Content Based Image Retrieval using Color and Texture Features

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Abstract— Images are widely used nowadays and image retrieval as one of the interesting applications. It is an appropriate case to be implemented in CPU using new algorithms. In a collection of digital images people can efficiently make use of image retrieval tools to retrieve the images using different methods for image retrieval. Image processing technique like Image Retrieval which is a computationally intensive task can be made to exploit in CPU to extract information more efficiently. Image Retrieval finds wide range of application especially in Art Collections, e.g. Fine Arts Museum of San Francisco, Medical Image Databases, e.g. CT, MRI, Ultrasound, The Visible Human, Scientific Databases, e.g. Earth Sciences, and in General Image Collections for Licensing, e.g. Corbis, Getty Images. In defense, these techniques are used Color, Texture, Shape and others. Existing systems are primitive in terms of optimal utilization of CPU using previous algorithms; implementing image retrieval on CPU using new algorithms or other platforms provides greater speedup and scalability. The major Task of this paper is to implement Color Features using (Average Intensity, Average Colors and Color Histogram) and Texture Feature Extraction using (Hough Lines, SIFT, Blob Detection, Gradient Orientation and Magnitude and Contour Detection) in CPU. These features are used to search images in an image database which is similar like image query. Retrieval system is evaluated by using Recall and Precision and Average precision measures.

Key words: Color Features, Texture Features

I. INTRODUCTION

Images are widely used nowadays and image retrieval as one of the interesting applications of image processing. To retrieve the images there are different methods for image retrieval. A new algorithm to increase the speed is very much required in today’s scenario. Color features and Texture features are generally used to develop image retrieval tools.

Content-based image retrieval systems have become a reliable tool for many image database applications. There are several advantages of image retrieval techniques compared to other simple retrieval approaches such as text based retrieval techniques. CBIR provides a solution for many types of image information management systems such as medical imagery, criminology, and satellite imagery [1]. Pictures are generally utilized these days and image retrieval is a stand-out amongst the most intriguing applications and picture preparing is a suitable case to be actualized in serial computation. In a collection of digital images people can efficiently make use of image retrieval tools to retrieve the images there are different methods for image retrieval.

Content based image retrieval (CBIR) has been a standout amongst the most dynamic exploration regions in a wide range of image-related fields in the course of the last few decades. The application territories incorporate web looking or searching, networking for picture storage and transmission, common picture preparing and biomedical examination or research. In the medical field, hundreds and a huge number of computerized pictures are routinely created consistently in continually expanding amounts for determination and treatment. Other than the consistent developing rate of picture creation, clinical decision support strategies, for example, case-based reasoning and/or evidence based medicine are making a convincing requirement for dependably retrieving pictures leading to support for an assortment of distinctive demonstrative choices [2].

The major task of this project is to implement color moments and texture feature extraction for image retrieval. These features are used to search images in an image database which is similar like image query. Retrieval framework is assessed by utilizing Recall and Precision and Average exactness measures.

II. THE BASIC CONCEPTS OF CBIR SYSTEMS

Fig. 1 shows architecture of CBIR system. Fig. 1 shows architecture of content based image retrieval system. CBIR is a technique used for extracting similar images from an image database [3]. There are two main functions supported color moments and texture feature extraction used for describing image content. Different CBIR systems have adopted different techniques like global color and texture features whereas few others have used local colors and texture features. CBIR is a reliable tool for many image database application [4].

III. COLOR FEATURES

A. Average Intensity

Intensity is the mean esteem; the estimation of a pixel is called its power. The Intensity of a picture can be utilized to a worldwide measure of that picture, for example, mean pixel power. A relative measure of picture power can be considered like how brilliant (mean pixel Intensity) the picture seems contrasted with an alternate picture. Intensity of a picture can likewise be considered like how splendid
the picture is contrasted with how brilliant the presentation is equipped for delivering [5, 6].

**B. Average Colors**

The most important properties of an image are color. Shading elements are one of the fundamental qualities of the substance of pictures. Human eyes are helpless to hues, and shading components permit human to discover protests in the pictures. Hues is one of the component are utilized as a part of picture handling in light of the fact that they offer capable descriptors that can be utilized to perceive and take out articles from a photo. Shading components additionally give controlling data about pictures, and they are extremely useful for picture recovery procedure [7, 8].

