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HYBRIDIZED FEATURE DESCRIPTOR (HFD) FOR CONTENT BASED IMAGE RETRIEVAL ON LARGE IMAGE DATABASES

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ABSTRACT

In this paper, the hybridized feature descriptor has been utilized for the CBIR engines. The content based image retrieval (CBIR) systems are being popular among the internet users and they provide them the various ways to find the desired image contents from the online image databases. Content based image retrieval (CBIR) systems offer the query inputs in the form of text keywords, specifications, image properties, color patterns, texture patterns or image itself as the input query. The image based query systems are getting the popularity as they lower the complexity to enter the type of colors, color patterns, texture patterns, etc in the customized query inputs. The proposed model has been designed in the layered approach, where the image features are matched one after one to prepare the final image ranking. The proposed model outperforms the existing models because of its hybrid feature descriptor solution proposed by the amalgamation of the color and low rank features computed with feature fitness validation. The proposed model performance has been evaluated in the form of various performance parameters of accuracy, ranking/index building time, library lookup time, precision, recall, etc. The experimental results have proved the efficiency and robustness of the proposed model and proved it as the effective CBIR system.

INTRODUCTION

A huge collection of images and videos are available for the public on the internet and as a result, there is high demand of multimedia information. The need for development of multimedia and communication technology is rapidly rising. To handle the huge databases, efficient tools are required for image and video retrieval. Earlier, the text keyword approach was used for this purpose where each image was manually annotated by a set of keywords and then, these keywords were used for image retrieval. But this approach has two demerits. Firstly, the manual annotation is very tedious and time consuming. Secondly, the human perception is highly subjective and it varies from one individual to the other which may lead to annotation inaccuracies. Thus, to overcome the limitations of text keyword approach, the content based image retrieval (CBIR) was developed. The CBIR approach doesn't use a set of keywords. Instead, each image is indexed by its visual features like color, shape and texture which are in the form of feature vectors. The use of such low-level visual features for image retrieval makes the CBIR systems computer centric.

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The performance of such systems is not satisfactory because of semantic gaps and subjectivity in human perception. Semantic gap occurs due to the differences between the information extracted from the visual data and how that information is interpreted in real world (Krishnapuram *et al*., 2004). The human beings always use high-level features like keywords for understanding the image contents. They find it extremely difficult to describe the images they are searching for using low-level image features. On the other hand, most of the image processing techniques extract low level features such as shape, color, texture, etc. from the images. There is no one-to-one mapping between the features required by users (high-level) and the features generated by image processing algorithms (low-level). Despite of a large amount of research efforts expended for the development of an efficient CBIR system, the performance of CBIR systems is still not satisfactory due to difference between the system generated low level features and semantic concepts. Second reason is the human perception subjectivity because human perception varies differently for different persons under different circumstances. Humans may perceive the same image differently. So to overcome these problems research focus should be on high level querying and browsing.

Relevance Feedback Techniques: It is a method of step by step automatic refinement of the query given by user. It was first implemented in text based information retrieval. It is applied to reduce the gap between the high level image concepts and low level features. To implement the relevance feedback in CBIR system, minimum requirements which need to be fulfilled are that based upon the predefined similarity metrics. The initial results should be shown to the user by the system. Secondly, user must indicate the relevancy of an image that is which one is relevant and which is irrelevant. Lastly, depending upon the negative and positive feedback, the system must change its mechanism. The main purpose of relevance feedback technique is to understand the user needs and return the results in a refined manner (Xin and Jin, 2003). Query shifting concept is also used which means moving the query more towards the relevant image than the region of irrelevant image

Literature Review

Gudivada *et al.* (1995) proposed an algorithm which is strong as it can manage interpretation, scale, and rotation fluctuations in pictures. The calculation has quadratic time unpredictability regarding the aggregate number of articles in both the database and inquiry pictures. Authors presented the thought of measuring a framework's recovery quality by having a specialist who indicated the normal rank request concerning every question for an arrangement of test inquiries. This empowered them to exhaustively asses the nature of calculations for recovery in picture databases. Smeulders *et al*. (2000) presented a survey of 200 references in substance based picture recovery. The paper began with examining the working states of substance based recovery: examples of utilization, sorts of pictures, the part of semantics, and the tangible crevice. Ensuing segments examined computational ventures for picture recovery frameworks. Step one of the audit was picture handling for recovery sorted by shading, composition, and nearby geometry. Highlights for recovery were talked about next, sorted by: aggregate and worldwide highlights, notable focuses, question and shape highlights, signs, and auxiliary blends thereof. Comparability of pictures and protests in pictures was evaluated for each of the highlight sorts, in close association with the sorts and method for criticism the client of the frameworks is equipped for giving by cooperation. Lu *et al*. (2003), suggested that relevance feedback was an intense method for image recovery and has been a dynamic exploration bearing for as far back as couple of years.

