Satellite Image Classification using Neural Network and Support Vector Machine

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Abstract **- The satellite image is one of the main sources for capturing the geo-spatial information, but it is difficult to classify such images manually. Satellite image classification is an important task because it is the only way we can know about the land cover map of inaccessible areas. Instead of searching an image in huge databases, images are classified in classes and retrieved from that particular class by using Soft computing techniques such as Artificial Neural network and Support vector machines.**

Keywords**— Satellite image, classification, Neural Network.**

I. INTRODUCTION

Various application domains include large amount of digital images. We are unable to access such images unless they are organized so as to allow proficient browsing, searching, and retrieval. The images can be classified by probabilistic techniques, maximum likelihood classifier, parallelepiped etc. but these are very slow and accuracy is very less. So soft computing techniques based on uncertainty are used. An objective of a proposed system is to provide a standardized and efficient way for classifying satellite image types that can be used as an operational tool in an image analysis.

II. SOFT COMPUTING TECHNIQUES FOR IMAGE CLASSIFICATON.

Now Different advanced techniques in image classification like Artificial Neural Networks (ANN), Support Vector Machines (SVM), Fuzzy measures and Genetic Algorithms (GA) Self organizing maps (SOM) are developed for image classification.

A. Artificial Neural Network (ANN)

ANN has a natural tendency for storing experiential knowledge. Objective of ANN is to transform the input into meaningful output. Neural networks can solve difficult classification problems used across almost all modern information systems, in all industry, government, and academic sectors.

B. Support Vector Machines (SVM)

A SVM can map the input data into high dimensional feature space and construct optimal separating hyper plane in this space for binary classification. It employs optimization algorithms to locate the optimal boundaries between classes.

C. Fuzzy Measures

In Fuzzy measures, different stochastic relationships are identified to describe properties of an image. If the fuzzy property is more related to a region, then a fuzzy measure is used.

D. Genetic Algorithms

The features like texture or the average value of nearby pixels are necessary to get good spectral information. Hence to choose these features automatically a new evolutionary hybrid genetic algorithm is used. [1] Genetic algorithms are most useful for problems with a large irregular search space where a global optimum is required. [14]

E. Self Organizing Maps (SOM)

Self-organizing maps reduces the dimensions of data through the use of self-organizing neural networks. The problem that data visualization attempts to solve is that humans simply cannot visualize high dimensional data as is so techniques are created to help us understand this high dimensional data.

III. PROPOSED SYSTEM

Remote sensing images include possible classes like water bodies, forests and urban land cover. The textural features are extracted and then images are classified using following classification methods.

- Artificial Neural Networks (ANN)
- Support Vector Machines (SVM)

A. Artificial Neural Networks

An artificial neural network usually called neural network (NN)**.** It is a mathematical model or computational model

which consists of an interconnected group of artificial neurons and it processes information using a connectionist approach to computation. They take in **r**eal-valued input from multiple other nodes and they produce a single real valued output.
The phases of proposed classification technique

- Network Design
- Neural Network Training
- Image classification using Neural Network

1) *Network Design:* Network is designed using Feed forward network which uses back propagation algorithm.
The feed forward back propagation network is a very popular model in neural networks. It does not have feedback connections, but errors are back propagated during training. Back propagation network consists of at least three layers of units: an input layer, at least one intermediate hidden layer, and an output is propagated forward to the output layer.

Layout:

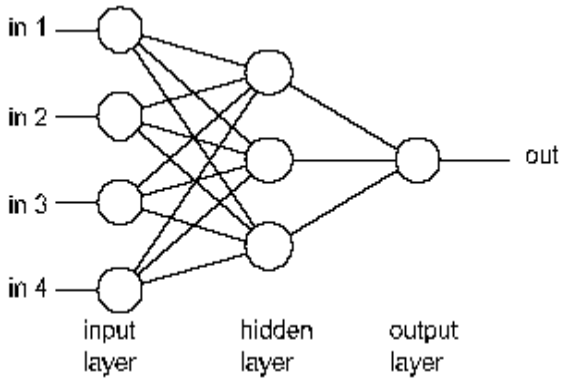

Fig.1 Neural Network design using Back Propagation

2) *Neural Network Training:* The feed forward back propagation network undergoes supervised training. To teach the neural network we need training data set. The training data set consists of input signals(textural features) assigned with corresponding target (desired output). The network training is an iterative process. The weights are initially assigned randomly. In each iteration weights coefficients of nodes are modified using new data from training data set.
The computed pattern and the output pattern are compared, a function of this error for each component of the pattern is determined, and adjustment to weights of connections between the hidden layer and the output layer is computed. The procedure is repeated with each pattern pair assigned for training the network.

