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Image Segmentation with Artificial Neural Networs Alongwith Updated Jseg Algorithm

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***Abstract**: Image segmentation plays a very crucial role in computer vision. Computational methods based on JSEG algorithm is used to provide the classification and characterization along with artificial neural networks for pattern recognition. It is possible to run simulations and carry out analyses of the performance of JSEG image segmentation algorithm and artificial neural networks in terms of computational time. A Simulink is created in Matlab software using Neural Network toolbox in order to study the performance of the system. In this paper, four windows of size 9*9, 17*17, 33*33 and 65*65 has been used. Then the corresponding performance of these windows is compared with ANN in terms of their computational time.*
***Keywords:** ANN, JSEG, spatial segmentation, bottom up, neurons.*

I. Introduction

Segmentation of an image entails the partition and separation of an image into numerous regions of related attributes. The level to which segmentation is carried out as well as accepted depends on the particular and exact problem being solved. It is the one of the most significant constituent of image investigation and pattern recognition method and still considered as the most challenging and difficult problem in field of image processing. Due to enormous applications, image segmentation has been investigated for previous thirty years but, still left over a hard problem. Image segmentation is not anything other than a pixel classification. Several segmentation algorithm proposed in literature [1],[2],[3] were designed to process images initially characterized by complex objects, textures, shadows and brightness. Pal and pal [4] provided a detail review on image segmentation techniques. Multi class image segmentation is crucial step towards image understanding [5] and has a variety of applications related to consumer electronics fields such as image annotations and image editing and also content base image retrieval [6]. JSEG [7] introduces a notion of "J –image" to measure the confidence of pixels to be boundaries or interiors of color textured regions, and uses a region growing technique to segment the image based on J image. JSEG is one of the popular and simple segmentation algorithms. Beside this, artificial neural networks (ANN) and genetic algorithm are also used for image segmentation [8]. Chao wang et.al proposed a multistage segmentation method of oil spills Synthetic Aperture Radar images using JSEG and spectral clustering [9]. T. Brodson presented the recent developments and applications in image analysis in food industry using JSEG [10]. In this paper we deal with images of natural scenes and segmentation is done with improved JSEG algorithm with modified K means clustering along with artificial neural network.

1.1 Problem Formulation

Image segmentation is a process of separating images into small section that can be used as meaningful objects in computing and searching techniques. These segments are developed by using a number of processing techniques that are clustering, J-fractal image calculation. In Bottom Up approach techniques like JSEG, pixels of image are processed and divided into classes. These classes are used for indentifying image segments, once pixels are labeled using classes. The classes are clustered to divide image pixels and for image segments. Existing JSEG image segmentation technique uses K-Means for clustering. But there are a number of clustering variations of K-means available which can be used for improving results of image segmentation. K means clustering algorithm suffers from problem of over segmentation which is a big problem in process of segmentation in case of JSEG. We will be experimenting with available clustering techniques for building image segmentation. Many of existing segmentation techniques such as direct clustering methods in color space work well on homogeneous color regions. Natural scenes are rich in color and texture. Parameter estimation is a difficult problem and requires good homogeneous region for robust estimation. A new approach called JSEG is proposed towards this goal. This approach does not tend to estimate a specific model for a texture region. It test for the homogeneity of a given color pattern, which is computationally more feasible method. JSEG algorithm can be improved by adding enhanced classification and modified K means clustering.

II. Proposed Method

In this paper, segmentation of natural scene images are carried out with updated JSEG method along with artificial neural networks. Due to nature of non linear vectors, ANN based classification method associated with pattern recognition is used. Multi layer perceptron is appropriate for default ANN topology to be implemented through a customized back propagation algorithm for complex patterns.

2.1 Artificial Neural Network

An artificial neural network is a scheme based on the process of biological nervous system. It resembles the functioning of our human mind. These systems are information dispensation model and are motivated by the way, the human intelligence works. The basic processing elements of neural networks are called artificial neurons [11] or simply neurons. Neurons may share some properties of biological neural networks. It is an adaptive system that changes its configuration based on internal or external information that flows from end to end through the system. Learning in genetic or biological system involves alternation in synaptic relations that exists among neurons. This is exact used for ANN as well. They are dominant tools for modeling particularly when the original data relationship is not recognized. ANN can learn by examples. After training, they can be used to forecast the outcome of new independent input data.

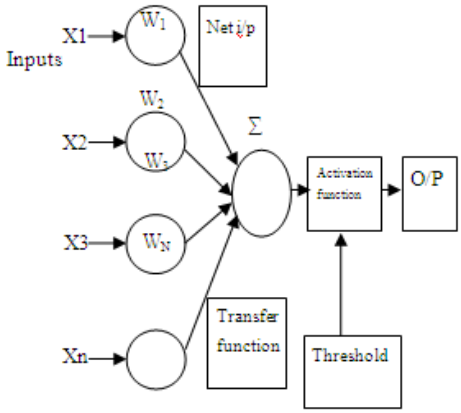

Figure 1: Artificial neural network

The figure 1 shows that there are N inputs to the system and associated weights up to $w_{N.}$. In a simple mathematical model of neuron, the effects of the synapses are represented by connection weights that modulate the effect of associated input signals and the non linear characteristics exhibited by the neurons that are represented by the transfer function [12]. Weights are directly related with the learning capability of the system.

