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Towards Fast and Efficient Foreground Colour Based Image Search Using Supervised Learning and Its Comparison with Unsupervised Learning

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Abstract

Content Based Image Retrieval is a method of finding similar images for the given query image from database, is an interesting and most emerging field in the area of `image search`. Current approach includes the use of colour in the entire image, but we are focusing on image search based on foreground colour. Identifying the object accurately from the database is one of the most difficult and

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open problem in computer vision. Here in this article, we limit ourselves to human dresses as foreground. We have empirically located the foreground region and learnt the color model of it using supervised learning and then used a simple K-nearest neighbour method for image classification. In this article we have also compared three different methods of color based matching and retrieval.

Keywords

Image Processing, Content Based Image Retrieval, Supervised Learning, Unsupervised Learning, Image Search, Image Classification, Computer Vision.

Introduction

The field of CBIR has generated much interest in the past decades, and a large scale benchmarking effort is under-way. The approach generally used to test CBIR system is creating a data base of images with appropriate semantics labels.

In these approaches we have two problems:

1. Labelling and annotation of the images of database manually is intellectually difficult and time consuming.
2. The second problem is there should be perfect retrieval of the images which matches the database labels and which satisfy the user.

To overcome the first problem i.e. instead of retrieving the image on the basis of text, we introduce the CBIR system, in this the image is retrieved on the basis of content i.e. color, shape and texture. We have chosen color field for the extraction of images out of several images.

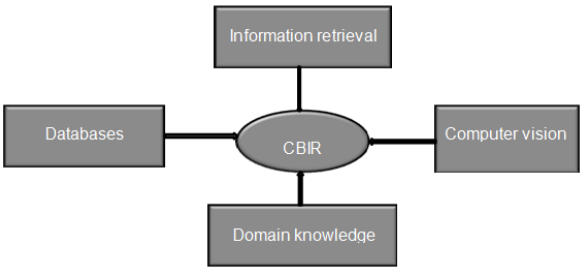

Figure 1: *CBIR System*

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CBIR System

Till now the abstraction is done on the basis of both foreground and background color.

So, this paper proposes the method to retrieve image based on dominant colors in the foreground image. The foreground of the image only gives semantics compared to the background of the image.

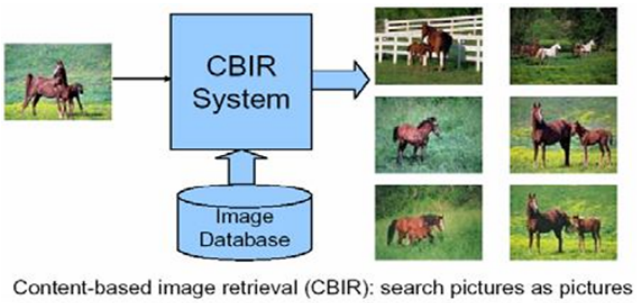

Figure 2: *CBIR: Search Pictures as Pictures*

Related Work

The image retrieval mainly has two steps:

1. Feature Extraction.
2. Query Execution.

By using the following methods, the features of the images are extracted:

Colour Feature Extraction

The color features used in this algorithm are color histogram, average color and cumulative histogram.

1. **Colour Histogram:** The color histogram is a figure which is made with color values as abscissa and the frequency of the pixels with this color as vertical coordinate.
2. **Average Colour:** Average color is defined as weighted average of the colors in the color histogram.

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3. **Cumulative Histogram:** Cumulative histogram is a figure which is made with color values as abscissa and the frequency of all pixels from origin of coordinates to the color as vertical coordinate. Once the features have been extracted, it is matched with the feature of the query image by computing a similarity measure to search for the most relevant images in the database.

Image Retrieval

For image retrieval following methods have been used:

1. **Discrete Cosine Transform:** The discrete cosine transform (DCT) is closely related to the discrete Fourier transform. It is a separable linear transformation; that is, the two-dimensional transform is equivalent to a one-dimensional DCT performed along a single dimension followed by a one-dimensional DCT in the other dimension. Mainly three different techniques are used here for image retrieval, which are listed below.
   a) DCT Row Mean,
   b) DCT Column Mean and
   c) DCT Combination: Here first the row mean and column mean of an image are found and then discrete cosine transform is applied on them to get feature vectors of image for respective technique of image retrieval.

2. **Image Retrieval using DCT Row Mean:** Here first the row mean of query image is obtained. Then the DCT row mean feature vector of query image is obtained by applying DCT on row mean. For image retrieval using DCT row mean, these query image features are compared with DCT row mean features of image database by finding Euclidean distances.