3) *Image classification using Neural Network:* This phase refers to the testing of neural network. Test image's data set is provided as a input to trained neural network and Neural network classifies image to particular class

B. Support Vector Machine

The support vector machine (SVM) employs optimization algorithms to locate the optimal boundaries between classes.
The phases of proposed classification technique

- Textural Feature Extraction using Gray level co-occurrence matrix(GLCM)
- SVM Training and Testing.

1) *Textural Feature Extraction using Gray level co-occurrence matrix(GLCM):* The GLCM is a matrix of frequencies at which two pixels, separated by a certain vector occur in the image. The distribution in the matrix will depend on the angular and distance relationship between pixels.
From GLCM, many useful textural properties are extracted such as Contrast, Correlation, Energy and Homogeneity to expose details about the image content

2) *SVM Training and Testing:* The basic idea of SVM is to construct a hyperplane that maximizes the margin between negative and positive examples.
For implementing SVM on image classification, we are given a certain number p of training data, each data has two parts: the n-dimensional vector of image features and the corresponding labels of data (either 1 or - 1).

$$S = \{(x_i, y_i) \mid x_i \in \Re^n, y_i \in \{-1, 1\}\}_{i=1}^{p}$$

Then Images are classified using trained SVM

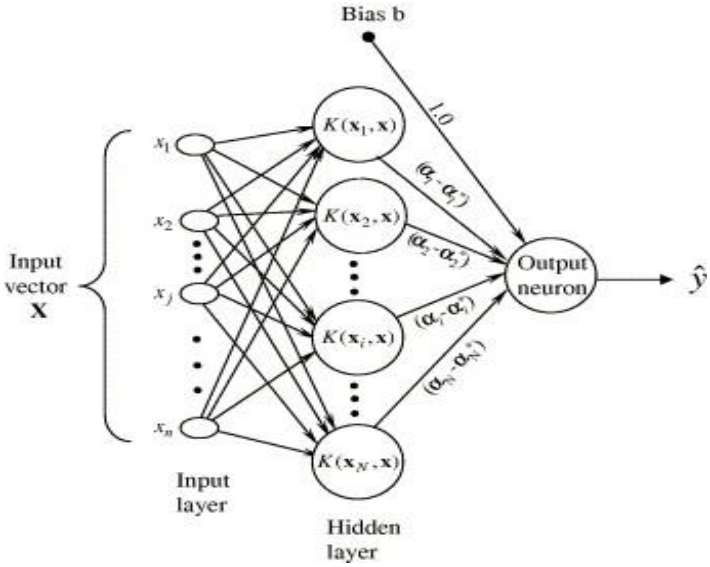

Fig. 2 Architecture of SVM

IV RESULT

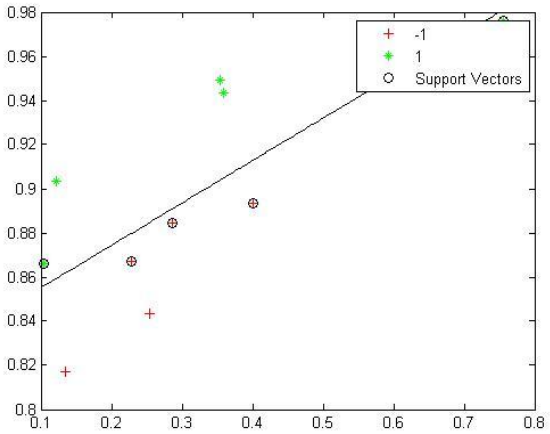

Fig. 3 SVM Training

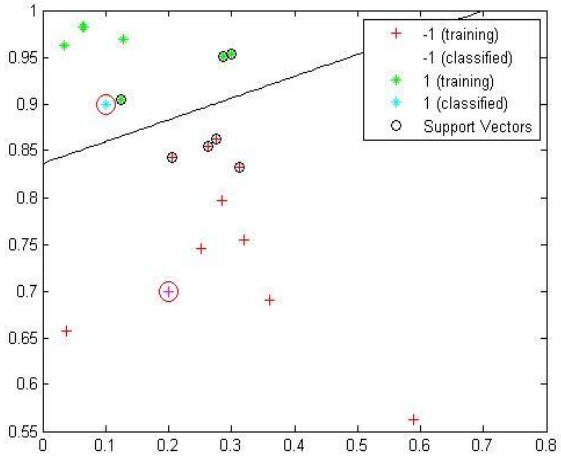

Fig. 4 SVM Testing

The above graphs show the results of SVM training and classification using SVM respectively. From the above figures, the boundary can separate properly the data in the 2 classes.

V. CONCLUSION

This paper attempts to study and compare artificial neural networks and Support vector machine for image classification. The study concluded that the neural network approach of classification improves the accuracy and the finer information from the individual class is obtained by using textures.

The training speed in the neural networks depends on network structure, momentum rate, learning rate. In SVM it depends on training data size and class separability. [15]

REFERENCES