The primary request (mean), the second (standard deviation), and the third-arrange (skewness) color moments have been ended up being proficient and compelling in speaking to shading conveyances of pictures. In the event that the estimation of the i th shading channel at the j th picture pixel is pi j, then the color moments are as per the following:

1. **Moment 1: Mean**
   \[ E_i = \frac{1}{N} \sum_{n=1}^{N} p_{i,j} \]  

2. **Moment 2: Standard Deviation**
   \[ \sigma_i = \sqrt{ \frac{1}{N} \sum_{n=1}^{N} (p_{i,j} - E_i)^2 } \]  

3. **Moment 3: Skewness**
   \[ \gamma_i = \frac{1}{N} \sum_{n=1}^{N} \left( \frac{p_{i,j} - E_i}{\sigma_i} \right)^3 \]  

By ascertaining the 3 color moments for every picture channel (H, S, V), the shading component vector will be a nine measurement vector [8, 9, 10].

**C. Color Histogram**

Color histogram in picture handling is a representation of the sharing of hues in a picture. It indicates unique sorts of hues showed up and the measure of pixels in every kind of the hues showed up. The color histogram for a picture is built by hues inside the picture and including the quantity of pixels of every color. The component or feature vector of a picture can be subsidiary from the histograms of its shading segments and ultimately can set the quantity of receptacles in the shading histogram to discover the element vector of wanted size, the shading histogram can be fabricated for any sort of shading space, a shading histogram can be additionally verbalized as "Three Color Histograms", each of which demonstrates the intensity division of every individual Red/Green/Blue shading channel. In this manner the lattice code of a picture is acquired through the quantization of the feature or element vector got from the histogram of the wanted shading segment of the picture. With a specific end goal to have comparative components of all pixels in an image.

**D. Gradient Orientation and Magnitude**

A gradient or angle picture is a directional change in the intensity in a picture. Picture inclinations may be utilized to take out data from pictures .The gradient of an image

**IV. Texture Features**

**A. Houghlines**

The main function of this module is to find the lines in an image by invoking Hough Lines function of openCV. Before using this function image is converted into blur by using Gaussian Blur function and then canny edge detection function is used to find the edges in an image finally the output of canny function is passed as an argument to the Hough Lines function to find the lines.

**B. Sift**

Local binary pattern and distinguishing key-points are also part of frame difference methods. Scale Invariant Feature Transform (SIFT) based methodology distinguishes key points in a picture. The SIFT groups a component identifier and an element descriptor. The locator extricates from a picture various pictures (credited areas) in a manner which is steady with (some) variety of the light, perspective and other review conditions. The descriptor partners to the districts a mark which recognizes their appearance effectively and firmly, [11]. SIFT descriptors are regularly utilized find comparable districts as a part of two pictures. For every descriptor in past picture, it finds the nearest descriptor in current picture, if number of such matches is under 50%, then current picture is considered.

Scale Invariant Feature Transform (SIFT) was proposed by David Lowe. This calculation has the capacity identify and portray nearby picture highlights proficiently. There are four vital phases of this calculation: key point identification, scale-space extrema discovery, and key point descriptor and orientation assignment [12].

**C. Blob Detection**

The real undertaking of blob detection in the field of computer vision is to recognizing regions in the computerized picture that contrasts in the properties, for example, shading or shine, contrasted with the territories close-by those districts. A blob is a region of an advanced picture in which a few properties are steady or so change inside of an endorsed scope of qualities, all the focuses in a blob can be watchful in some sense to be like one another [13]. Blob detector has two fundamental classes, for example, 1) Differential methods based on derivative expressions is called differential detectors and 2) Methods in view of neighborhood extrema in the power scene is called watershed recognition. This paper concentrates on differential indicators and won't consider watershed-based methodologies. There are a few inspirations for examining and creating blob finders one is to give inverse data in regards to districts, which is not got from corner identifiers or edge indicators and in alternate areas like histogram examination, blob locators can likewise be utilized for top identification with application to division. Another regular utilization of blob descriptors is texture analysis and texture recognition. Blob detection procedure is utilized for an assortment of utilizations like in a "Vision-based Multitouch Technique" [13].

**OpenCV calcHist function is used to compute the histogram and store the corresponding pixels as red, green and blue in a separate variables and finding average values of all pixels in an image.**
measure how it is varying. Two types of information will be provided by the gradient orientation. First is magnitude of the gradient tells how rapidly the image is changeable, and the other is the direction of the gradient tells the direction in which the image is varying most rapidly. Gradient pictures are made from the first picture (by and large by convolving with a channel, one of the most straightforward being the Sobel filter) for this reason. Every pixel of an angle picture measures the adjustment in power of that comparable point in the first picture, in a known heading. To get the complete scope of bearing or direction, inclination pictures in the x and y headings are figured.