2.1a Types Of Learning In Ann

Learning is the part and parcel property of ANN. There are three types of learning in ANN. They are supervised learning, unsupervised learning and reinforced learning.

Supervised learning: - This type of learning is based on error between output and input data. A teacher or supervisor is offered during learning process and offered projected output. Training is done on each and every input pattern. Learning process is based on comparison between expected output and obtained output. The error generated is used to adjust network parameters that results better and improved output. Global information should be there to accomplish supervised learning. This method of learning is offline as its learning period and operation period are different. Least mean square and back propagation networks are examples of supervised learning.

Unsupervised learning: - In this type no teacher is presented to teach to the network. Unsupervised learning is very complex and difficult to implement [13]. The desired outcome is not presented to the network. The system learns of its own by discovering and adapting to the structural features in the input sample of data. It is based only on the local information. A neural network is said to learn online if it learns and operates at same time. This type of learning is online and hence used in our approach. Examples of this learning are Hebbian learning and competitive learning.

Reinforced learning: - This type of learning is output based learning. Although a teacher existed during the procedure but, the teacher is not going to present the actual output. The teacher only indicated whether the output is correct or incorrect. A reward is given for each correct answer and a penalty is applied for each wrong response. It is least used type of learning method in ANN.

2.1.b. Advantages of ANN

ANN offers certain advantages:-

- **Robustness:-** ANN is robust in nature. They are able to cope with number of difficult situations. The decay of nerve cells does not tend to affect the performance of the system at all.
- **Fault Tolerance:-** ANN is capable of finding fault themselves. The easiness of detecting errors is crucial characteristic of neural networks.
- **Parallel Computation:-** The networks performs in a parallel and corresponding distributed way which leads to increase in speed and rate of the operation.
- **Flexibility:-** ANN have the ability to adjust automatically to new environment without any pre programmed instructions. It regulates itself with surroundings without any human intervention.
- **Mapping capabilities:-** ANN exhibits mapping capabilities. They can map input patterns to their associated output pattern [14].
- **Adaptive learning: -** The skill to discover how to do different tasks on the data specified for training or initial practice.
- **Self organization: -**An ANN knows how to generate its own organization or illustration of the information it receives throughout its learning instant.
- **Real time operation: -** ANN calculations can be approved in parallel and particular hardware procedures are being deliberated and manufactured which take benefit of this potential.

2.2 JSEG

JSEG stands for j value segmentation. It is the very powerful method to test the homogeneity of the image with given color consistency pattern and is quite efficient in computational terms. Image segmentation is one of significant mission in computer vision. Segmentation subdivides an image into its constituents regions and objects. Segmentation is the process of observing the image and dividing the contents inside the image into various segments having common characteristics such as color, semantics meaning etc. Segmentation in images is done in order to simplify the representation of images into something that is meaningful and easier to analyze. JSEG algorithm is used to segment color images with homogeneous regions to generate clusters in the class. JSEG make use of unsupervised type of learning. It deals with the following assumptions for the acquired image:-

- Image containing identical and uniform color surface regions.
- Color information is represented by quantized colors.
- Color among two adjoining and boundary regions is distinguishable.

JSEG is a bottom up approach and make use of spatial segmentation. JSEG is a classical approach for classification. JSEG is based on the concept of region growing. JSEG is robust method of segmenting natural images. The JSEG algorithm simplifies color and texture of images. Basically, JSEG algorithm segments the images of natural scenes properly. Segmentation of natural scene images is quite difficult and complex task because unlike artificial and synthetic images, they are composed of more or less pure textures and the texture properties are not well defined. There is no need to adjust parameters manually for each image. In JSEG, a spatial segmentation algorithm is employed on a quantized class map. In the spatial segmentation, the J image which represents the region interiors and region boundaries is deliberated using a homogeneity evaluation J. After that, a random class region growing and region merging algorithm is performed which is used to segment the image. It offers estimation and assessment of color textures. JSEG algorithm consists of three stages- Color space quantization, hit rate regions and similar color region merging.

i) **Color space quantization**: - Color space quantization minimizes the number of separable colors used in an image in such a way that the new image created should be visually analogous to the original image. The color quantization quantizes the colors in image into several representative classes that can differentiate regions in the image [15]. A variety of algorithms are used for color space quantization. Quantization is carried out with minimum coloring. Each color is associated with a class. Pixels in original image are replaced by classes to form the class map. Various colors are quantized in image into several representative classes that can differentiate regions in the image. Spatial distribution of colors is not considered in color space quantization.

ii) **Hit rate regions**: -Before performing hit rate regions, J-image must be created. J-image is a class map for each windowed color region, where positive and negative values represents edges and textures of the processing image. The pixels values used as a similarity algorithm for the hit rate region. These values are called 'J-values'. These values are calculated from a window placed on the quantized image, where the J-value belongs [16].

iii) **Similar color region merging:** - Segmentation of natural images is by far a difficult task, since natural images exhibits significant in homogeneities in color and texture [17], [18].This stage is employed to verify the homogeneity of images. Images of similar color and same visual distinctness are merged together simultaneously with the help of diverse algorithms. Histograms are used for region merging. Histogram merging is the universal contrast handling practice, which improves the images from human visual perceptive. Histogram

equalizes the saturation and intensity components in the images. They are quite efficient and competitive method in terms of time complexity.

