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Image Retrieval with Adaptive SVM and Random Decision Tree

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***Abstract*—In this paper, we conduct research on the image retrieval algorithm based on the support vector machine and the decision tree. Image database retrieval system is the core part of the image database, the system uses a certain algorithm of image to transform the image data in the database, operation and organization, and connecting with the complete image database retrieval algorithm of the image retrieval function, in order to obtain the retrieval results, to meet the needs of users to meet the needs of its users. Have the feature such as shape, texture, color data, which determines the image database has a different way of conventional database retrieval. In order to improve the efficiency of the image database retrieval, must be carefully designed the structure of image database retrieval system, adopt efficient image retrieval method quickly. Our research proposes the novel perspectives of the related issues that obtain the feasible and effective.**

Keywords—Image Retrieval; Algorithm; Support Vector Machine; Decision Tree; Learning

I. INTRODUCTION

With the rapid development of the multimedia technology and the Internet, the explosive growth in the number of images, the plight of puts people in a lot of data, in order to get more accurate results accord with the actual demand of personal retrieval, personalized image retrieval becomes research hotspot. The essence of personalization is according to different users with different service strategy, provide the different service content. Personalized image retrieval is based on the user to retrieve the result feedback active learning and record the user's interest, and speculated that the user's interest requirements while getting the user's interest is the huge problems facing visual semantic gap between low-level features and the high-level semantics [1-2].

According to the literature review, the basic features of the images for retrieval could be generally summarized as the follows. (1) Color feature extraction. When the global features of image features with color intuitive, significant and the most widely used, the color histogram is the most commonly used the color feature representation. Color histogram through to quantify the different color in color space, the characterization of the proportion of all sorts of color in the image, but can't said the color specific spatial distribution of the general information. (2) Texture feature extraction. Texture feature is important in content-based image retrieval system of the low-level visual features, said the surface properties of objects in the image, not only contains important information about the structure of the composition of the object itself, but also characteristics of the object associated with the surrounding environment. Texture feature does not rely on color and rotation visual features, such as anti-noise capability is strong, widely used in the retrieval system. (3) Characteristics of the parallel connection. It can only reflect the underlying characteristics of the image color and texture characteristic of some aspect of the, for complex distribution of image retrieval, simply use color or texture characteristics and the retrieval effect is not very satisfactory. CCA is to analyze the interaction relationship between two sets of random variables of statistical methods, namely according to the two groups of correlation variable is analyzed and the greater the correlation, the better the performance [3-4].

SVM is based on the statistical learning theory developed a new classification method, it can solve the existing in the neural network learning and owe to learn, easy to get the problem such as the local minimum solution; In the small sample, nonlinear and high dimensional pattern recognition problems the advantage is obvious. Feature selection is good or bad that directly affects the classification result. Because the image information is rich, feature extraction of it extremely difficult, should be generally meet the translation, rotation and scale invariance. Image characteristics of expression way have a lot of, mainly from the color of the image contained in the aspects such as information, shape and texture information extraction. Histogram of the image color

features, contains more information, the range is wide, how simple and clear to express a problem has been the researchers to explore.

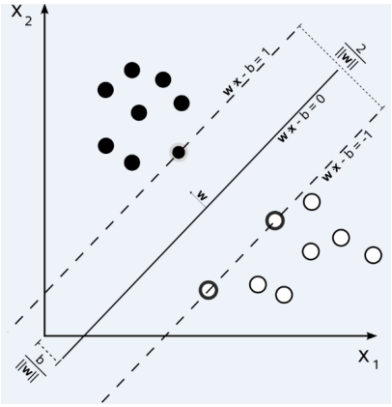

Fig. 1. The Demonstration of the Support Vector Machine

In this paper, we conduct research on the image retrieval algorithm based on the support vector machine and decision tree. In the target area for the use of color, texture and shape features describe the characteristics of an image, the image target area to extract image texture, color and shape feature information, and then to image retrieval is a focus in the study of this article.

II. Our Proposed Methodology

A. The Image Processing and the Machine Learning

Machine learning algorithm is the important theoretical basis of the classical statistics and the main research content is the gradual theory when the sample size tends to the infinity. However, the actual problem in the sample is often limited, and the inherent correlation of these samples is not usually for the additional samples cost is high. Therefore, when people use based on the sample size tends to infinity the gradual theoretical design of machine learning algorithms, in solving the problem of sample limited actual ragged [5, 15, 16].

