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Mini Review Paper

An Enhanced Approch for Content Based Image Retrieval

Patheja P.S., Waoo Akhilesh A. and Maurya Jay Prakash
BIST, Bhopal, MP, INDIA

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Abstract

Image classification is perhaps the most important part of digital image analysis. Retrieval pattern-based learning is the most effective that aim to establish the relationship between the current and previous query sessions by analyzing image retrieval patterns. We propose a new feedback based and content based image retrieval system. In this new approach we use neural network based pattern learning to achieve effective classification and with neural network we use decision tree algorithm to make less complex mining of images. That approach is more effective and efficient way for image retrieval.

Keywords: pattern-based learning, image retrieval, neural network.

Introduction

Image classification in large data base system is a typical and complex task as we know. To achieve effective and efficient method we are propose an approach based on neural network and decision tree. In this method neural network play an important roll as pattern recognizer and this patter is converted as a set of rules by which we can make a fast image retrieval system when our system is trained. One algorithm is trained and rules are extracted the classification is done by using user's feed back method.

Why we use neural Network: Traditional statistical classification procedures such as discriminate analysis are built on the Bayesian decision theory[1]. In these procedures, an underlying probability model must be assumed in order to calculate the posterior probability upon which the classification decision is made. One major limitation of the statistical models is that they work well only when the underlying assumptions are satisfied. The effectiveness of these methods depends to a large extent on the various assumptions or conditions under which the models are developed. Users must have a good knowledge of both data properties and model capabilities before the models can be successfully applied. Neural networks have emerged as an important tool for classification.

The recent vast research activities in neural classification have established that neural networks are a promising alternative to various conventional classification methods. The advantage of neural networks lies in the following theoretical aspects. First, neural networks are data driven self-adaptive methods in that they can adjust themselves to the data without any explicit specification of functional or distributional form for the underlying model. Second, they are universal functional approximates in that neural networks can approximate any function with arbitrary accuracy[2]. Since any classification procedure seeks a functional relationship between the group membership and the attributes of the object, accurate identification of this underlying function is doubtlessly important.

Third, neural networks are nonlinear models, which makes them flexible in modeling real world complex relationships. Finally, neural networks are able to estimate the posterior probabilities, which provide the basis for establishing classification rule and performing statistical analysis[3].

Decision tree: Decision trees are used to extract patter from neural network to use neural network the main key feature of decision tree are: i. simple to understand, ii. explanation for the result, iii, Can be combined with other techniques, iv.at least a solution provide.

Back Round

In digital image classification the conventional statistical approaches for image classification use only the gray values. Different advanced techniques in image classification like Artificial Neural Networks (ANN), Support Vector Machines (SVM), Fuzzy measures, Genetic Algorithms (GA), and Genetic Algorithms with Neural Networks are being developed for image classification.

Techniques of Image Classification: Image classification plays an important roll for many Studies in science and different type of environmental applications. There are many classification algorithms have been developed for classification of images. In this section we emphasizes on the analysis and usage of different advanced classification

techniques like Artificial Neural Networks, Support Vector Machines, Fuzzy Measures, Genetic algorithms and their combination for digital image classification. Finally the study depicts the comparative analysis of different classification techniques with respect to several parameters.

Artificial Neural Network (ANN): Neural Network can provide suitable solutions for problems, which are generally characterized by non-linear ties, high dimensionality noisy, complex, imprecise, and imperfect or error prone sensor data, and lack of a clearly stated mathematical solution or algorithm. A key benefit of neural networks is that a model of the system can be built from the available data. Image classification using neural networks is done by texture feature extraction and then applying the back propagation algorithm.

Textural features, the angular second moment, contrast, correlation and variance are calculated. After extracting the textural features the network is trained by standard back propagation algorithm (BKP).

The back propagation algorithm is implemented in these steps: i. Initialize weights, ii. Feed input vectors and compute the weighting sum and then apply sigmoid function, iii. Calculate error term for each output unit, iv. Calculate the error term of each of the hidden units, v. Adjust the weights.

Step 2, 3, 4 and 5 are repeated till the error is within acceptable limits after that it is ready to store for reference values.

Support Vector Machines: SVM is a supervised learning process in which data analyze and recognize patterns, used for classification and regression analysis. A good separation is achieved by the hyper plane that has the largest distance to the nearest training data points of any class (so-called functional margin), since in general the larger the margin the lower the generalization error of the classifier.

