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Texture Image Classification using Neurofuzzy Approach

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Abstract *Image classification is most emerging area in today's world. Variety of images classified using different methods. In this paper image classification based on two different approaches Artificial neural network and Neurofuzzy system and it is seen that Neurofuzzy system is better classification technique than ANN. The design used the discrete cosine transform (DCT) for feature extraction and artificial neural networks and neurofuzzy system for Classification. As DCT works on gray level image, the color image is transformed into gray levels. A neuro-fuzzy approach was used to take advantage of neural network's ability to learn, and membership degrees and functions of fuzzy logic. This paper proves that neuro-fuzzy model performed better than the neural network in classification of texture image of 2 different types.*

Keywords *- Neural network, DCT, Texture, Neurofuzzy*

I. INTRODUCTION

Digital image classification is the most appealing area which application shown in everywhere, it demands in every area like industry application, medical diagnosis and research area[18]. Two principal are of digital image one is improvement of pictorial information for human interpretation and second is processing of image data for storage, transmission and representation for machine perception[18]. Different techniques for image classification method like Artificial Neural Network, Fuzzy measures, Genetic Algorithms, Genetic Algorithms with Neural Networks, Support Vector Machines, Fuzzy support Vector Machines are being developed for texture image classification[7]. Here image classification implemented on ANN and than Neurofuzzy system. Every image classify according to its features. Image specify by different features such as color, shape and texture. Here we are taking texture image for classification.

II. CLASSIFICATION SYSTEM

Every classification system consist different component there are some feature extraction method and classification method. Here we are using DCT block based method for feature extraction.

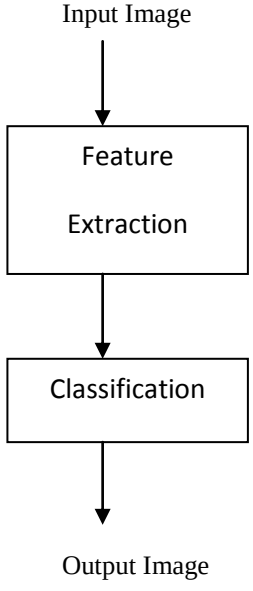


Figure 2.1 Classification System

Texture is as image consists of mutually related and interrelated elements. Because of this characteristic of texture it is use in recognition and interpretation. Texture classification can be divided into two groups, stationary and non-stationary texture classification. Single texture is present in a stationary texture. While multiple textures in one image are present in non-stationary texture[p].
Here Classification deals with 2 different type of texture image.

- Brick Texture
- Grass Texture

Image divided into 2 texture image classes. In this paper there are two different technique used for classification.

1. Artificial Neural Network.
2. Neuro fuzzy system.

III. FEATURE EXTRACTION

Major filtering approaches to texture feature extraction. Filtering approaches included are Laws masks , ring/wedge filters, dyadic Gabor filter banks, wavelet transforms, wavelet packets and wavelet frames, quadrature mirror filters, discrete cosine transform, Eigen filters, optimized Gabor filters, linear predictors, and optimized finite impulse response filters[8].

Texture is as image consists of mutually related and interrelated elements.[mera].

DCT Method

Most existing approaches in texture feature extraction use statistical methods. For the analysis of a texture image, it requires large storage space and a lot of computational time to calculate the matrix of features.

Here feature extraction method based on the Discrete Cosine Transform (DCT) coefficients of texture image. As DCT works on gray level image, the color image is transformed into gray levels.[19]

$$F(u,v)=1/\sqrt{2} * c(u)\, c(v) \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} f(i,j)*\cos\left[(2i+1)u\prod/2n \right].$$

$$\cos\left[(2j+1)v\prod/2n \right] \quad \text{for } u, v=0, 1, N-1$$

where

$c(x)= 1/\sqrt{2N}$ for $x=0$

$c(x)= 1$ otherwise

The inverse DCT transform is.

$$f(u,v)=c(u)\, c(v) \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} c(u)\, c(v).F(u, v)*\cos\left[(2i+1)u\prod/2n \right].$$

$$\cos\left[(2j+1)v\prod/2n \right] \quad \text{for } i, j=0, 1, N-1$$

The DCT coefficients of an image as a new feature, which have the ability to represent the texture features of an image and it can be directly applied to image data in the compressed domain [19]. This may be a way to solve the large storage space problem and the computational complexity of the existing methods.

The DCT is closely related to the discrete Fourier transform; the DFT is actually one step in the computation of the DCT for a sequence. The DCT, however, has better energy compaction properties, with just a few of the transform coefficients representing the majority of the energy in the sequence.

IV. METHODOLOGY

This paper use DCT for texture image compression and its DCT coefficients so developed is use to train the two models:

- Neuro Network Model.
- Neuro Fuzzy Model.

Depending on this training it is going to classify any unknown sample of texture image taken from database. Models based on soft computing easy to implement and produces desirable mapping function by training on the given data set.
By simulating both the model we found that Neuro Fuzzy model is performing better than Neuro Network model.
We use gray image for training and testing purpose. Fuzzy logic having different classes and produce result based on linguistic rule base. Fig 4.1 shows steps for classification.