[1] Sonika JindalL ,Richa Jindal "Comparing Different Soft Computing Techniques For Classification Of Satellite Images" Journal of Information Systems and Communication, Volume 3, Issue 1, 2012.

[2] Navdeep Kaur Johal Samandeep Singh Harish Kundra "A hybrid FPAB/BBO Algorithm for Satellite Image Classification" International Journal of Computer Applications (0975 – 8887)Volume 6– No.5, September 2010

[3] V.K.Panchal Parminder Singh Navdeep Kaur Harish Kundra "Biogeography based Satellite Image Classification" *(IJCSIS)* International Journal of Computer Science and Information Security,Vol. 6 , No.2, 2009.

[4] S.V.S Prasad, Dr. T. Satya Savitri Dr. I.V. Murali Krishna "Classification of Multispectral Satellite Images using Clustering with SVM Classifier" International Journal of Computer Applications (0975 – 8887) Volume 35– No.5, December 2011

[5] Qi Gu, Zhifei Song "Image Classification Using SVM, KNN and Performance Comparison with Logistic Regression" Final Project Report

[6] Helmut Berge and Dieter Merk "A Comparison of Support Vector Machines and Self-Organizing Maps for e-Mail Categorization" Article in a conference proceedings.

[7] Giorgos Mountrakis, Jungho Im, Caesar Ogole "Support vector machines in remote sensing: A review" ISPRS Journal of Photogrammetry and Remote Sensing ELSEVIER

[8] P. Lingras and C.J. Butz "Precision and Recall in Rough Support Vector Machines"Andrea Vedaldi and Andrew Zisserman Image Classification Practical, 2011

[9] Andrea Vedaldi and Andrew Zisserman Image Classification Practical, 2011

[10] Jason Weston "Support Vector Machine (and Statistical Learning Theory) Tutorial NEC Labs America Princeton, USA.

[11] Ron Meir "Support Vector Machines -an Introduction" Department of Electrical Engineering Technion, Israel

[12] Anders Karlsson "Classification of high resolution satellite images"

[13] Iordanis E. Evangelou, Diofantos G. Hadjimitsis, Athina A. Lazakidou3 and Chris Clayton "Data Mining and Knowledge Discovery in Complex Image Data using Artificial Neural Networks" University of Oxford

[14] Andrew Jackson "Genetic Algorithms for Use in Financial Problems" Sydney Australia

[15] M.Seetha, I.V.Muralikrishna, Member, IEEE , B.L. Deekashatulu, Life fellow,IEEE. "Artificial Neural Networks and other methods of image classification" Journal of Theoretical and Applied Information Technology