The inductive principle behind SVM is structural risk minimization (SRM). Risk of a learning machine (R) is bounded by the sum of the empirical risk estimated from training samples (Remp) and a confidence interval (ψ): $R \leq Remp + \psi$ [8]. The strategy of SRM is to keep the empirical risk (Remp) fixed and to minimize the confidence interval (ψ), or to maximize the margin between a separating hyper plane and closest data points[3].

The implementation of SVM required these steps: A classification task usually involves separating data into training and testing sets. Each instance in the training set contains one “target value" (i.e. the class labels) and several “Attributes" (i.e. the features or observed variables). The goal of SVM is to produce a model (based on the training data) which predicts the target values of the test data given only the test data attributes. Transform data to the format of an SVM package, Conduct simple scaling on the data, Consider the RBF kernel K(x; y) = $e^{-\gamma\|x-y\|^2}$, Use cross-validation to and the best parameter C and , Use the best parameter C and to train the whole training set, Test. The best parameter might be a selected by the size of data set but in practice the one obtained from cross-validation is already suitable for the whole training set[4].

Fuzzy Measures: In Fuzzy measures, different relationships are identified to describe properties of an image. The members of these property set are fuzzy in their contribution. The fuzzy measure gives the possibility to describe different types of stochastic properties in the same form. If the fuzzy property is more related to a region, then a fuzzy measure is used. Fuzzy function is used if a stochastic property is to be described by a particular distribution of gray values. The fusion of these two stochastic properties is represented as a fuzzy measure and fuzzy function defines on an area which is achieved by a fuzzy integral. The result of fuzzy integral is a new fuzzy measure[5]. The fuzzy measures are implemented in these steps: i. Extraction of stochastic properties, ii, gather Stochastic Information, iii. Apply Fuzzy Functions, iv. Fusion of Fuzzy Properties by Fuzzy Integrals.

The summation of all combinations of fuzzy measures with fuzzy functions makes sure, that all possible properties in all combinations, which should be considered, are used. In such a way an image is obtained, where the (grey) values represent a measure for the membership to the texture. In this way different elementary stochastic properties are combined in many ways for the extraction of relevant information. In order to achieve this different approaches have to be applied for the elimination of the elementary stochastic properties within an image.

Genetic Algorithms: The features like texture or the average value of nearby pixels are necessary to get good spectral information. The different kinds of spatial content information could also be added into the pixel feature vector as additional feature dimensions. So there are a large number of choices for additional feature vectors that could make classification better than just having the raw spectral values as feature vectors.

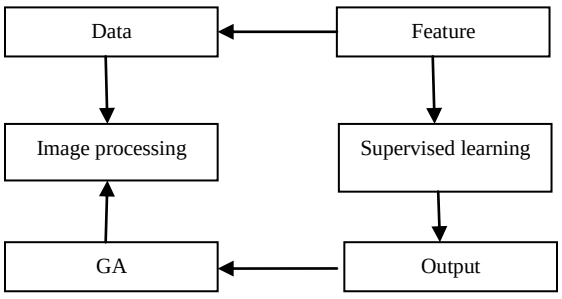

Figure-1
Process of genetic algorithm process

The genetic programming system based on a linear chromosome that manipulates image processing programs that take the raw pixel data planes and transform them into a set of feature planes. This set of feature planes is in effect just a multi-spectral image of the same width and height as the input image, but perhaps having a different number of planes, and derived from the original image via a certain sequence of image processing operations. The system then applies a conventional supervised classification algorithm to the feature planes to produce a final output image plane, which specifies for each pixel in the image, whether that feature is there or not. Figure illustrates this hybrid scheme. In this structure finally raw data planes are transformed into a set of feature planes by an image processing program that is evolved by genetic algorithm[6].

Genetic Algorithms and the Neural Network: The technical design of the evolutionary strategy of connection weights training can be described as: i. Decode each individual (genotype) in the current generation into a set of connection weights, ii. Decode each individual (genotype) in the current generation into a set of connection weights, iii.Evaluate each set of the connection weights by constructing the corresponding neural network structure and computing its total mean square error, iv. Select parents for reproduction based on their fitness, v. The population of current generation is mapped onto a roulette wheel, vi. Apply search operators in conjunction with the crossover and /or mutation operator.