3. **Image Retrieval using DCT Column Mean:** Here first the column mean of query image is obtained. Then the DCT column mean feature vector of query image is obtained by applying DCT on column mean. For image retrieval using DCT column mean, these query image features are compared with DCT column mean features of image database by finding Euclidean distances using the formula.

4. **DCT Combination Image Retrieval:** Here both row mean and column mean of query image are obtained. Then the DCT row mean feature vector of query image is obtained by applying DCT on row mean and DCT column mean feature vector is obtained by applying DCT on column

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mean. For image retrieval using DCT combination, both feature vectors are considered together for comparison with database image features.

Background

RGB Colour Histogram

1. The RGB colour model is an additive colour model.
2. Purpose of RGB model.
3. Sensing.
4. Representation.
5. Display.
6. RGB is a device-dependent colour model.

Additive Primary Colours

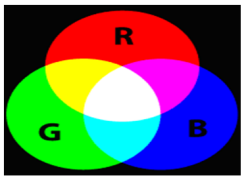

Figure 3: *RGB: Additive Primary Colours*

Proposed Work

The drawback of the methods used till now is it can not retrieves the same objects of varying sizes as the similar image. For the smaller object the background will be the dominant region as shown in figure 4. The proposed method can answer this problem because of considering only the foreground information and neglecting background details.

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Figure 4: *Dominant Background Images*

K-Nearest Neighbour based on Foreground Objects

Dominant color identification based on foreground objects retrieves more number of similar images based on foreground color irrespective of size. The foreground information of the images are enough to identify the images properly. This is implemented by the proposed algorithm.

Supervised Learning

The procedure for supervised learning is as follows:

1. Firstly we are teaching a computer how to recognize different colours.
2. As it learns to recognize the colour.
3. We mix all the colors together and ask it to extract a particular colour.

Training

1. Heuristically locate foreground in image.
2. Create color histogram for located foreground region.
3. Normalize color histogram.
4. Store normalize color histogram with their class label (like Red=1, Green=2, etc.).

Testing

1. User will input test image.
2. We will calculate normalized color histogram for foreground region of test image same as training part.

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3. Now will apply k-nearest neighbour approach to assign class to test image.
4. We will display all the images of that class.

The above technique is applied on the color images stored in database to determine the foreground dominant color and then the features are extracted and is stored. When the query image is supplied by the user, the foreground dominant color of the query image is determined. By the use of retrieval technique, the foreground dominant color of the query image is matched with the foreground dominant color of database image, and the most relevant image is retrieved.

Experimentation and Results

The following table describes about the number of images we took for dataset and also a number of images for testing. Firstly computer is made familiar with all the different colors and once it became familiar we apply testing. On of the image in the test folder is given as input image, then it search for the images similar to the color of the input image, the more nearest matching image is extracted out form huge number of images as an output. The figure 5 shows the input image, then the output image which matches with it.

Colour	Number of Sample Images Used
BLACK	15
BLUE	15
RED	15
WHITE	15
YELLOW	15
TEST	26

Comparison

The procedure is shown in figure 6.
In unsupervised dress part: Computer is not trained for how to recognize the colours, it considers both the foreground and background of the image (as shown in figure 7). Due to this, we didn't get the accurate results.

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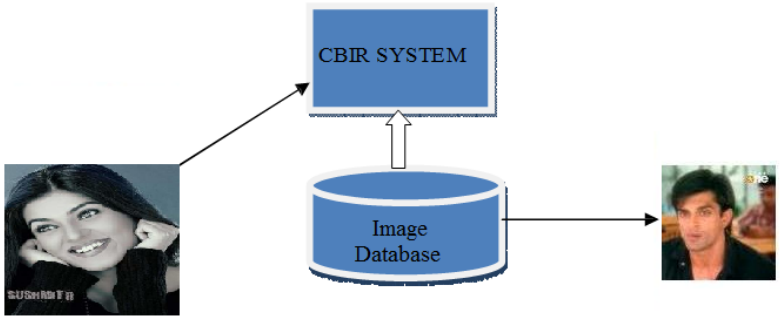

