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A Neural Network-Based Classification of Water Resource Images

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Abstract**—** Image classification from a database is particularly flinty for traditional machine learning algorithms because of the large number of images and variety of details that describe an image. For these reasons, traditional machine are unstable to classify images from a database. Furthermore, these machines take long time for classification. One of the existing methods for recognition, classification and retrieval of images is based on Artificial Neural Networks (ANN). Neural Network is an information processing ideal that is inspired by the way biological nervous system, such as the brain, process information. In the proposed system, image classification is based on Back propagation neural network with one hidden layer. There hasn't been any significant work for water resource classification. Hence, a need for robust algorithm with high classification accuracy is proposed in this paper.

Keywords* — *Artificial Neural Networks, Genetic Algorithm, Back-Propagation Algorithm.

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I. INTRODUCTION

The term image classification refers to the marking of images into one of a number of pre-defined categories. Although it seen not a very difficult task for humans, it has proved to be a difficult problem for machines. Image classification analyzes the numerical principals of various image features and organizes data into various classes. Classification algorithms typically use two stages of processing: training and testing. In the initial training stage, characteristic properties of typical image features are isolated and based on these, a unique description of each classification category, i.e. training class, is created. In the subsequent testing stage, these feature-space partitions are used to classify image features. The description of training classes is an extremely important component of the classification process. In supervised classification, statistical processes or distribution-free processes can be used to extract class descriptors. Unsupervised classification relies on clustering algorithms to automatically segment the training data into prototype classes. In either case, the motivating criteria for constructing training classes are that they are:

- Independent, i.e. a change in the description of one training class should not change the value of another,
- Discriminatory, i.e. different image features should have significantly different descriptions, and
- Reliable, all image features within a training group should share the common definitive descriptions of that group.

Main principle of image classification algorithm is to extract image features from a query image and compare these query image feature with the data base of images and classified this query image into one of the defined category [3].

In today's world the word knowledge has exchanged its meaning with information and hence to the data. In addition to it the rapid development in technologies in digital field and computing hardware makes the digital acquisition of information to be more in demand and popular. The term image classification refers to the labeling of images into one of a number of predefined categories. Consequently, there is an increasingly high demand for effective and efficient image indexing and classification methods, and image classification has become one of the most popular topics in the field of pattern recognition and image mining. Image texture, defined as a "function of the spatial variation in pixel intensities (grey values)", is useful in a variety of applications and has been a subject of intense study for many researchers. It is applied to many practical vision papers, such as biomedical imaging, ground classification, segmentation of satellite imagery, and pattern recognition [3].

Image classification plays an important role in many computer vision applications, which is still a challenging problem in organizing a large image database. However, an effective method for such an objective is still under investigation. Image classification is a basic operation which is performed by different classifier on database image. Image classification algorithms can be designed by finding essential features which have strong discriminating power and train the classifier to classify the image. But particularly it is very difficult to classify given image from a data base by using traditional machine learning algorithms because of high number of images and many details that describe an image. Efficiency of traditional machine learning algorithm has already improved and sufficient number of literatures is available on this. As a result various research works are already engaged to evolve efficient method of image classification using latest digital image processing algorithm. The objective is to achieve a reasonable and highly efficient image classification algorithm which take a very little classification time and give highly accurate result for training and testing image. Keeping this objective in mind the research work in the present thesis has been undertaken.

The rest of the paper is organized as follows. Section 2 review some related work while Section 3 presents the detail of image classification methods. Section 4 discusses the results; Section 5 draws the conclusion and finally future scope.

II. LITERATURE SURVEY

In paper by Sanket D. Kharalkar, Prof. Sneha U. Bohra describes the Neural network based classification of water resource images. All the existing problems in the classification are examined in this paper. Neural network with back propagation and genetic algorithm is proposed for the classification of an image.

In paper by Rudolf Ressel, Anja Frost, and Susanne Lehner, authors have presented a paper of A Neural Network-Based Classification for Sea Ice Types on X-Band SAR Images. Classification paper used multilayer feed forward neural network. Ice-type classifier for Scan SAR Terra SAR-X that is based on GLCM (gray-level co-occurrence matrix) for feature extraction and subsequent supervised classification through an artificial neural network. The dataset to examine the validity of approach was a time series of TerraSAR-X images over an ice-infested Arctic region (Barents Sea near Svalbard) [2].

In paper by W. Dierking and C. Wesche, authors have proposed a paper of C-Band radar polarimetry–Useful for detection of icebergs in sea ice? MRF Segmentation and Object-Oriented Learning vector quantization. The paper described in this paper tries to overcome the problem of model-based texture analysis in SAR images, which is crucial because of speckle and cartographic resampling, which makes both first-order statistics(space-varying Kappa distribution of intensity) and second-order statistics (space varying autocorrelation function) hard to estimate in a local window. Texture is decomposed into grains through a segmentation stage, which is performed on the backscatter image and on at least one feature map. After segmentation, grains, instead of pixels, are classified by means of an object-oriented classifier. Geometrical, contextual, and radiometric descriptors are extracted from grains, to form a features vector associated to that grain. LVQ, trained by the available GT, or by a fraction of it, associates image grains to thematic classes [4].

