Survey: Crop Classification using Transform Domain Technique

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Abstract: Crops are highly cultivating all around the world and vary depending upon the quality of the land in each country. Crop classification is necessary to tell what crops they are and if they are good for that specific area. This classification will help agronomists to decide crop pattern and cultivation practice. Plants are a major source of food stuff, medicine and industry. However it is an important and difficult task to recognize species of crop on earth. Therefore it is necessary to design an appropriate recognition system of crops. Textures play important roles in crop classification applications, since images of real objects often do not exhibit regions of uniform and smooth intensities, but variations of intensities with certain repeated structures or patterns, referred to as visual texture. The textural patterns or structures mainly result from the physical surface properties, such as roughness or oriented structured of a tactile quality. It is widely recognized that a visual texture, which can easily perceive, is very difficult to define. The development in multi-resolution analysis such as DCT and wavelet transform help to overcome this difficulty. In this method, first of all, we created satellite imagery database of different crops and then extract features from each crop images and then different classifier are used for classification.

Keywords: Crop classification, DWT, DCT, KNN, SVM, Decision Tree, Neural Network.

I. INTRODUCTION

Texture is a property that represents the surface and structure of an Image. Generally speaking, Texture can be defined as a regular repetition of an element or pattern on a surface. Image textures are complex visual patterns composed of entities or regions with sub-patterns with the characteristics of brightness, colour, shape, size, etc. An image region has a constant texture if a set of its characteristics are constant, slowly changing or approximately periodic [3]. Texture can be regarded as a similarity grouping in an image [4]. Because texture has so many different dimensions, there is no single method of texture representation that is adequate for a variety of textures. Texture analysis is a major step in texture classification, image segmentation and image shape identification tasks. Image segmentation and shape identification are usually the pre-processing steps for target or object recognition in an image. Texture analysis refers to a class of mathematical procedures and models that characterize the spatial variations within imagery as a means of extracting information. Texture is a real construct that defines local spatial organization of spatially varying spectral values that is repeated in a region of larger spatial scale. Thus, the perception of texture is a function of spatial and radiometric scales. Descriptors providing measures of properties such as smoothness, coarseness and regularity are used to quantify the texture content of an object. Since an image is made up of pixels, texture can be defined as an entity consisting of mutually related pixels and group of pixels. This group of pixels is called as texture primitives or texture elements [5].
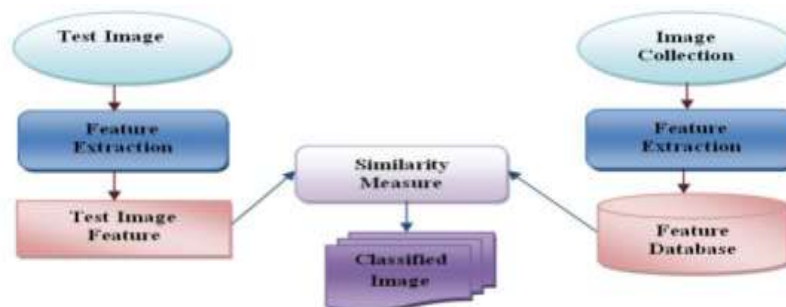
II. TEXTURE FEATURE EXTRACTION

Fig. 1: Basic diagram of crop classification

A. DISCRETE COSINE TRANSFOM

The 1-D DCT is given by
$$C(u) = \alpha(u) \sum f(x) \cos[\pi(2x+1)u/2N] \quad .... (1)$$

For u=0, 1, 2....N-1

$$\alpha(u) = \sqrt{\frac{1}{N}} \quad , \text{ for } u=0$$

$$\alpha(u) = \sqrt{\frac{2}{N}} \quad , \text{ for } u \neq 0$$

The 2-D DCT is given by

$$F(u,v) = \frac{2}{N} C(u)C(v) \sum_{y=0}^{N-1} \sum_{x=0}^{N-1} f(x,y) \cos[\frac{(2x+1)u\pi}{2N}] \cos[\frac{(2y+1)v\pi}{2N}]$$
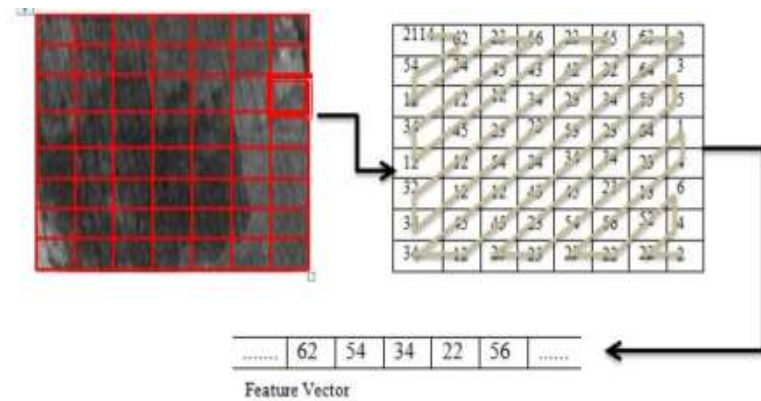

Fig. 2: Basic Diagram for DCT

For the DCT transform to work, firstly the RGB image is converted into Gray-image. This image is divided into 8x8 sized sub-blocks. Each of the 64 DCT coefficients is uniformly quantized. Quantization is defined as division of each DCT coefficient by its corresponding quantizer step size, followed by rounding to the nearest integer. The quantized DC coefficient is treated separately from the 63 AC coefficients. The DC coefficient is a measure of the average value of the 64 image samples. Since there is strong correlation between the DC coefficient of adjacent 8x8 block. This special treatment is used because DC coefficients frequently contain a significant fraction of the total image energy.