E. Contour Detection

A contour in a digital image is a set of connected pixels determined from the given input image according to a predefined set of rules. Edges in a image must be linked into a region boundary and contour. Contours can be used to detect objects in an image based on contour tracing algorithm. Contour can be represented as open or closed, closed contour indicates to a region boundary, boundary indicates closed path in an image. Plain objects detected in a image based on contour tracing algorithm in a binary image. There are three main steps of this algorithm 1) an image binarization; 2) closed contours detection in a binary image; 3) a plain object identification [1]. Image binarization depends on canny edge detection algorithm [14]. For a closed contour detection in a binary image scans the given input binary image line-by-line from left to right, and top to bottom. Plain object identification is based on the results of the closed contour detection algorithm [15].

OpenCV find contours function used to retrieves contours from black-n-white image and if contours value is zero then no contours found in an image otherwise finding average values of contours in an image.

V. MATCHING PROCEDURE

Here we have used Euclidean distance as the matching criteria and calculating distance between query image and database image. Images are sorted in ascending order of their distance calculated by Euclidean distance. The most well known comparability estimations are pictures with N-dimensional feature vector. Assume there are two element vectors X and Y such that X = (x0, x1, ..., xn-1) and Y = (y0, y1, ..., yn-1). [1] The Euclidean Distance between X and Y will be:

\[
D(X,Y) = \sqrt{\sum_{i=0}^{n-1} (x_i - y_i)^2} 
\]

(4)

VI. EXPERIMENTS AND RESULTS

In the proposed technique robustness and effectiveness of the project is assessed, there are two main considerations are viewed as, that is precision and recall. Precision measures how well the recovered things coordinate the alluded query picture and recall uncovers the rate of significant records that are recovered by the module [16, 17].

Formulas for Precision and Recall are defined as follows:

Precision = \frac{\text{Number of relevant images retrieved}}{\text{Total number of images retrieved}}  \quad (5)

Recall = \frac{\text{Number of relevant images retrieved}}{\text{Total number of relevant images}}  \quad (6)

The average precision value for the pictures that has a place with the qth classification or class (Aq) has been figured by utilizing the equation [18]:

\[
AP = \sum_{k=1}^{m} \frac{p(k)}{A_q} 
\]

(7)

1000 pictures in the database are composed in 10 comparability classes that is test of MPEEG-7 picture database are demonstrated in Appendix-A. The Serial usage of the image retrieval method is done utilizing C++ language and OpenCV utilizing a PC with Intel Core i5 Pentium Processor (2.5GHz) and 8GB RAM.

### Table 1: Evaluation of Color and Texture Features

<table>
<thead>
<tr>
<th>Semantic Groups</th>
<th>For Color Feature</th>
<th>For Texture Feature</th>
<th>For Color &amp; Texture Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africans</td>
<td>0.55</td>
<td>0.25</td>
<td>0.70</td>
</tr>
<tr>
<td>Beaches</td>
<td>0.35</td>
<td>0.35</td>
<td>0.60</td>
</tr>
<tr>
<td>Buildings</td>
<td>0.25</td>
<td>0.60</td>
<td>0.75</td>
</tr>
<tr>
<td>Buses</td>
<td>0.40</td>
<td>0.95</td>
<td>0.90</td>
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<tr>
<td>Dinosaurs</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Elephants</td>
<td>0.45</td>
<td>0.01</td>
<td>0.60</td>
</tr>
<tr>
<td>Flowers</td>
<td>0.15</td>
<td>0.85</td>
<td>0.90</td>
</tr>
<tr>
<td>Horses</td>
<td>0.55</td>
<td>0.75</td>
<td>0.80</td>
</tr>
<tr>
<td>Mountains</td>
<td>0.25</td>
<td>0.01</td>
<td>0.50</td>
</tr>
<tr>
<td>Foods</td>
<td>0.40</td>
<td>0.65</td>
<td>0.75</td>
</tr>
</tbody>
</table>

![Fig. 2: Precision results of Color Moments, Texture Feature, and combination of Color and Texture Features](image-url)
VII. CONCLUSION

A software package to perform image retrieval includes color moments and texture feature extraction has been collectively implemented using OpenCV with C++. The implementation has been tested on different categories of input images like Elephant, Flowers, Horses, Mountain, Food, Africa people, Beaches, Buildings, Bus and Dinosaur. A single input image with 256X384 or 384X256 resolution is taken from the database for image retrieval and the runtime was 720.05 second in CPU for 1000 images. WANG picture database is utilized to assess the proposed technique in light of the fact that it is broadly utilized for framework assessment. Trial results for ten class pictures demonstrated that the proposed technique has higher recovery precision than those in view of color and texture features individually. Since the strategy utilizes multi-features, which make utilization of every features interesting points of interest.

REFERENCES