In paper by JuhaKarvonen, MarkkuSimilä, and Marko Mäkynen, authors have presented a system of Open Water Detection from Baltic Sea Ice Radarsat-1 SAR Imagery.An algorithm for open water and sea ice discrimination for Radarsat-1 Scan SAR images is presented. The algorithm is based on segmentation and local synthetic aperture radar signal intensity autocorrelation [5].

In paper by Leen-Kiat Soh , and Costas Tsatsoulis , authors have presented a system of Texture Analysis of SAR Sea Ice Imagery Using Gray Level Co-Occurrence Matrices. The system uses gray-level co-occurrence matrices (GLCM) to quantitatively evaluate textural parameters and representations and to determine which parameter values and representations are best for mapping sea ice texture. They conducted experiments on the quantization levels of the image and the displacement and orientation values of the GLCM by examining the effects textural descriptors such as entropy have in the representation of different sea ice textures [6].

III. ARTIFICIAL NEURAL NETWORK (ANN)

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous papers, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing paper. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. An ANN is configured for a specific application such as pattern recognition or data classification, through a learning process. Learning in biological papers involves adjustments to the synaptic connections that exist between the neurons. This is true for Artificial Neural Networks as well.

Genetic Algorithm

The genetic algorithm is a search technique based on the concept of evolution and in particular with the concept of the survival of the fittest [3]. The application of genetic algorithm on neural network makes a hybrid neural network where the weights of the neural network are calculated using genetic algorithm approach. From all the search spaces of all the possible weights, the genetic algorithm will generate new points of the possible solution.

Back-Propagation Algorithm

In order to train a neural network to perform some task, we must adjust the weights of each unit in such a way that the error between the desired output and the actual output is reduced. This process requires that the neural network compute the error derivative of the weights (EW). In other words, it must calculate how the error changes as each weight is increased or decreased slightly. The back propagation algorithm is the most widely used method for determining the EW. Back propagation, an abbreviation for "backward propagation of errors", is a common method of training artificial neural networks. It is a supervised learning method and is a generalization of the delta rule. It requires a dataset of the desired output for many inputs, making up the training set. It is most useful for feed-forward networks (networks that have no feedback) or simply that have no connections that loop.

IV. RESULT ANALYSIS

From the Literature survey, it is clear that there is lack of efficient paper for the classification of satellite water resource images. So, we compare satellite images with the SAR (Synthetic Aperture Radar) Images. Comparison is based on the time taken by the images to classify the water resources after applying proposed algorithm.

After applying artificial neural network, we have calculated the time required for the parsing result. From the parsing result time, it is clear that the time required to classify water resource satellite images is less than that of the SAR images. Hence our research is more useful in classifying satellite images than SAR images. Figure shows the comparison of time taken by a satellite and SAR images.

Table: Time taken for classification by ANN.

Time taken for classification by ANN		
Name of images	Satellite Image Time(Sec)	SAR Image Time(Sec)
a	0.31	0.38
b	0.32	0.37
c	0.35	0.39
d	0.36	0.37
e	0.34	0.4
f	0.35	0.41
g	0.34	0.36
h	0.31	0.42
i	0.29	0.41
j	0.35	0.39

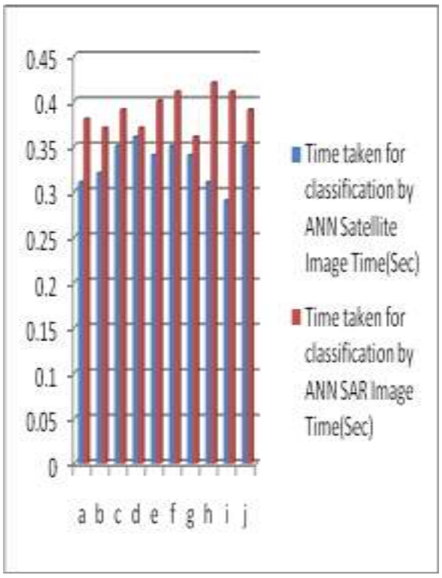

Figure: Time taken for classification by ANN.

Above graph shows that, when we compare the time required to classify the water resources in SAR and satellite images, time required to classify water resource in satellite image is less than that of the SAR image.

V. CONCLUSION

The paper introduced in the proposed work implemented artificial neural network based classification of water resource images. No efficient work has been performed on jpeg images. In this approach, we have used artificial neural network for water resource image classification. A very important feature of such networks is their adaptive nature, where "learning by example" replaces "programming" in solving problems. In the implementation of artificial neural network based image classification paper for water resources, it is proposed to use genetic algorithm. For the classification of water resource images, the proposed paper implements artificial neural network with back propagation model for image classification. The architecture of the classification paper uses a jpeg satellite images to perform essential preprocessing operation to detect water resource in an images. With the proposed methodology, it is not only possible to recognize satellite images but also an SAR images.

From the experimental result, it can be committed that, the proposed architecture can effectively classify water resources in satellite images within promising time slice.

VI. FUTURE SCOPE

Proposed architecture can be made online so that we can connect the system with GPS system and using it identification of unknown water resource is possible. If, the shortest path between the water resource and drought area is calculated with the help of proposed architecture, then it is very useful in the irrigation purpose. Hence, proposed architecture is useful in the agriculture purpose in future.

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