Aiming at the existing problem of high-dimensional data index technology, this paper proposes a hash function of supervised learning algorithm, the use of the hash function will be the original space of learning to the characteristics of vector map for binary coding, coding by calculation of hamming distance retrieval. The main purpose of this article is based on the current encoding discriminant less than shortcomings, using machine learning algorithm hash function, make the code after quantitative discriminant feature not only can increase to some extent, but also can ensure same semantic features of the local structural. For the small sample machine learning algorithms in the learning and owe this problem, statistical learning theory, put forward the structural risk minimization principle, namely the set of functions as a nested function subset sequence structure, make all subsets according to the size of the VC dimension, in the same subsets confidence limit is the same, looking for minimum in each subset empirical risk, select the minimum subset of minimizing the sum of empirical risk and basic confidence limit, and then achieve the goal of expected risk minimization, the minimum subset make empirical risk function is the optimal general function [6-7].

B. The Decision Tree

The decision tree algorithm is a kind of typical inductive learning algorithm as it uses the greedy strategy top-down recursively to construct the decision tree [11, 12].

This algorithm on the assumption that the sample of the attribute value and the classification is the premise of discrete values, using the information entropy as a heuristic strategy to establish a clear decision tree, because of some things in the real world attributes is very similar, if in accordance with the standards of clear them into different categories, may cause the loss of information. In view of the uncertainty existing in the real world, people put forward a kind of decision tree induction algorithm, namely fuzzy decision tree algorithm.

Information fusion is refers to the acquisition and integration of the various information sources, generating a complete, accurate and comprehensive information effectively and it is directly from the source of information is more concise and less redundant and the use. The decision tree classification model is divided into single decision tree and compound decision tree two broad categories: single decision tree refers to the segmentation of each node using the same algorithm, including univariate decision tree and multivariate decision tree, compound decision tree is refers to the classification of each decision tree with different decision rules and algorithm [13, 14].

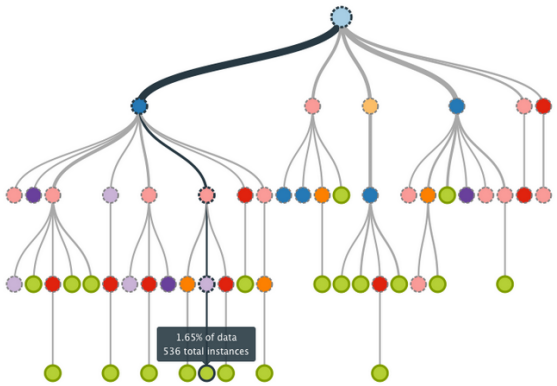

Fig. 2. The Architecture and Topology of the Decision Tree

Build a tree, we will first need to select an attribute as a root node, then every possible value of this attribute as a branch in each branch again find an attribute as a property of the next node of the branch, so until all attributes are selected. Commonly used the decision tree algorithm adopts entropy as the selection criteria and the related fuzzy integral could be expressed as the follows.

$$sample = (c)\int dd^{\mu} = \sum_{j=1}^{n}\left\{d_{ij} - d_{i,j-1}\right\}\mu_j \qquad (1)$$

Split the branch node makes the greatest feature of the information gain weight when is the best splitting component and the information gain function is defined as follows [8].

$$G(I, f_i, I_k) = -E(I) + E(I_{rk}, f_i) \times p(I_{rk}) \quad (2)$$

Random forests are composed of multiple decision trees. In order to ensure the randomness of the structure of the decision tree in the process of the training sample selection decision tree to introduce randomness, randomly selected from all the training samples every time a subset while as the training sample single decision tree and the classifier for decision profile is defined as follows [17, 18].

$$\begin{bmatrix} d_{11}(x_k) & \cdots & \\ \vdots & & \vdots \\ d_{L1}(x_k) & \cdots & \end{bmatrix} \quad (3)$$

C. The Support Vector Machine

Regression analysis is based on a given set of the sample data, a reflection to seek optimum function of the sample data. In other words, it is according to a set of error function, the function relationship between the desires of the best fitting sample data set to minimum error fitting. In this case even if the use of the improved algorithm is still consumes too long training time. On the other hand, usually describe the texture information of the dimensions of the feature vector is higher, this will cause obtained by SVM classifier of the support vector set contains larger, and thus classification was slow. Therefore, we propose the listed function for optimization.

$$y = f(x) = w\vartheta(x) + b \quad (4)$$

In this type of application, however, they are usually contain a lot of redundant information in the training sample, if the compression of the sample set in a reasonable manner, reducing the size of the training sample, can while maintaining the accuracy of classifier to improve the speed of training and classification namely the desires of the optimal regression function hyperplane is as follows [9-10].

$$f(x, \alpha_i, \alpha_i^*) = \sum_{i=1}^{n} (\alpha_i - \alpha_i^*) K(x_i, x_j) + b \quad (5)$$

Different kernel functions corresponding to different learning machine, the most commonly used kernel function are polynomial nucleus, the Gaussian kernel and Sigmoid function, etc., in different applications can be flexible to choose, but there is no general method of the basic kernel function and the parameters selection. We could revise the classification function as the follows.

$$f(x) = \operatorname{sgn}\left[\sum y_i \alpha_i k(x_i, x) - b\right] \quad (6)$$

D. The Enhanced Image Retrieval Algorithm

Enter a query examples of image, the user wants to the CBIR system can quickly return to semantically related image retrieval results, so the ideal image characteristics should has the dimensions of the lower and higher ability of semantic differential.