2.2a Methodology used in JSEG

The scheme of JSEG is to spill the segmentation process into two stages discussed above- color quantization and spatial segmentation.

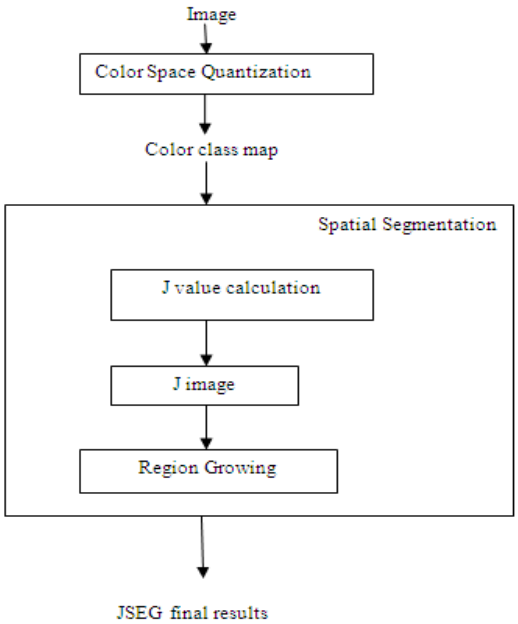

Figure 2: Methodology used in JSEG

First step is to quantize unlike colors of images into separate classes that can be used to spot various regions in an image. Pixels in image are replaced by corresponding and equivalent color class labels, forming a class map of the image. The main focus is on spatial segmentation, where a principle for "good" segmentation using the class map is projected. Apply the criterion to local windows in the class map outcomes in the "J-image", in which high and low values corresponds to possible boundaries and interiors of color texture regions. Region growing method is used to segment the image based on multi-scale J images. They are based on similarity between the pixels in the region. Region growing provides a number of segmentation maps which contains huge figure of segments. The scales used in region growing method are important parameters in order to determine the accuracy of the segmentation process.

2.3 Advantages of JSEG

- JSEG works on images of natural scenes which composed of complex objects, textures, shadows and brightness.
- JSEG algorithm has very good computational capability and is a robust algorithm.
- JSEG algorithm does not require any pre processing and post processing techniques, also there is no need to adjust parameters manually.
- JSEG can be applied to both structured and non structured objects. Non structured objects are those which do not have any specific shape like river, sky.

III. Methodology Used

The methodology used in this approach is summarized as follows:

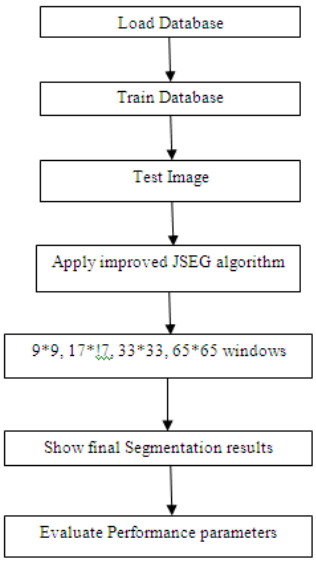

Figure 3: Methodology used

Step1: Load image: This is the first step in which image is loaded into the system directly. When we click on load database, the system will ask for how many images you wanted to load into the system for performing the process of segmentation. In this approach we make use of 8 images. These images are directly loaded into the system as shown in figure 5.

