Approach to Retrieve Content-based Image from a Clustered Database Based on a Dominant Colour

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ABSTRACT

Over the past few years, there has been a significant increase in both the availability and significance of image retrieval systems. One of the most important aspects of the photographs during the search process is their colour. Since there are many widely used techniques for color-based comparison and retrieval. In this research, we present a Dominant Colour extraction scheme that allows us to extract the image's colour features. We utilise quantization to represent the extracted prominent colours within a bound after extracting the dominant colours. We cluster the database and index the images based on quantized value. When an image which is set as question is sent as input into the system, it will only identify cluster in the image and search the image rather than the entire database utilised similarity metric in.

Keywords: Quantization, Clustering, Dominant Color, CBIR.

1 Introduction

Image Based on Content retrieval, over the past few years, has developed into an enthralling and compelling research area. The visual information retrieval system is one of the most significant and rapidly expanding study fields in information technology, with applications in many fields including designing of new fashion, crime prevention, medical science etc. However, all of these systems share the same approach for retrieving images based on their content, which is to categorize images using predefined identifiers and descriptors or to browse through the entire large collection while visually scanning each image. Both retrieval paradigms will function, but the absence of robust, flexible image-retrieval mechanisms may severely restrict the applicability of these systems. As a result, researchers developed CBIR. As the retrieval process is based on the visual analysis of contents that are present in the query image, perception can cause issues. One of these low-level properties, colour, is crucial to CBIR since it can withstand complex backgrounds and is independent of the size and orientation of the image. As the retrieval process is based on the visual analysis of contents that are present in the query image, perception can cause issues.

Low-level visual elements, such as colour, shape, texture, and spatial arrangement, are calculated from the query in CBIR and matched to order the result [1]. Seven colour descriptors are defined by MPEG-7 [3,4]. It has GoF/GoP colour, scalable colour histogram, colour structure, prominent colours, and more. A description defining language, so-called descriptors, description schemes, systems tools, and other multimedia description tools are all standardised by MPEG-7. In the sense that it is not specifically tailored or optimised for a certain application domain, MPEG-7 is general. However, it is evident that among its most significant application domains are image and video database applications. Therefore, regardless of the precise colour distribution, humans perceive images as a combination of dominant colours at the macroscopic level [5]. Although it lacks specific semantic information, DCD in MPEG-7 offers an efficient, condensed, and intuitive salient colour representation that describes the colour distribution in an image or a region of interest. There are two key parts to this feature descriptor:

- Characteristic hues

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- The proportion of every color

Only a large number of disparate photos with the same largest DC may be retrieved using these dominant colours and their percentages. When the backdrop colour of an image makes up the biggest percentage, the difference typically appears. Because of this, the MPEG-7 DCD has undergone several improvements. In order to retrieve a picture from the sizable database, we are creating in this study an efficient colour extraction strategy.

Additionally, the Quadratic Similarity Measure (QSM) employed by Yamada [12] and Deng [13] for the MP7DCD has some flaws. The first, straightforward improvements that were made to enhance QSM are shown in [9,11]. In order to tackle the QSM problem, authors in [11] also suggest using a similarity measure for the palette histogram. A new similarity measure was also suggested in [6] in order to outperform QSM and all of the aforementioned improvements [9]– [11]. Mutual colour ratio (MCR), which lessens their reliance on the largest DC, was employed in [7]. All of the aforementioned dissimilarity metrics will be modified in the current effort to enhance their performance. In this study, we suggest a novel clustered and indexed database to improve retrieval. The database in all of the earlier efforts may have good performance is not guaranteed because the data has not been both clustered and indexed. The new database will be constructed in the current work, which guarantees a good level of time complexity.

2 Relating Works

Over the past ten years, content-based picture retrieval research has drawn a lot of interest. Content-based image retrieval (CBIR) has been identified using several different methodologies. In order to determine how similar two images are, most CBIR approaches extract low-level characteristics automatically (such colour, texture, shapes, and object arrangement) and compare feature differences. Image content has been described using colour, texture, and form attributes [2]. The most prevalent low-level visual properties is the colour, and it is unaffected by the orientation of the image as well as the size of image [1]. The colour histogram, colour correlogram, and dominant colour descriptor (DCD) are examples of traditional colour characteristics utilised in CBIR.