Once visual word tree is built, it needs to define the query image and the database image similarity criteria, using the hierarchical feature of tree structure and inheritance relationships between nodes, simply by comparing the different image from top to the bottom in the word tree path similarity to determine the similarity between images. To improve the efficiency of a large database of the score calculation, the inverted structure of the document image words said bag model. Each node in the visual word tree associated with an image list contains word characteristics, as well as characteristics of word frequency in the corresponding image.

In the process of algorithm implementation, only calculate the leaf nodes of the reverse document. Inverted file structure of the intermediate node can be caused by the child nodes of the corresponding branch inverted file merging. Stored in the node of the reverse document length is used to calculate the weight of the node, if the length more than scheduled length indicate that the node corresponding words often appear in image, have lower representative that can be similar to that of text processing will stop these information less words as words shall be removed. Assuming that the weight of each node is not the database is known. We define the similarity features as the follows.

$$S_{similarity} = \sum_{i=1}^{J} n_i (\mu_i - \mu)(\mu_i - \mu)^T \quad (7)$$

The significance of the similarity calculation formula is to reduce the computational complexity of the vector distance. As a result of the reverse document indexing structure that make originally the distance calculation of the complex reduced to only by conditional statement to query vector and the vector database to a non-zero value at the same time the corresponding dimension of the elements of the cumulative sum, because the number of visual words tends to be very big, the query image library is very big and the simplified calculation will greatly improve the efficiency of retrieval.

$$S(q, d) = \left\| \frac{q}{\|q\|} - \frac{d}{\|d\|} \right\| \quad (8)$$

Reduced if the data set is classified information, of course, we want to use when the characteristic dimension of category information improve the identification ability of projection space. LDA is such a kind of method and it makes every effort to make the projection data is more advantageous to the distribution of the general classification that holds the listed advantages. (1) Hierarchical tree structure than the depth of the flat structure has better search ability that can be used in a variety of the sophisticated search algorithm, and therefore more suitable for sea quantity images for quick retrieval. (2) Visual word tree there is no limit to the number of visual words, but with the increase of number of words to improve characteristics of image representation ability, better retrieval effect. (3) Image retrieval computational cost and leaves of the tree node number growth in pairs, and computational cost in the flat structure with the number of words of linear growth, greatly influence the efficiency.

This section presents the performance of the image retrieval and image classification experiment methods. Image retrieval experimental data sets including 15 images, image

classification experiment data sets including 20 images, each contains 400 images.

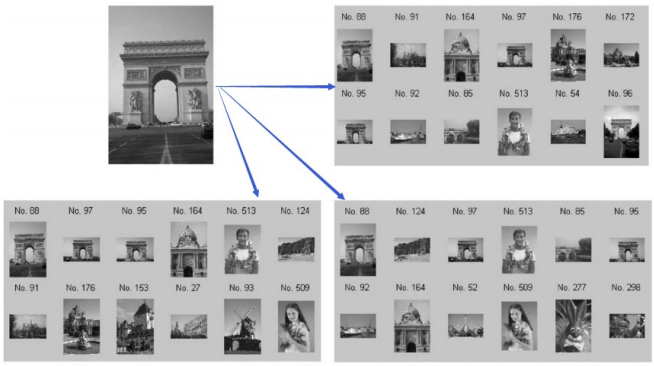

Fig. 3. The Simulation on the Image Retrieval Algorithm

III. SUMMARY

In this paper, we conduct research on the image retrieval algorithm based on support vector machine and decision tree. Content based image retrieval is refers to the direct retrieval that according to the description of the various characteristics of image content, it can find out from the database with the given characteristics or contains the specific content of the image and it is based on keywords retrieval method, which is different from general traditional fusion image understanding, pattern recognition technology. Relevance feedback is refers to refine the query through the human-computer interaction, hope to refine the query results can accord with the user's query intention more. The standpoint of the relevance feedback is to emphasize to the user as the center rather than the computer as the center. Based on this, we propose support vector machine and decision tree based image retrieval algorithm that enhance the traditional approaches.

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