2007 Third Int. IEEE Conf. Signal-Image Technol. Internet-Based Syst.*, pp. 696–701, Dec. 2007.

[13] A. Kohan, A. M. Borghaee, M. Yazdi, S. Minaei, and M. J. Sheykhdavudi, "Robotic Harvesting of Rosa Damascena Using Stereoscopic Machine Vision," vol. 12, no. 2, pp. 231–237, 2011.

[14] T. Arif, Z. Shaaban, L. Krekor, and S. Baba, "Object Classification Via Geometrical , Zernike And Legendre Moments," 2009.

[15] M. H. Razali, W. I. Wan Ismail, A. R. Ramli, M. N. Sulaiman, and M. H. Harun, "Development of Image Based Modeling for Determination of Oil Content and Days Estimation for Harvesting of Fresh Fruit Bunches," *Int. J. Food Eng.*, vol. 5, no. 2, Jan. 2009.

[16] A. Z. Chitade, "Colour Based Image Segmentation Using K-Means Clustering," vol. 2, no. 10, pp. 5319–5325, 2010.

[17] R. S. Sarkate, N. V. Kalyankar, and P. B. Khanale, "Application Of Computer Vision And Color Image Segmentation For Yield Prediction Precision," *2013 Int. Conf. Inf. Syst. Comput. Networks*, pp. 9–13, Mar. 2013.

[18] N. N. Kurniawati, S. N. H. S. Abdullah, S. Abdullah, and S. Abdullah, "Investigation on Image Processing Techniques for Diagnosing Paddy Diseases," *2009 Int. Conf. Soft Comput. Pattern Recognit.*, pp. 272–277, 2009.

[19] L. Busin and N. Vandenbroucke, "Color Space Selection For Unsupervised Color Image Segmentation By Histogram Multithresholding Laboratoire LAGIS - UMR CNRS 8146 Université des Sciences et Technologies de Lille Bâtiment P2 59655 Villeneuve d ' Ascq - FRANCE Ecole d ' Ingénieurs du Pas-de," pp. 203–206, 2004.

[20] K. Bhattacharyya and K. K. Sarma, "ANN-based Innovative Segmentation Method for Handwritten text in Assamese," vol. 5, pp. 9–16, 2009.

[21] R. P. Krishnan, S. Sofiah, and M. Radzi, "Color Recognition Algorithm using a Neural Network Model in Determining the Ripeness of a Banana," no. October, pp. 11–13, 2009.

[22] A. F. Aji, Q. Munajat, A. P. Pratama, H. Kalamullah, J. Setiyawan, and A. M. Arymurthy, "Detection of Palm Oil Leaf Disease with Image Processing and Neural Network Classification on Mobile Device," *Int. J. Comput. Theory Eng.*, vol. 5, no. 3, pp. 528–532, 2013.

[23] S. T. Monteiro, Y. Minekawa, Y. Kosugi, T. Akazawa, and K. Oda, "Prediction of sweetness and amino acid content in soybean crops from hyperspectral imagery," *ISPRS J. Photogramm. Remote Sens.*, vol. 62, no. 1, pp. 2–12, May 2007.

[24] C. Amza, "A Review On Neural Network-Based Image Segmentation Techniques," no. 1, pp. 1–23.