Different spontaneous parameter estimation procedures have been proposed for importance input. Furthermore, strategies that perform improvement on multilevel picture substance model have been figured. Nonetheless, these systems just perform significance criticism on low-level picture highlights and neglect to address the pictures' semantic substance. In this paper, they proposed a significance input structure to exploit the semantic substance of pictures notwithstanding low-level highlights Xin *et al*. (2003), made use of Gaussian mixture model for the representation of user's distribution of target which is responsible for the narrowing down the gap between high level and low level features. Since current image recovery frameworks are unequipped for catching client's conflicting aims, system is proposed to determine client's contention input. Trial results demonstrated that framework which can continuously enhance its recovery execution through gathered client communications. Krishnapuram *et al*. (2004), have proposed FIRST i.e. Fuzzy Image Retrieval System which uses the fuzzy set theory to represent an image, similarity measure and relevance feedback. FIRST incorporates these ideas. FIRST make use of attributes, spatial relations and linguistic queries to handle the exemplary based graphical sketches. Fuzzy attributes relational graphs are used to represent the images.

Liu *et al*. (2007), keeping in mind the end goal to enhance the recovery exactness of substance based picture recovery frameworks, examination center has been moved from planning modern low-level highlight extraction calculations to diminishing the 'semantic hole' between the visual highlights and the abundance of human semantics. This paper endeavored to give a thorough overview of the late specialized accomplishments in abnormal state semantic-based picture recovery. Yang *et al*. (2009) proposed NIR is an open source distributed computing empowered substance based picture recovery framework. With the improvement and promotion of distributed computing, more specialists from diverse exploration ranges do research with the assistance of distributed computing. This paper exhibited thoughts, discoveries, outline and the framework from our work of NIR. Chang *et al*. (2010) analyzed the contents of image and suggested that retrieval of semantics is important during semantic based image retrieval. PCA (principal component analysis) is applied to extract the image features and then concatenate them with Fuzzy-ARTNN. Dillon *et al*. (2010) discussed that Cloud will reshape the entire industry as a revolution. In this paper, aim is to discuss the challenges and issues of Cloud computing. First two related computing paradigms - Service-Oriented Computing and Grid computing are discussed and also their relationships with Cloud computing. Cao *et al*. (2014) suggested that for the purpose of protecting data privacy, data has to be in the encrypted form before outsourcing it to the cloud. It replaced the traditional technique of data utilization based on plaintext keyword search. Work done in this paper focused on the multi- keyword search over encrypted cloud data. For the future work authors have suggested schemes to reduce overhead over computation and communication. Mohana *et al*. (2015) suggested that Content Based Image Retrieval (CBIR) is a proficient recovery of important pictures from substantial databases taking into account highlights separated from the picture. The paper proposed a framework that can be utilized for recovering pictures identified with a question picture from a huge arrangement of particular pictures.

Experimental Design

To bridge the semantic gap, machine-learning, classification and clustering techniques have been widely used in the preprocessing stages or during the relevance feedback. Relevance feedback makes the user participate in image retrieval system through human-machine interaction; capture the user's search intention in order to improve retrieval results, so it has been extensively studied. Recently, there have been many relevance feedback algorithms. They improve the image retrieval results to some extent. Relevance feedback technology can be divided into two categories in the CBIR, one is to adjust some parameters in the similarity measure according to the user's feedback, the other is probabilistic view, to calculate each image in line with user's requirement according to user's feedback, and the images with high

probability will be return. In this paper, the hybridized feature descriptor is constructed to describe the relevance between the query and database images in the database. The similarity factor is calculated by SVM based learning model. It can achieve very good results under the limited feature matching paradigm:

Algorithm 2: HFD based CBIR using Color and Texture

1. Load database in the Matlab workspace
2. Resize the image according to the smaller sized image
3. Convert image from RGB to Gray
4. Normalize the gray image for fixed mean
5. Generate the histogram of RGB
6. Find entropy, standard deviation and local range of Gray
7. Combine the image feature
8. Load the test image
9. Apply the procedure 2-7 to find combine feature of test image
10. Determine the normalized Euclidean distance of test image with stored image of database
11. Sort the normalized Euclidean distance values to perform indexing under the SVM classifier.

PERFORMANCE EVALUATION

RESULTS AND DISCUSSION

The proposed CBIR model has been tested with the 10 query objects/images in order to understand the performance of the proposed model. The proposed model has been tested with the 500 images in the training dataset. The training dataset is a validated dataset by the several institutes and contains the images from various categories, like tribal, monuments, urban, beach, digital, etc. The proposed CBIR model is based upon the hybridized feature descriptor. The matching content filter is fulfilled by the support vector machine on the basis of the feature descriptors computed over the input image data, and keep filtering the content each time the user perform the search with the selected query image. The result has been obtained in various forms such as absolutely similar images, total detected images, detected absolutely similar images and image not detected and false image detection. There parameters are used to judge the accuracy of the proposed model. The accuracy of the proposed CBIR model has been measured using the statistical type 1 and type 2 errors. The statistical type 1 and type 2 errors include the true positive, true negative, false positive and false negative values.