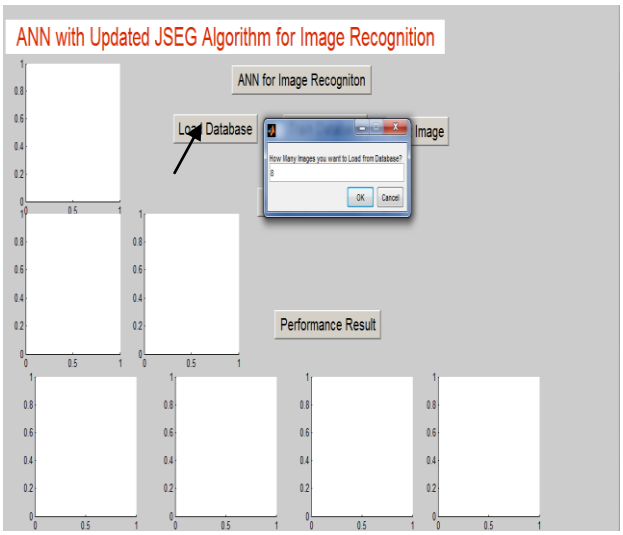

Figure 4: Loading of database into the system

Step 2: Train database: In this step, neural network is trained. In the figure 5, when we click on train database, the training of neural network starts. In figure 6, it has been shown that the system takes 126 iterations to be trained successfully. Once the system has been initialized, it is ready to train. Number of characteristics is considered while training neural network like how many iterations the system will take to train itself, time taken to train the system, performance, gradient, validation checks. The value of these parameters varies from image to image. For this image the value of performance and gradient are 0.0913 and 0.0512 respectively. The error generated here is gradient error. Gradient means change of error energy with respect to weight value. Training in neural network involves finding the least value of a complicated non linear function called error function. In our system, we have set 5000 iterations but the network trains in taking 126 iterations also called epos. There is also choice of selecting how many images we want to train. Here we have chosen 8 images as shown in figure 5. Training is very important process in neural network. Due to this feature we call it that the neural network resembles the working of human brain in its functionality. It learns what we taught to it .

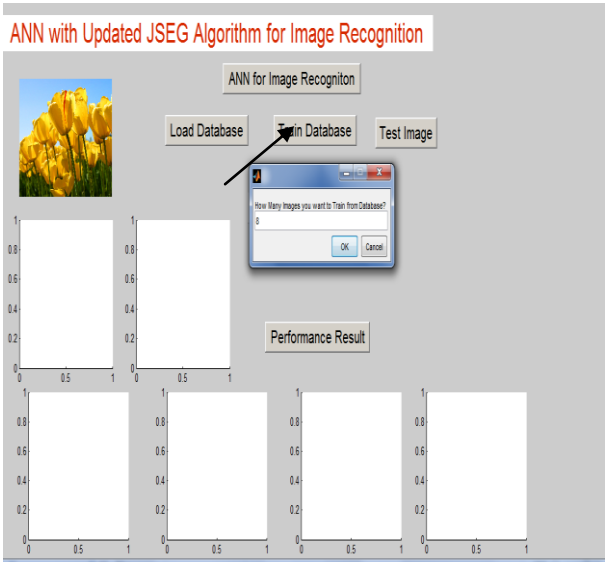

Figure 5: Training of database

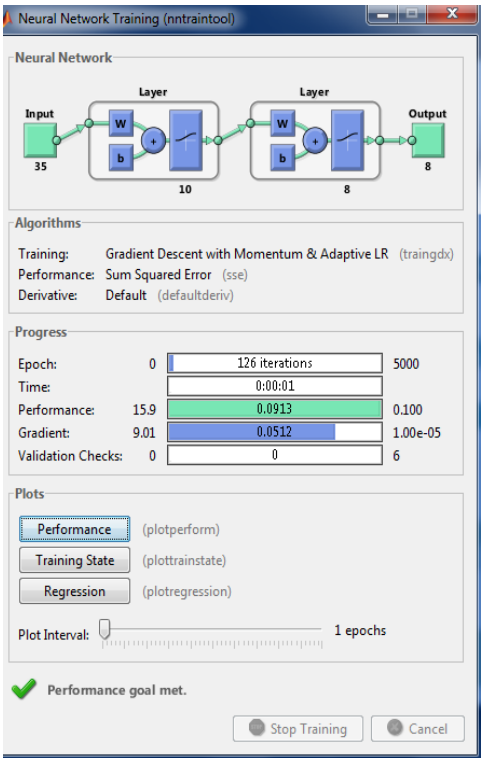

Figure 6: Training of neural network successfully

Step 3: Test Image: In this step, testing of image has done. The image loaded into the database has been matched with the image to be trained. In figure 7 it has been shown that the test image has matched with 8th image from the database loaded in the system. Now the matched image is ready to perform the process of segmentation.

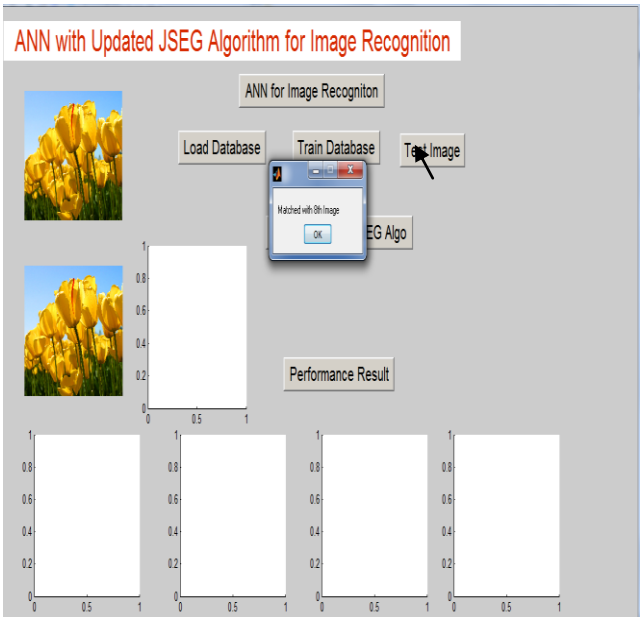

Figure 7: Testing of image from database

Step 4: Apply improved JSEG algorithm: JSEG method consists of various windows. The windows used here are 9*9 windows, 17*17 windows, 33*33 windows and 65*65 windows. The size of the window is inversely proportional to the number of pixels in the image. The size of the window affects the performance of the segmentation results. J values are calculated on these windows centered over pixels. Window dimensions determine the size of image regions, for intensity and color boundaries in images. The larger window size detects the region boundaries and the smaller window size referred to change in intensity. By varying the window size**,** multistage J images can be calculated and process of segmentation on different images can be performed.