Comparative Analysis: The image classification techniques like artificial neural networks, support vector machines, fuzzy logic, genetic algorithms and their combination are analyzed and compared with respect to several parameters. Artificial neural networks have the advantages mainly of more tolerance to noise inputs and representation of Boolean function apart from others. But too many attributes may result in over fitting. In support vector machines over fitting is unlikely to occur. The computational complexity and complexity of decision rule are reduced in SVM. Fuzzy measures have the benefit of identification of various stochastic relationships to describe the properties of the image. But priori knowledge is very important to get good results.

Genetic algorithms are primarily used in optimization and always have a good solution. But the computation of scoring function is non trivial. The artificial neural networks and support vector machines follows non-parametric approach whereas fuzzy measures use stochastic properties for image classification. The selection of non-linear boundary is efficient when the data have only few input variables in ANN and vice versa in SVM. In fuzzy logic it depends on priori knowledge.

Where as in genetic algorithms it depends on the direction of decision. The training speed in the neural networks depends on network structure, momentum rate, learning rate and converging criteria. In SVM it depends on training data size and class reparability. Fuzzy logic incorporates the training speed depending on the isolation of the relevant information by iterative application of the fuzzy integral. The training speed could be improved by refining irrelevant and noisy genes in genetic algorithms. Along with these the parameters accuracy and general performance are tabulated in table[4].

Praposed Model: In this paper we are discuss various methods and techniques by which image classification performed in effective and efficient manner. Here we are going to propose a new way for classification for image retrieval system. In this model we use neural network, decision tree and user feedback for classification of image.We proposed a new approach for Content based image retrieval system feedback based image classifier in efficient manner.

Table-4
Comparative analysis of image classification techniques

Parameter	Artificial neural network	Support vector machine	Fuzzy logic	Genetic algorithm
Type of approach	Non parametric	Non parametric with binary classifier	Stochastic	Large time series data
Non linear decision boundaries	Efficient when the data have only few input variables	Efficient when the data have more input variables	Depends on prior knowledge for decision boundaries	Depends on the direction of decisions
Training speed	Network structure, momentum rate ,learning rate, converging criteria	Training data size, kernel parameter	Iterative application of the fuzzy integral.	Referring irrelevant and noise genes.
Accuracy	Depends on number of input classes.	Depends on selection of optimal hyper plane.	Selection of cutting threshold	Selection of genes.
General performance	Network structure	Kernel parameter	Fused fuzzy integral.	Feature selection.

We have prepared a database consisting a number of images. Here user required to input the test image or query image and selected object images. now Features like color and texture are then extracted from test (query) image and object images. Similarities distances are measured and calculating linear Coefficient of Correlation between tests (query) and object images. On the basis of coefficient of correlation Training set is formed into two categories (relevant and irrelevant). Then using those labeling the neural network based classifier is trained[7].

These feedback rounds go on iteratively and each time a refinement of the images shown to the user is done. Finally those images which are judged by the classifier as positive are taken. The classifier results are produced in a decision tree algorithm to extract rules from it. Now the query image is plotted in the positive set.

Those images which are nearest to the query image based on these rules set similarity ranking are taken and shown to the user. We are going to follow these steps for our proposed technique.

Data Preprocessing: Initialize with various object images, Create a Block Matrices, Calculate Mean μ of Block Matrices and Concatenate.

Feature Extraction: Convert Block Matrices "f & g" RGB from space to HSV from space, where f and g represent the average values of vectors, Extract feature vector Vj from HSV space. And combined all color and texture features.

Similarity Computation: Calculate Euclidean Distance then get Euclidean, Repeat above procedure for n object images now we have "N" object image and its Euclidean distance Matrices.

Relevance Feedback: Mark all Images as Relevant Images as well as Irrelevant Images and Forms set Rr and Ri. (Where Rr ε Tr and Ri ε Tr) and Tr is Training Set.

Training and Rule Extraction: The set Rr is modified by including the query image selected by user in it. Calculate feature vector of Rr and Ri. Feature vectors of Fr forms the positive set and feature vectors of Fi forms the negative set of data points for training the classifier.

These sets are then given as input to classifier. The feature set of Tr is calculated and then fed to classifier for classification so that the separate data points in training set as positive or negative. After that classified data we apply decision tree for explanation of rules. This Process is iterated many times. According to user input.

Result Processing: Collect the set FT_r from the last iteration of training. Now, say user wants g numbers of images from the database which are most relevant to the query image

Conclusion

Here, the above approach is just a proposal about a new system. In future we design a tool for the above given method for image classification and provide compression for that system.

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