B. DISCRETE WAVELET TRANSFORM

Another form of representing a signal is called as transform of a signal. The wavelet transform provides time frequency representation of the signal wave is an oscillating function of time or space and is periodic whereas wavelets are localised waves. The information content present in the signal does not get changed. In this paper discrete wavelet trans form is applied on the colour texture images and the level of decomposition was extended to eight sub bands to reach some finest scale and from each sub band energy features are extracted and they act as a feature vector for further texture classification process.
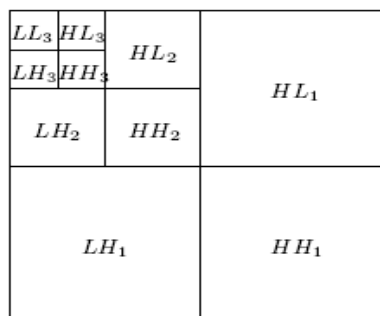

Figure 3: Image De composition (3-D)

The information contained in the output sub bands of the DWT are:

- LL coefficients which correspond to a low pass filter to rows, followed by low pass filter to columns.
- HL coefficients which correspond to a low pass filter to rows, followed by high pass filter to columns.
- LH coefficients which correspond to a high pass filter to rows, followed by low pass filter to columns.
- HH coefficients which correspond to a high pass filter to rows, followed by high pass filter to columns. When a separable transform is applied, only the LL coefficients may need further decomposition. When this decomposition is done at many levels, we get the sub band decomposition in Figure 2.

III. Crop classification

A. K- Nearest Neighbour

KNN is the simplest classifier is the type of the lazy learning or instance based learning. KNN used for pattern recognition, in which classification is performed on basis of closest training samples in the feature space. In this method the sample is classified on the majority voting of its neighbours. This classifier performs exclusively when applied on the large data set. This classifier appropriate performed on the multi model classes.

B. Artificial Neural Network

Artificial neural network is simplified model of the brain. It composed of many interconnecting artificial neurons that cooperate to perform the desired specific physiological function. The neural network is used to perform just like the human brain and solve the complex problems in less computation as compare to other algorithms. [11]. It is used for pattern recognition, classification, and feature extraction.

There are three common structure of neural network.
i. Single layer feed forward
ii. Multi-layer feed forward
iii. Recurrent Neural Network

Back-propagation is very popular investigated method for training neural network.

C. Support Vector Machine

Support Vector machine is used for the pattern classification and nonlinear regression. SVM can also perform in face recognition, text categorization and cancer diagnosis. [7] SVM has many features for example quadratic programming problem is well optimized as compare to the neural network performance. [8] SVM takes input and data and predicts, for every input, that input belongs to which class. SVM model is a representation of the example as many points in the feature space. The detail of the SVM can be seen in [11].

D. Decision Tree

Like the decision tree and neural network, decision table is also for the prediction. It is classification model which consist the hierarchical table in which each entry on the higher level is broken into the sub attributes which composed the new table. The structure is like the dimensional stacking [9].

E. Bayesian Network

Another probabilistic model is used as classification algorithm in our proposed system. Bayesian classifier is the statistical classifier which based on the Bayes theorem. Based on the attributes of the objects, it assigns the associate classes to those objects. Naïve Bayesian produces more accurate results when applied to the large data sets. The detail of Naïve Bayesian can be seen in the [10].

IV. EXPERIMENTAL RESULTS AND DISCUSSIONS

Propose technique is tested on the CROP image. This system is implemented in the MATLAB environment. Resize all images of the same size and divide each image into 16 blocks of size 32×32. And calculate the DCT and DWT features from each block. After this calculation we obtain feature vector which is use as input to the classifiers. We have done different training and testing ratios for each classifier. We have used Neural Network, K nearest neighbour, Support vector machine, Decision Tree and Naïve Bayesian for classification purpose. We have used ten-fold cross validation for training and testing on data set for classification. First of all, we calculate the DCT features from each image and

classify them by ten -fold cross validation. Table 1 shows the accuracy of the five classifiers on DCT features with ten folds cross validation.
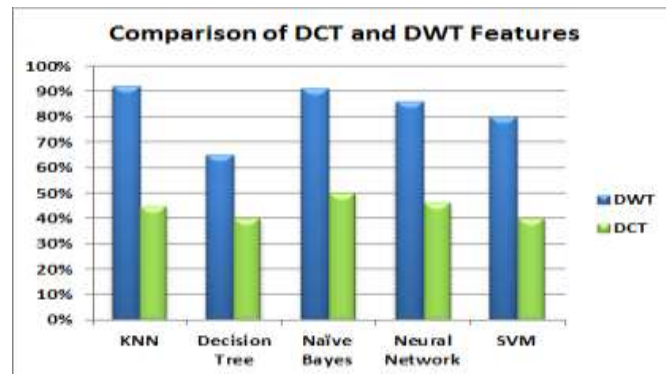

Figure 4: Comparison of the Accuracy of DCT and DWT Features

V. CONCLUSION AND FUTURE WORK

We propose the Texture-classification system. We divide the satellite imagery into sub images and calculate the DCT and DWT features individual and pass these features to the classifiers. The accuracy of the DWT features is most accurate as compare to the DCT features. We used 10-folds cross validation for classification. We used Neural Network, Naïve Bayesian, K nearest neighbour, Support vector machine and Decision Tree classification algorithms. The accuracy of the k nearest neighbour is most efficient as compare to the other classifier is approximately 92%. Data used in these experiments are noisy; we will remove the noise from the data for superior output in the future.

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