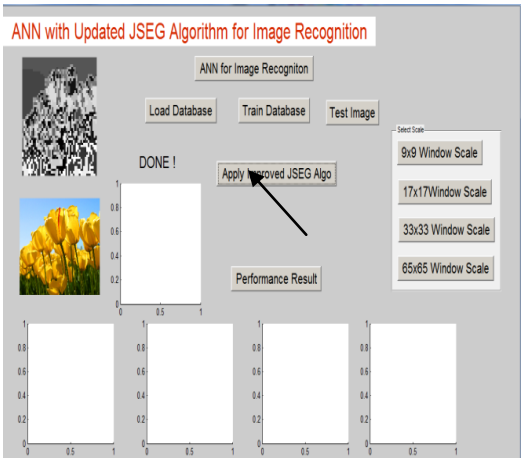

Figure 8: Segmentation by improved JSEG

Step 5: Show final Segmentation Results: In this step, segmentation results with four windows using improved JSEG method have been shown. We can easily make comparison between different segmentation windows with help of final segmentation results.

Step 6: Performance Parameters: Different types of performance parameters are compared in this step. Various parameters are computational time, performance, training state, regression. The results of segmentation are related to the performance of these parameters.

IV. Results

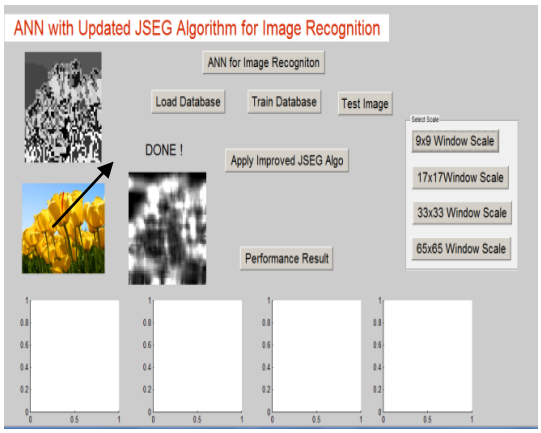

Figure 9: Segmentation by improved JSEG 9*9 windows

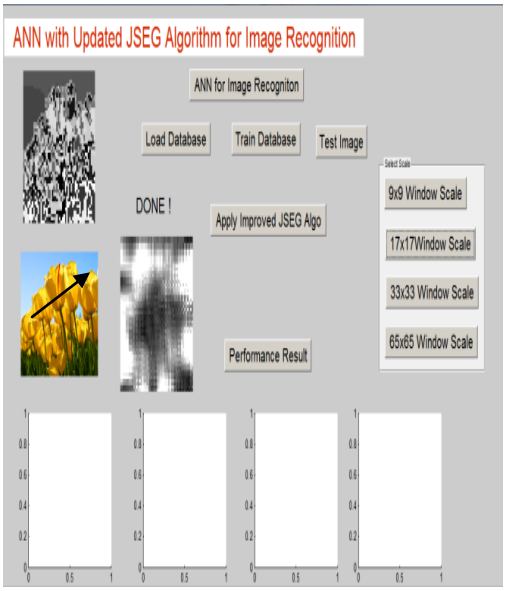

Figure 10: Segmentation by improved JSEG 17*17 windows

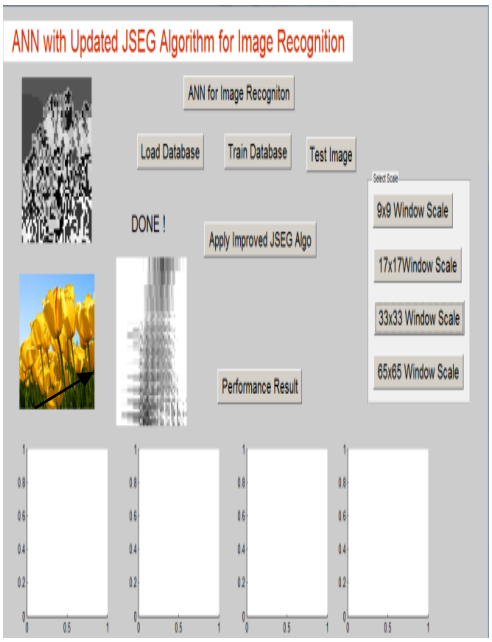

Figure 11: Segmentation by improved JSEG- 33*33 windows

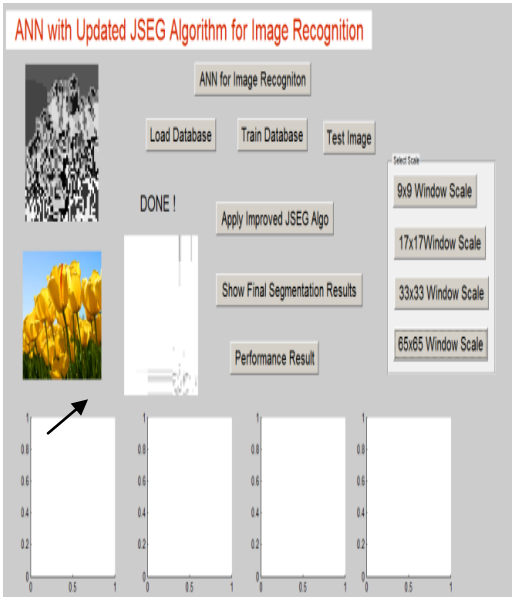

Figure 12: Segmentation by improved JSEG- 65*65 windows