V. CLASSIFICATION

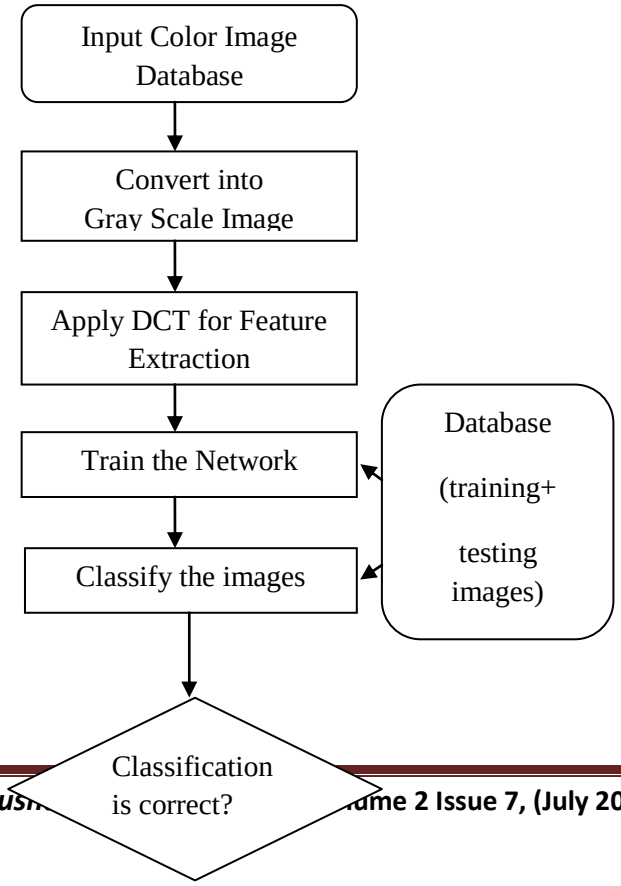
There are two model used in these paper for classification.

1. *Artificial Neural Network*

A key benefit of neural networks is that a model of the system can be built from the available data. ANN learns by adjusting the interconnections or synaptic weights between layers. It is best suited for training purpose.

2. *Neurofuzzy Classifier*

A neuro-fuzzy approach was used to take advantage of neural network's ability to learn, and membership degrees and functions of fuzzy logic. A training set was used to create and train the classifier system.



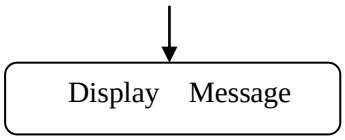


Fig 5.1 Classification Method

VI. IMPLEMENTATION

The Texture Database having different images for different textures that are Brick, Grass. The database includes images for the testing purpose. These testing images are used to test the training Model for its accuracy. Matlab toolbox used for training and classification purpose.

Step 1: Open image for classification.
Step 2: Convert into gray level.
Step 3: Calculate DCT coefficients.
Step 4: Train Using ANN and ANFIS.
Step 5: Classification Using ANN and ANFIS.

VII. EXPERIMENTAL RESULT

DCT feature used to represent different texture image.

Load Image for Feature Extraction.

a) Grass Texture b) Brick Texture

Figure 7.1 Texture Image.

Training Image using Neural Network.

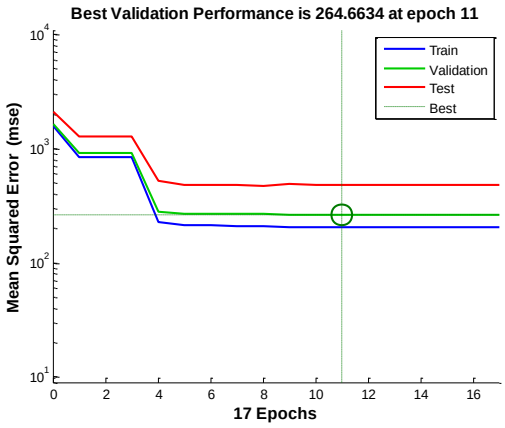


Figure 7.2 ANN Training of a Image.

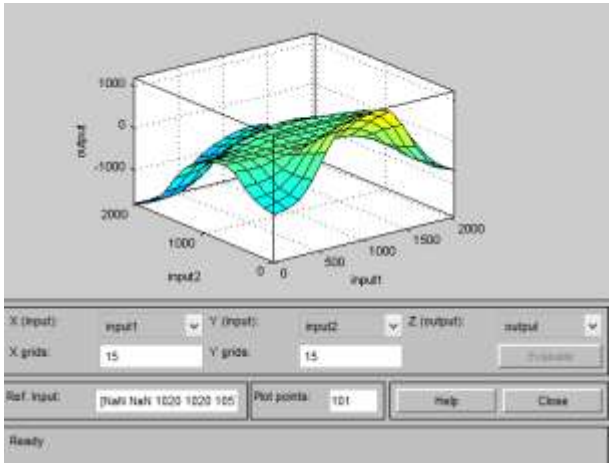


Figure 7.2 ANFIS Training of a Image.

The learning surface and the membership function are shown for the ANFIS created fis file. It is always the same for all the input images and it should be that ways only.

To show that ANFIS is better than ANN we have to consider the performance plot of ANN and the surface plot of ANFIS. The performance plot of ANN shows the best value of classification possible at specific number of epochs. And corresponding surface plot of ANFIS, a large number of similar best values exist for just one epoch. This means what the ANN learns to classify after number of iterations, the ANFIS can learn in just one iteration, because of the power of neurofuzzy rule base

VIII. CONCLUSION AND DISSCUSSION

This is the fundamental difference between ANN and ANFIS. While the learning of ANN is parameterized by the variation in input data, the learning of ANFIS is fixed by the rules and membership function values that we define. The surface plot of the rule base just shows that no matter how different the input image can be, the solution of classification will always lie on that surface. The same is not true for ANN. Because of this ANFIS is much more capable at providing correct results than ANN.

In this paper we classify 2 different types of textures using artificial neural networks and Neuro Fuzzy Neural Network. To find texture features, DCT coefficients are used. Neurofuzzy use one-pass training. Neurofuzzy performed the neural network with the best classification. Neurofuzzy produce desirable mapping functions by training on the given data set. Some applications are detection of machine surface defects in industry. classification of satellite images in order to landmark the terrain, Detection of Blood cancer, Diagnosis of medical image, Research and Engineering Purpose, Defense application etc.

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