Figure 5: *CBIR Approach*

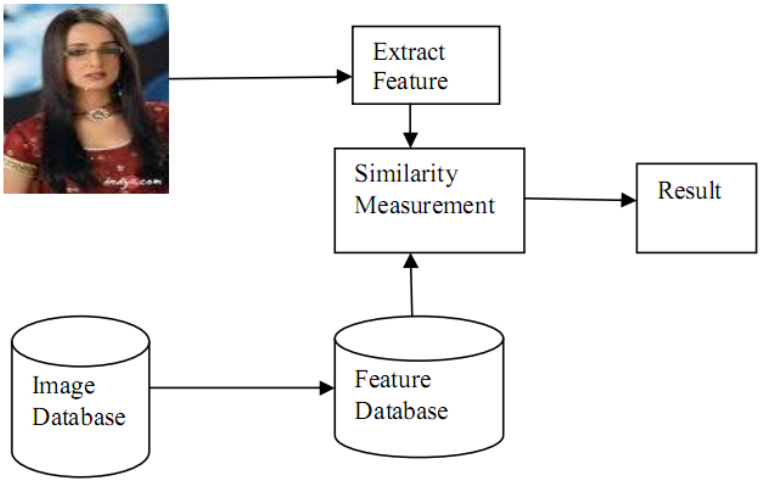

Figure 6: *The CBIR Procedure*

In supervised whole image: Computer is first taught how to recognize the colours and then retrieval of the image is done on the basis of both foreground and background (as shown in figure 8). This gives a bit better results then unsupervised dress part but not that accurate as we expected.

In supervised dress part: Computer is first taught how to recognize the colors and then retrieval of the image on the basis of both foreground and background is done (as shown in figure 9). This gives a us a better results then unsupervised dress part but not as accurate as expected.

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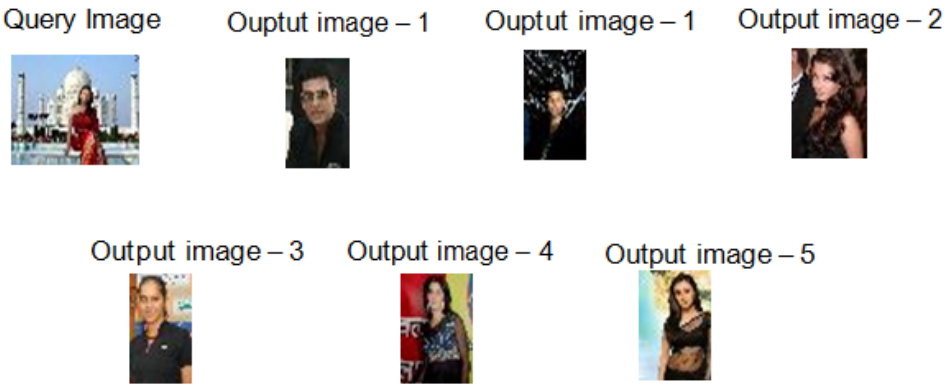

Figure 7: *Unsupervised Searching of Images with Red Colour Dresses*

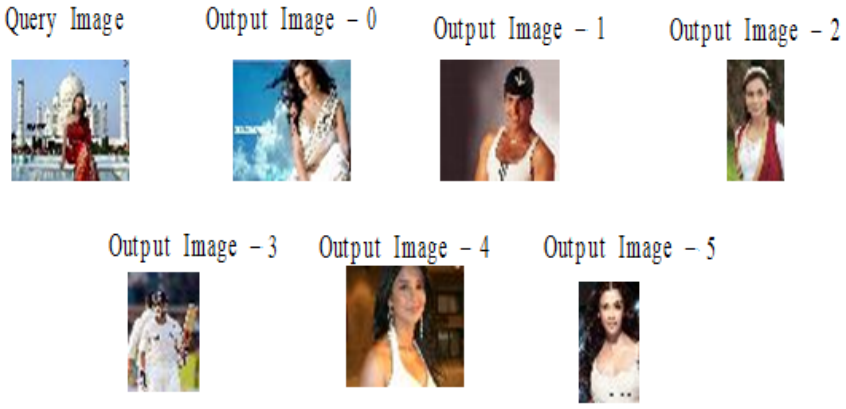

Figure 8: *Supervised Searching of Images with Red Colour Dresses*

Conclusion and Future Work

The proposed technique of K-Nearest Neighbour on foreground objects is a meaningful technique to retrieve the images based on color. The first step of segmenting foreground from background is a good improvement over a work of existing dominant region color indexing in which there is a chance of considering the background as the dominant color region even though that doesn't provide any semantics to the image. Identifying background as dominant color region is restricted in the proposed technique. Modifying the image into 25 color combination image will narrow the process of identifying the dominant color

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Figure 9

and improve the efficiency of retrieval system. The Experimental result shows that the proposed technique is efficient and accurate without any validation and K=1 and our training image is small compared to the existing dominant color region based Indexing. In future, it is recommended to improve the efficiency and accuracy by validation and trying with different value of K. Shape feature can be incorporated to retrieve more meaningful images.

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