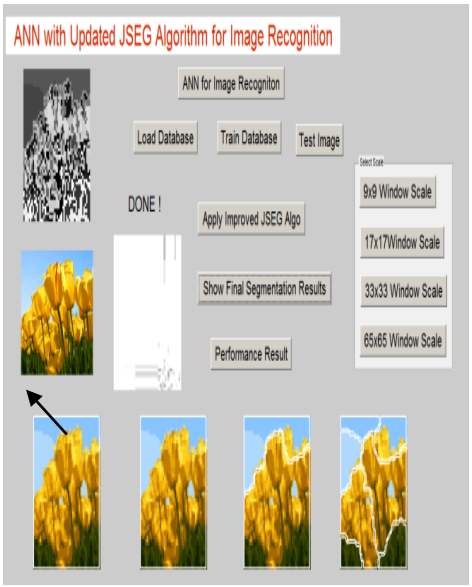

Figure 13: Segmentation results by four windows for test image 1

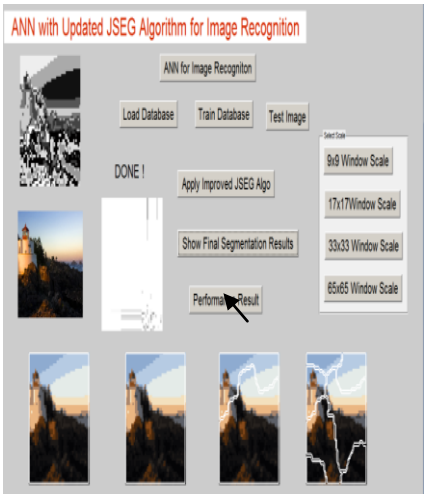

Figure 14: Segmentation results by four windows for test image 2

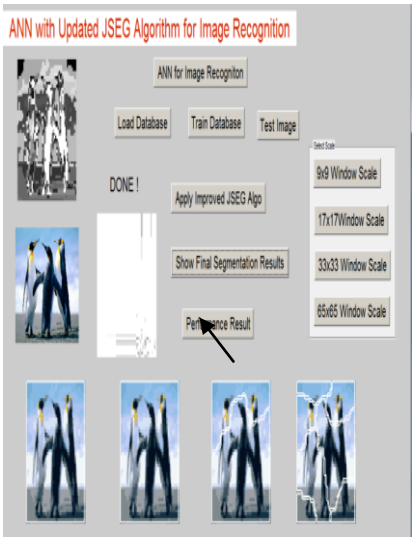

Figure 15: Segmentation results by four windows for test image 3

V. Performance Parameters

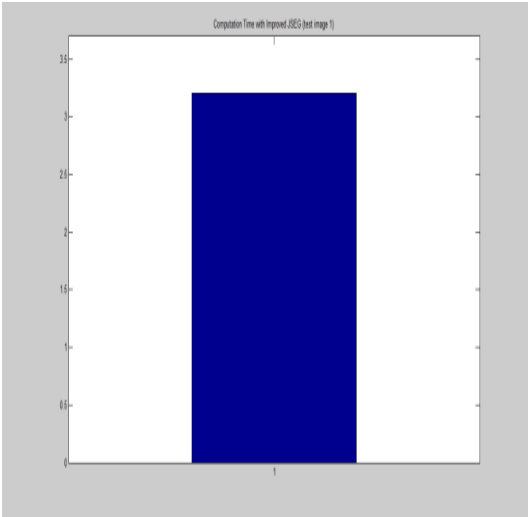

Figure 16: Computation time with JSEG for test image 1

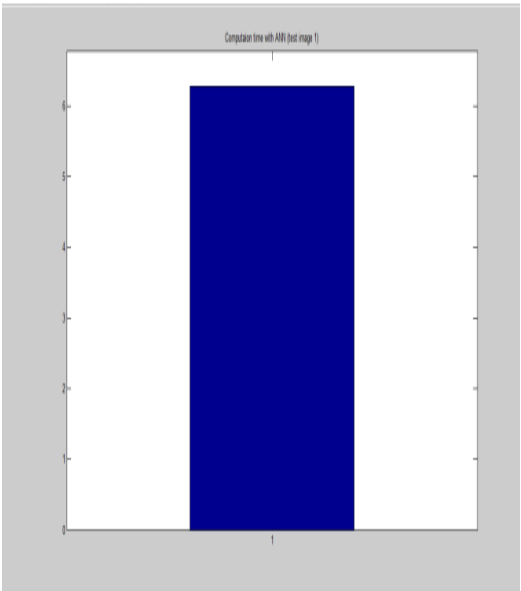

Figure 16: Computation time with ANN for test image 1

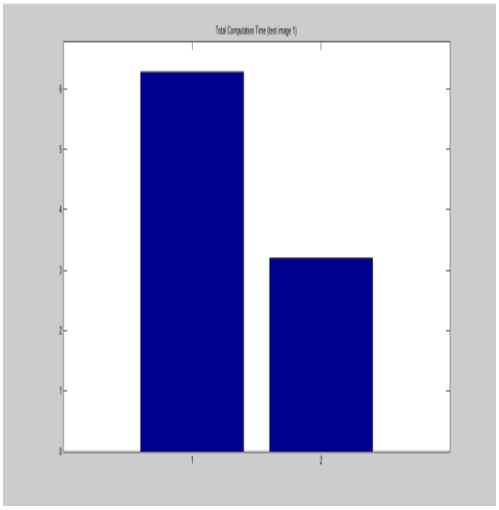

Figure 18: Comparison of Computation time for test image 1

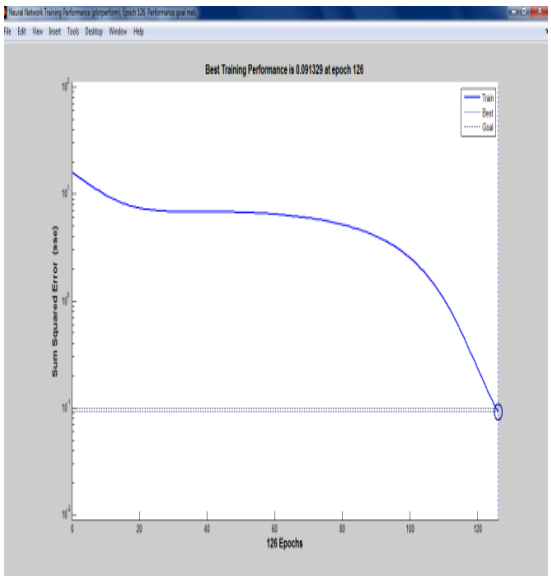

Figure 19: Best Training Performance Time

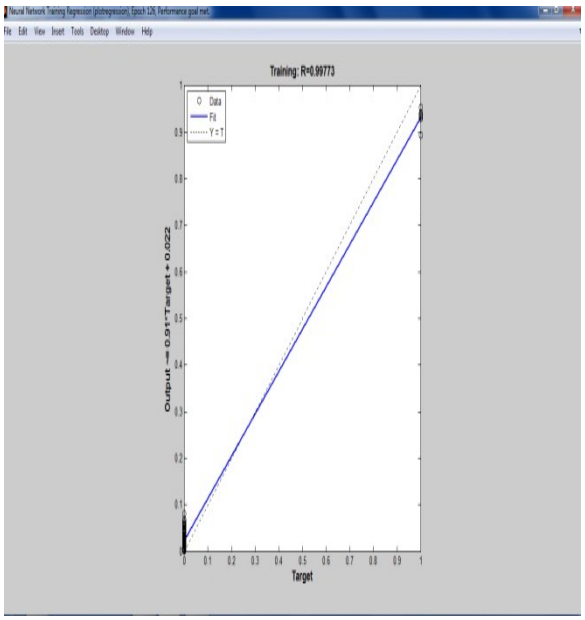

Figure 20: Training vs. Target plot

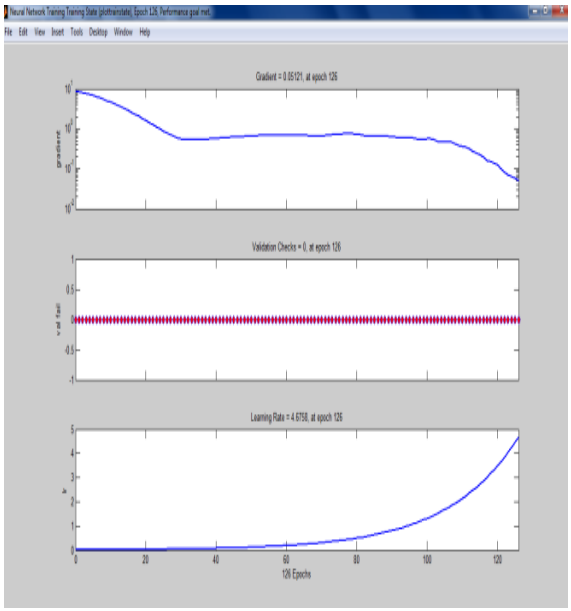

Figure 21: Performance Parameters

VI. Conclusion And Future Scope

Image segmentation is carried out to recognize the objects in images. This work presented how efficiently image segmentation is carried out with improved JSEG and ANN. Computation time with improved JSEG algorithm is 3.2 while with ANN it is almost double that is 6.2. So, we can conclude that improved JSEG algorithm performs better in these terms. Improved JSEG method overcomes the problem of over segmentation that occurs in simple JSEG algorithm. The future work will focus on adding more performance parameters like power signal to noise ratio (PSNR) and mean square error (MSE) to compare the performance of ANN and improved JSEG with modified K means clustering for image segmentation. This algorithm can be applied to natural scene images without any manual factor adjustment. Moreover, it is quite robust method. The proposed method represents an incorporated segmentation and recognition system. The proposed artificial neural network is quite fast and quick to train as well as test.

