Recognition of vehicle based on hybrid features

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Abstract— Content Based Image Retrieval (CBIR) is a technique used for recognition of similar vehicle images from a large database. Content Based means search analysis based on the contents of an image. Content refers to the color, texture and shape or any other information. The feature descriptors of the content can be obtained from the image itself. All CBIR systems perform search and retrieval operations in image database using image features like color, texture and shape. In this paper, vehicle image recognition is performed by extracting information related to color, texture and shape features. Color features include the color moments, Texture features are derived from the gray level co-occurrence matrix and the shape features are derived from the canny edge operator. These features are examined in order to search and recognize similar images from image database. This was mainly due to semantic gap between the low level visual features (color, texture, and shape) and the high level human perception. In order to reduce the gap, the interactive Relevance Feedback (RF) is introduced in CBIR.

Index Terms— Color, texture, shape, relevance feedback and similarity measure.

1 INTRODUCTION

THE image information obtained from color or texture or shape feature is not sufficiently robust for accurately describing the image content. The aim of this paper was to integrate these distinct features of the image to produce better results across various datasets. Color is one of the most widely used features in CBIR. It is not capable of changing to the size and the orientation of the image. Color can be represented by feature descriptors such as color spaces, color histogram and color moments. In this recognition process, mean, variance and skewness of the statistical values of the input image forms the color feature vector. Texture refers to the natural surface properties of an object and their relationship to the surrounding environment. Each texture image is described by a Gray Level Co occurrence Matrix (GLCM). Shape is a feature that represents the contour of an object in an image. Shape feature can be obtained using canny edge operator. During retrieval, Euclidean distance measures the similarity of the query image and images in the benchmark database in various dimensions such as color, texture, and shape, to recognize the vehicle images which are similar. After obtaining some relevant transportation images, the user evaluates the retrieved images more or less relevant to the query one. By using RF technique the system updates the queries so as to place more weight on relevant element and less on irrelevant one[3].

CBIR systems retrieve the relevant images in the database using visual content of images, color, texture, shape and so on. The CBIR system so called iPURE (intra-query Perceptual and User-friendly Retrieval) [1] incorporates a novel methodology of intra-query modification and learning of user perception at the client-site in addition to RF in successive iteration. The texture features, like Block Difference of Inverse Probabilities (BDIP) and Block Variation of Local correlation Coefficients (BVLC) are proposed [2] for CBIR. The COREL database and VisTex database were used to evaluate the performance of the proposed retrieval method. All these approaches (color, texture or shape based) can perform well when applied to a specific type of data set. They produce poor results across the datasets or when different datasets are used. By integrating these four distinct features of the image may produce better results across data sets. Features from color, texture and shape properties are extracted and fused before comparison for recognition of images with the image database. The paper attempts to bridge the lacuna between the descriptors of the query image and the database.

2 METHODOLOGY

The entire system operates in three phases. In the first phase, the features are extracted from the query image. In the second phase, based on the feature extracted the similarity is measured between the descriptors of the query image and the images in the database, to retrieve similar images posted against the query image. In the third phase, Relevance feedback is adopted to reduce the gap between human perception and system representation.

2.1 Color Features

A color moment is a widely used feature for image representation. The input RGB (Red, Green and Blue) image is converted into YC_bC_r color space. Y is the luma component and C_b and C_r are the blue-difference and red-difference chroma components.The statistical color features such as mean, variance and skewness are extracted from the above spaces.Finally 27-dimensional color vector is obtained for the entire image by concatenating the mean, variance and skewness feature vector of different color spaces. These statistical features are calculated based on an overlapped window size of 3x3.

2.2 Texture Features

Gray Level Co occurrence Matrix (GLCM) based texture feature extraction introduced by Haralick has been considered as the powerful technique. GLCM method comes under the statistical approach of texture analysis which describes texture as a set of statistical measures based on the spatial distribution

of gray levels. The texture measure such as entropy, energy, variance, mean and contrast are calculated based on window size of 3x3.

$$Entropy = \sum p(i,j)(-\ln p(i,j))$$

$$Energy = \sum p(i,j)2$$

$$Variance = \sum p(i,j)^2$$

$$Mean = \sum (i * p(i,j))^2$$

$$Contrast = \sum (p(i,j) * (i,j)^2)$$

2.3 Shape Features

The shape feature in the context refers the shape of the particular region. For this purpose canny edge detection algorithm is applied over the segmented image. The segmented image is obtained by segmentation process such as Fuzzy C Means clustering (FCM) strategy [5].