Table 1. The statistics of the total results on 10 images

Index	Total Number of Similar Images	Absolutely Similar Images	Total Detected Images	Detected Absolutely Similar Apples	Images not Detected	False Image Detection
F1.jpg	7	6	6	6	0	0
F2.jpg	30	26	26	25	1	1
F3.jpg	6	5	4	4	1	0
F4.jpg	13	13	13	13	0	0
F5.jpg	25	24	23	23	1	0
F6.jpg	15	15	13	13	2	0
F7.jpg	10	10	10	10	0	0
F8.jpg	3	3	4	3	0	1
F9.jpg	10	9	9	9	0	0
F10.jpg	6	0	0	0	0	0
TOTAL	125	111	108	106	5	2

Table 2. Type 1 and Type 2 statistical errors

Parameter	Value
True Positive	106
False Positive	2
True Negative	14
False Negative	5

Table 3. The performance measurement parameters and statistical errors

Parameter	Proposed Scheme	Existing Scheme
Accuracy	95.50%	89%
Error Rate	4.50%	11%
Sensitivity	95.50%	89%
Specificity	87.50%	-
Positive likelihood ratio	7.64	-
Negative likelihood ratio	0.05	-

Table 4. The performance measure in the terms of elapsed time

Image	Elapsed Time of proposed scheme
F1.jpg	7.34
F2.jpg	14.11
F3.jpg	10.60
F4.jpg	7.36
F5.jpg	7.88
F6.jpg	6.88
F7.jpg	10.52
F8.jpg	13.95
F9.jpg	5.07
F10.jpg	1.83

The true positives are the correctly searched results, whereas the false positive shows the possibility of false results. The true negative value indicates the correct rejection of the objects, whereas the false negative indicates the false rejection of the image content. The performance of the proposed model has been further analyzed using the various performance parameters such as accuracy, error rate, sensitivity, specificity, positive likelihood ratio and negative likelihood ratio.

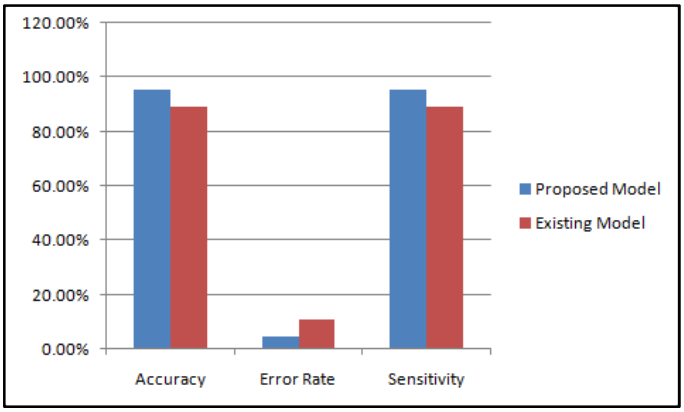

Figure 1. The performance comparison of proposed model and existing model

The accuracy indicates the possibility of the correct results appearance from the proposed CBIR system. The error rate gives the probability of the errors in the proposed CBIR model based upon long term memory. The sensitivity is the parameter to indicate the case of rejection of the truly false results or image objects in the training image data in accordance with the query image provided by the user, whereas the specificity is the parameters to indicate the appearance of the correct results against the input query image. The positive and negative likelihood ratio indicates the rule-in and rule-out of the correct results produced by the CBIR systems. The proposed model has been tested on the basis of the elapsed time between the existing and proposed schemes. The elapsed time tells us about the response delay when the input query image is processed. The elapsed time clearly indicates the effectiveness of the proposed model. The average time of the SVM for ranking preparation has been marginally lower than the neural network or k-nearest neighbor based techniques, when it comes to build the semantic relationship library (SRL). The image ranking technique build the SRL for the runtime period and flush it afterwards, whereas the HFD technique will keep the SRL in the shape of runtime ranking array, which increases the efficiency of the proposed model to manage the results with higher level of accuracy.

Conclusions

This paper is about querying an image and obtaining a reduced set of candidate images. The color histogram for an image is constructed by quantizing the colors within the image and counting the number of pixels of each color. The feature vector of an image can be derived from the histograms of its color components and finally can set the number of bins in the color histogram to obtain the feature vector of desired size. The algorithm is similar to the experience of mechanism of human brain and has an initial learning mechanism.

Experimental results clearly show the effectiveness of the algorithm. The support vector based proposed model has performed better than the existing schemes when implemented with the support vector machine (SVM) over the hybridized feature descriptor (HFD) computed over the given image data. The proposed model has been developed as the quick response system and has produced the results in the lowest time possible. In the future, the proposed model feature descriptor will be improved and enhanced in order to channelize the behavior classifier as the auto fuzzyfier for the early sample elimination, which may achieve the higher convergence rate in the minimum time to make the system faster.

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