A colour histogram, which is the most often used colour representation, lacks spatial information. A colour correlogram depicts the chance of finding colour combinations at a given distance from the pixel and provides information about spatial distance. A colour correlogram, as opposed to a colour histogram, has a better retrieval accuracy because of this. The k-th element for (i,j) for a colour correlogram of an image defines the likelihood of finding a pixel of colour j at a distance of k from a pixel of colour i in the picture. Such an image feature turns out to be resilient in tolerating significant variations in the look of the same picture brought on by shifting viewing locations, shifting backdrop scenes, partial occlusions, sharply changing camera zoom, etc. It is more suited for image retrieval than the colour correlogram since it offers substantial computing advantages. MPEG-7 colour descriptors are DCD [3, [4]. A place of interest or an image's conspicuous colour distributions are described by DCD provide an effective, concise, and intelligible depiction of the colours presented there. The linear block algorithm (LBA), developed by Yang *et al.* in [6], is a colour quantization technique for dominant colour extraction that has been demonstrated to be effective in both colour quantization and computation. By representing the local features of the picture with a bitmap and the global qualities of the image with colour distributions, mean value, and standard deviation, Lu *et al.* [8] are able to increase the retrieval system's accuracy and successfully retrieve more related images from the digital image databases (DBs). To improve the efficiency of MPEG-7 DCD, [7] employed a weighted DCD for content-based picture retrieval. In this study, we'll swap out the DCD with a dominant colour extraction strategy.

3 Proposed System

The most important process in Content-based Image Retrieval is feature extraction, which is carried out in the first stage. The foundation of the suggested technique is the Dominant Colour characteristic of an image, therefore determining the dominant colour of an image is the first step. The main colour extraction from the picture is somewhat confined by the quantization approach. The quantized values are used to index the photos and divide them into several groups. The clustered pictures are indexed using colour indexing, and the database then saves the image. After that the processes of feature extraction and quantization after receiving the query image will be done immediately. The biggest benefit of our work is the fact that obtaining photos from the database takes less time now that the clusters have been found for the query images. Therefore, only the relevant cluster needs to be searched, rather than the entire database. Fig. 1 displays a diagrammatic representation of proposed system.