2.4 Color, texture and Shape based Feature vecor generation

Image retrieval is done based on the combination of color (YC_bC_r), texture and shape features. A set of mean, variance and skewness of the three different color spaces, Gray Level Co occurrence Matrix and edge of the segmented image are used as a feature vector in CBIR. When the query color image is given as input to the system, color, texture and shape features are extracted. Similarity measure calculates the distance between a query image and images in a database. In this paper Euclidean distance is used as similarity measure. The goal is to select the n best images that resemble the query image. This involves the selection of n top-matched images by measuring the distance between the query image and the image in database. In this work, Euclidean distance is used as similarity measure. The concept of RF was introduced into CBIR from text-based information retrieval in the 1990s and has become a popular technique in CBIR [4]. Image retrieval displays the retrieval results based on color, texture and shape. However, the images are matched based on low level visual features the similar or target images may be far away from the query image in the feature space and they are retrieved in limited number in the first iteration. Hence the RF mechanism has been introduced into the image retrieval system, and the interactive search technology based on the RF is of practical usage. When a query image is given as an input to the database, 15 similar images with respect to the feature vector of the query images are extracted. Using RF, the user selects the images that are relevant to the query image and all the feature vector of the image is selected including the query image are fed back for the similarity measure to improve the retrieval performance. The RF technology search automatically with respect to the user's RF of the preceding retrieval results and thereby enables the retrieval to approach the user's expectation with a better one.

A user submits a query image into the system and then the similarity measurement module of the system compares the query features with those images in the database and finds the most similar images to the query image. These images are ranked based on the similarity. Under each image a select bar is attached so that the user informs the system by confirming which image is relevant. After the user evaluates these images, the system adjusts the similarity measure according to the user's point of view and provides refined search results. The user can repeat this process until the user is satisfied with the retrieved results.

Figure 1. (1.a-1.f) shows the retrieved results of 'Lorry' query when posted to the database. It shows the 10 best matched images out of 15 displayed before applying RF with the query image displayed in the top-right corner. It is observed that some retrieved images are similar to the query in terms of its feature extraction. However this method gives about 47% precision in the first iteration. RF that had been introduced into the image retrieval system adjusts the search automatically according to the user's RF with preceding retrieval result. It is a very effective mechanism and has shown significant improvement in the retrieval results within few iteration. Figure 3.f shows the improvement of retrieval after 5 iterations. Further, it is observed that when subject to five iterations, the performance has been increased to 100% precision level. Figure 1.(2(a)-4(f)) shows the retrieval results when Bike', 'Bus', and ' Car' query from the General database are posted. This system improves the retrieval performance in successive iterations of RF as compared to existing algorithms.

2.5 Relevance Feedback

CBIR is a technique to retrieve images, which are semantically relevant to a query image provided by a user from an image database. It is based on representing images with visual features, which can be automatically extracted from images such as color, texture and shape. However, CBIR systems still lag behind the best text based search engines of today, such as google, yahoo, Alta vista etc. The main problem here is the extent of mismatch between user's requirements as high level concepts and the low level representation of images; this is the well-known semantic gap problem. Hence, RF mechanism has been adapted by most recent approaches to bridge this gap and to scale up the performance in CBIR systems. When RF is used, image retrieval is considered an iterative process in which the original query is refined or modified interactively,