General Remarks

This paper deals with segmentation of natural scene images. Natural scene images imply that there is no need to apply pre-processing and post- processing techniques before applying segmentation process. ANN's are used for recognition as well as segmentation of images and updated JSEG algorithm is used for segmentation with enhanced K means clustering. Lots of image segmentation algorithms are proposed and discussed in literature [a-r]. Still segmentation needs further improvements to avoid over segmentation which leads to degradation of quality of images. This problem can be overcome by considering additional parameters related with quality of images like PSNR, MSE.

References

[1]. Y.LIU,X.ZHOU,"Automatic texture segmentation for texture-based image retrieval". In: International Multimedia Modelling Conference, 10, Prodeedings .IEEE Computer Society, 285-290 (2004)

[2]. J. CHEN, T.N. PAPPAS, A. MOJSILOVIC, B. ROGOWITZ, "Adaptive image segmentation based on color and texture". In: International Conference on Image Processing, v. 3, 777-780 (2002)

[3]. P.R. HILL, "Wavelet based texture analysis and segmentation for image retrieval and fusion".PhD (Thesis) – University of Bristol, Department of Electrical and Electronic Engineering (2002)

[4]. N.R. Pal, S.K. Pal. "A Review On Image Segmentation Techniques". Pattern Recognition,26(9): 1227-1294 (1993)

[5]. Z. Zhu, Y. Wang, and G. Jiang, "Statistical Image Modeling for Semantic Segmentation", ", IEEE Trans. on Consumer Electronics, vol. 56, no. 2, 777-782 (2010)

[6]. S. N. Sulaiman and N. A. M. Isa, "Adaptive Fuzzy-K-means Clustering Algorithm for Image Segmentation" IEEETrans. on Consumer Electronics, vol. 56, no. 4,2661-2668 (2010)

[7]. Y. Deng and B. S. Manjunath, " Unsupervised segmentation of color –texture regions in images and video" , IEEE Trans. Pattern Anal. Mach. Intell., vol. 23, no. 8, 800-810 (2001)

[8]. P. M. Birgani, M. Ashtiyani and S. Asadi. "MRI Segmentation Using Fuzzy C-means Clustering Algorithm Basis Neural Network". In Proceedings of 3rd International Conference on Information and Communication Technologies: From Theory to Applications (2008)

[9]. Chao Wang, Li-Zhong Xu, Xin Wang and Feng-Chen Huang, "A Multi-scale Segmentation Method of Oil Spills in SAR Images Based on JSEG and Spectral Clustering", International Journal of Signal Processing, Image Processing and Pattern Recognition Vol.7, No.1, 425-432 (2014)

[10]. Tadhg Brosnan, Da-Wen Sun, "Improving quality inspection of food products by computer vision—a review", Journal of Food Engineering 61,3–16 (2004)
[11]. M.Schuster and K. K. Paliwal,"Bidirectional recurrent neural networks", IEEE Transactions on Signal Processing,vol 45, 2673–2681 (1997)
[12]. Yusuf Perwej , November," Recurrent Neural Network Method in Arabic Words Recognition System" ,International Journal of Computer Science and Telecommunications (IJCST), published by Sysbase Solution (Ltd), UK, London, vol. 3, Issue 11,43-48 (2012)
[13]. Sang Sung park,Won Gyo Jung,Young Geun Shin,Dong Sik Jang, Department of Industrial system and Information Engineering, Korea University, South Korea, "Optical character system Using BPAlgorithm".
[14]. Neural networks,Fuzzy logic and Genetic Algorithms by S.Rajasekaran and G.A. Vijayalakshmi Pai.
[15]. K. Madhu and R.I. Minu, " Image segmentation using improved JSEG", IEEE Proceedings of the International Conference on Pattern Recognition, Informatics and Mobile Engineering, 37-42 (2013)
[16]. Luciano C.Lulio, Mario L. Tronco, Arthur J. V. Porto, "Cognitive merged Statistical Pattern Recognition Method for Image Processing in Mobile Robot Navigation", IEEE Proceedings of Brazilian Robotics Symposium and Latin American Robotics Symposium, 279-283 (2012)
[17]. D. Panjwani and G. Healey, "Markov random field models for unsupervised segmentation of textured colour images", IEEE Trans. On Pattern Analysis and Machine Intelligence, vol. 17, no. 10, 939–954 (1995)
[18]. C. H. Yao and S. Y. Chen, "Retrieval of translated, rotated and scaled colour textures", Pattern Recognition, vol. 36, no. 4, 913-929 (2003)