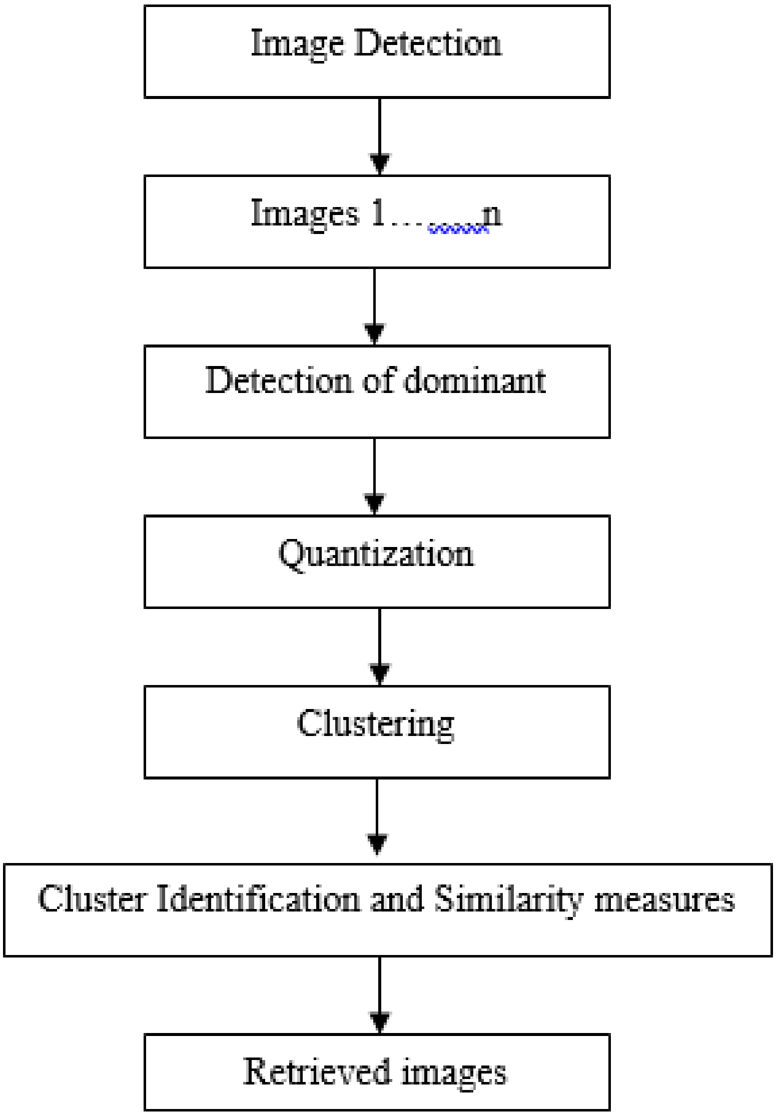

Figure 1: *Diagrammatic representation of proposed system*

The initial step in extracting an image's colour features is to fix the colour space. For the extraction of colour features, we are working in the RGB colour space. Utilising the thresholding technique, RGB is separated into R, G, and B stores. Calculated and stored in n_i (p) are the red, blue, and green colour means which are being represented in the equation given below. By independently computing the percentage of each color—blue, red and green; the dominating colours within these values are determined. The hue with the highest proportion is thought to be the dominating hue.

$$w_b(p) = \frac{n_b(p)}{n_r(p) + n_g(p) + n_b(p)} * 100$$

$$w_g(p) = \frac{n_g(p)}{n_r(p) + n_g(p) + n_b(p)} * 100$$

$$w_r(p) = \frac{n_r(p)}{n_r(p) + n_g(p) + n_b(p)} * 100$$

Equation representations

3.1 Clustering and Indexing

The method of grouping photographs based on quantized colour values is called clustering. Following clustering, different threshold values are applied to distinct tiny clusters. Indexing is done to each cluster as part of tagging them. Utilising the colour histogram, we use colour indexing.

Clustering is simply done by grouping the photos according to their quantized colour values. We divide the photos into smaller clusters by using a variable threshold value. As a labelling step, indexing is applied to each cluster. A colour histogram is used in conjunction with colour indexing. The photos are indexed with labels and kept in various clusters. Extract the image's dominant colour and do the quantization whenever a query image is received. Using the index values, it is possible to determine which cluster the picture belongs to.

3.2 Measuring Similarity using Equations

Large picture collections may be difficult to search, especially when trying to get photos based on their content. Most search engines compare the query image to every image in the database, ranking the photos according to how similar they are. Using a similarity metric, the two pictures are subtracted. Here, we employ the modified equation for Euclidean distance. If I_1 and I_2 are two photos, then the following may be done to determine how similar they are:

$$M(I_1, I_2) = \sqrt{\left(\mathrm{W_r(p_2)} - \mathrm{W_r(p_1)}\right)^2 + \left(\mathrm{W_g(p_2)} - \mathrm{W_g(p_1)}\right)^2 + \left(\mathrm{W_b(p)} - \mathrm{W_b(p_2)}\right)^2}$$

Measurement taken using the above equation gives $\mathrm{W_r}, \mathrm{W_g}$ and $\mathrm{W_b}$ are the primary colour values in the components of red, green, and blue.

4 Result of Experiments

Retrieval tests are carried out to demonstrate the suggested CBIR system's usefulness in real-world applications. Recall and accuracy are used to assess the procedure. A search's recall rate is calculated by dividing the total number of relevant documents that were found (and should have been retrieved) by the number of documents that were actually found. Contrarily, an accuracy rate is calculated by dividing the number of relevant documents found divided by the total number of documents obtained by a search.

We chose database ground truth Corel pictures for the trials. There are ten categories, and each category has 100 photos. Mountain, dinosaurs, Africans, buses, elephant, horses, flowers, structures, meals, and beaches are just a few of the categories. Reference given in the figure 2, the images are 256 ×384 in size, while other corel databases have images that are 128 × 85 in size and feature butterflies, vehicles, etc.

Figure 2: *Sample images of Flower, coral reefs, sunset and butterfly*

Both the total number of photos that each query successfully retrieved and the total number of successfully retrieved relevant photographs are recorded. The recall and accuracy numbers for each query will be interpolated. Then, for each image category, the average precision at each recall level is calculated. The retrieval process takes shorter time than previous systems while the time complexity is also measured which can be identified in the Fig 3.

Figure 3: *Result after colour retrieval*

5 Conclusion

In this research, we proposed a clustered database-and also content-oriented image system to retrieve the dominant colour which is the basics. The technology confines the image's main colour to a certain level using the quantization approach. In our study, we used quantized values to index and arrange the photos into several clusters. Anytime the system is given a query image, it recognizes the cluster to which the image belongs. As a result, it searches the relevant cluster and retrieves the photographs rather than scanning the entire database. In comparison to other systems, experiments demonstrate that the retrieval time complexity is less difficult, and the accuracy rate is likewise good.

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