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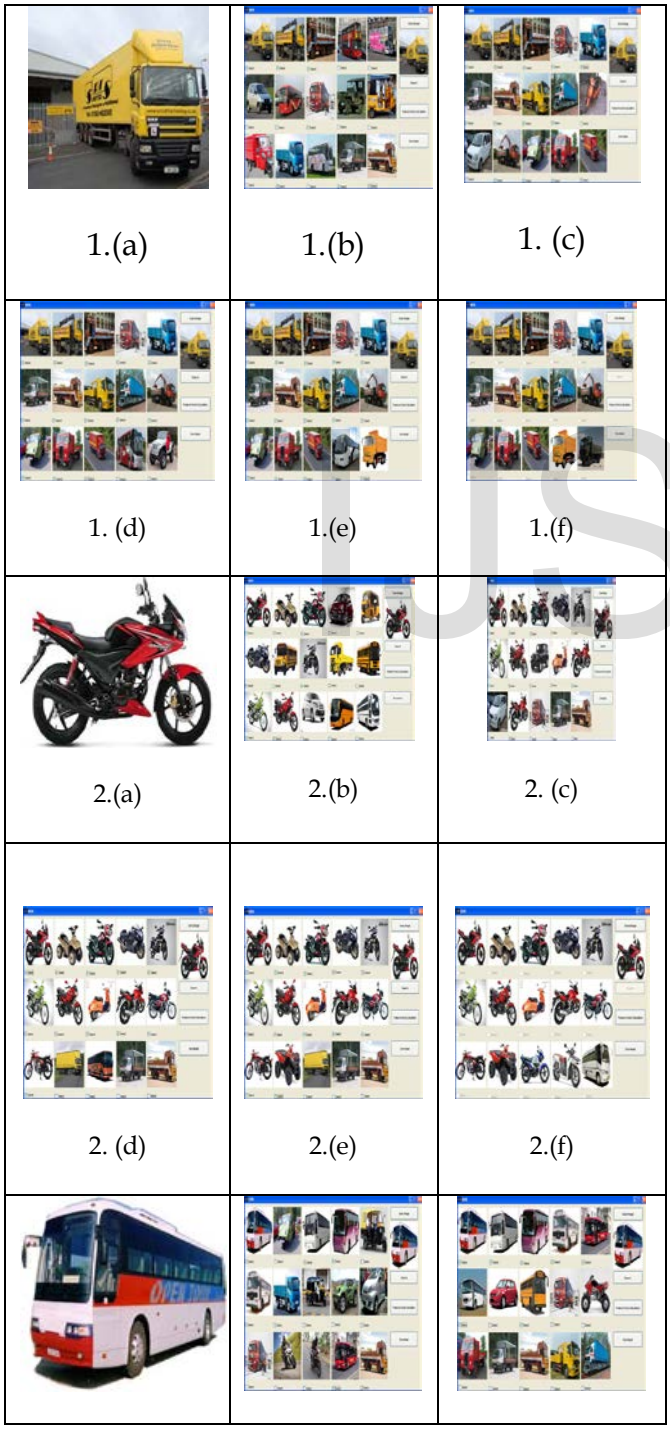
to progressively obtain a more accurate result. At each iteration the system retrieves a series of images ordered according to a given similarity measure and requires user interaction to mark the relevant and non-relevant images among the retrieved ones. This information is used to adapt the settings of the system and to produce a new set of retrieved images. The process is repeated until the retrieval contains a relevant enough image or a desired or sufficiently good (in terms of user's interest) picture is found.



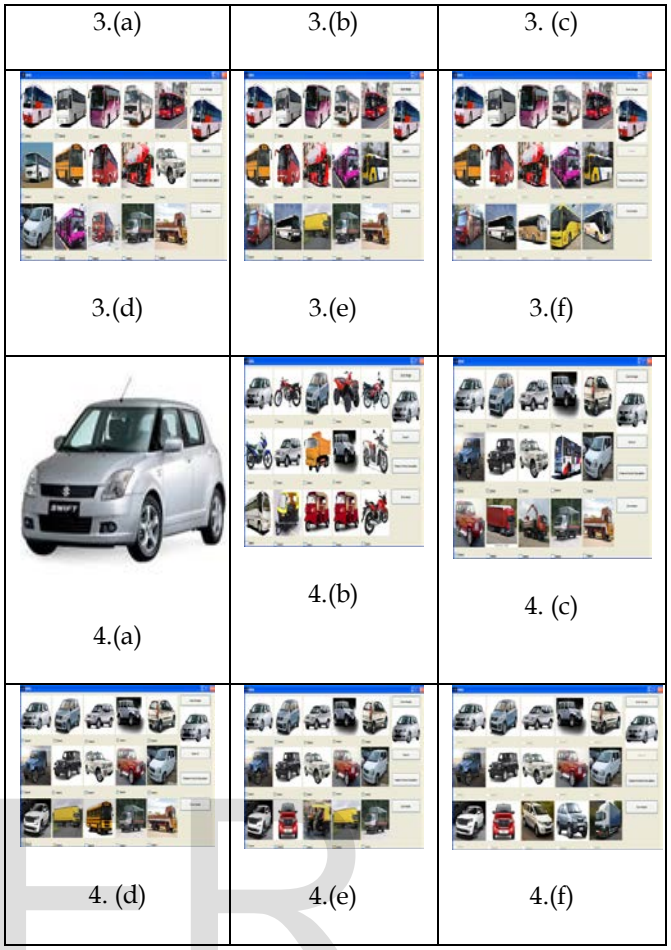


Figure 1 Top 15 retrieved images obtained by retrieving 'Lorry', 'Bike',' Bus' , and 'Car' query from the General Transport database.
(a) Query Image, (b) iteration 1, (c) iteration 2, (d) iteration 3, (e) iteration 4 and (f) iteration 5

Precision measures the ability of the system to retrieve only models that are relevant.Precision is used to measure the performance of the image retrieval.

4 Conclusion

In this paper color, texture and shape based RF image retrieval is proposed. The color feature texture feature and shape feature are extracted from an input image to form feature vector and is compared with query feature vector using Euclidean distance. Finally, RF mechanism is incorporated to increase the performance of the image retrieval. However increase in the iterations will certainly improve the retrieval results with high precision.

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