A Study on Various Approaches of Content-Based Image Retrieval System

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ABSTRACT *Content-Based Image Retrieval is the field of digital image processing that has been used for the extraction of valuable information from huge datasets. In this process of CBIR, images have been extracted from huge datasets based on content available in the images. Various types of images are available under digital imaging. Different types of features have to be computed so that images can be extracted from the datasets on the basis of features. In this paper, various approaches have been discussed that has been used for the extraction of features based on content. Color, shape and texture based features have been extracted from the digital images so that relevant information available in the datasets can be extracted. This paper comprises review about various approaches of feature extraction from digital images. On the basis of review of these approaches, one can analyze best approach for feature extraction.*

Keywords: *CBIR, HSV, SIFT, SURF, GLCM and LBP*

1. INTRODUCTION

1.1 Content-based image retrieval (CBIR)

Content-based image retrieval (CBIR), also known as Query by image content (QBIC) and Content-based visual information retrieval (CBVIR) is the application of machine vision strategies to the picture recovery issue that is the issue of hunting down computerized pictures in huge databases. Substance based picture recovery is restricted to customary idea based methodologies. CBIR 1 implies that the inquiry dissect the particles of the picture instead of metadata. CBIR is attracted to the light of the fact that depends simply on meta data "The expression "content" in this setting may allude to colors, shapes, compositions, or whatever other data that can be gotten from the picture itself. CBIR is attractive in light of the fact that ventures that depend simply on metadata are reliant on annotation quality and culmination. Having peopled physically clarifies pictures by entering decisive words or metadata in an extensive database can be drawn out and may not catch the catchphrases wanted to depict the picture. The assessment of the viability of catchphrase picture hunt is subjective and has not been decently characterized. In the same respect, CBIR frameworks 2 have comparative difficulties in characterizing achievement.

1.2 CBIR Techniques

Numerous CBIR frameworks have been produced, yet the issue of recovering pictures on the premise of their pixel substance remains generally unsolved.

1.3 Query Techniques

Diverse executions of CBIR make utilization of distinctive sorts of client questions. Question by illustration is an inquiry procedure that includes furnishing the CBIR framework with a case picture that it will then base its pursuit upon. The hidden inquiry calculations may fluctuate relying upon the application; however result images should all share normal components with the given sample.4

1.4 Semantic retrieval

Semantic recovery begins with a client making an appeal like "discover pictures of Abraham *Lincoln*". This sort of open-finished undertaking is extremely troublesome for machines to perform - Lincoln may not generally be confronting the cam or in the same instance. Numerous CBIR frameworks accordingly for the most part make utilization of lower-level gimmicks like composition, color, and shape. These gimmicks are either utilized as a part of mix with interfaces that permit simpler data of the criteria or with databases that have as of now been prepared to match peculiarities, (for example, confronts, fingerprints, or shape matching). In any case, as a rule, picture recovery obliges human input keeping in mind the end goal to distinguish more elevated amount ideas.

1.5 Relevance Feedback

Consolidating CBIR seeks procedures accessible with the extensive variety of potential clients and their goal can be a troublesome errand. A part of making CBIR fruitful depends completely on the capacity to comprehend the client intent. CBIR

frameworks can make utilization of pertinence input, where the client dynamically refines the query items by stamping pictures in the results as "important", "not significant", or "nonpartisan" to the inquiry question, then rehashing the hunt with the new data. Illustrations of this kind of interface have been developed.5

1.6 Iterative/Machine Learning: Machine learning and application of iterative systems are getting to be more basic in CBIR.

1.7 Other query methods

Other inquiry strategies incorporate searching for instance pictures, exploring tweaked/various leveled classes, questioning by picture district (instead of the whole picture), questioning by numerous illustration pictures, questioning by visual portrayal, questioning by immediate detail of picture gimmicks, and multimodal inquiries (e.g. consolidating touch, voice, etc.)

2. REVIEW OF LITERATURE

M. Ortega, Y. Rui, K. Chakrabarti et al. (1997) 1"Supporting similarity queries in mars", MARS image fetching system was invented by U niversity of Illinois, and allows complex queries using Boolean operators over color, texture and shape and metadata.

MARS image retrieval system was invented by University of Illinois, complicated query by using Boolean operator over color. Color feature are hue and saturation histogram extracted from the HSV color space in 5*5 sub images. The contrast feature coarsens, directionality histogram is fitted same in 5*5 image. Shape feature is the deadline which is presented by the fourier descriptor.

C. Carson, M. Thomas, S. Belongie et al. (1999) 2"Blobworld: A system for region-based image indexing and retrieval", The University of California allow user to assign the importance of selected regions. Importance of color, text, speech, shape, location feature was explained here. The characteristics of color feature represent the 218 bin histogram in the lab space. Texture feature are the mean contrast & anisotropy over every blob & the shape feature are the area. These feature vectors are then mapped into a lower feature space using singular value decomposition (SVD) and indexed using R-trees.

C. R. Shyu, C. E. Brodley, A. C. Kak et al. (1999)3 "Assert: A physician-in-the-loop content-based retrieval system for HRCT image databases", system was developed at Purdue university. The image which computed It was designed especially for high resolution computed tomography images, since it uses some perceptual features specific to those images. It also included gray-level features, like mean and standard deviation, texture features like contrast, entropy and homogeneity and shape description such as the area. The feature vectors are indexed using the multi-hash method.

J. Z. Wang, J. Li, G. Wiederhold et al. (2001)4 "SIMPLICITY: Semantics-sensitive integrated matching for picture libraries", Semantics-sensitive Integrated Matching for Picture Libraries image retrieval system developed by Stanford University, in which images are represented via a set of regions that nearly corresponds to items that can be categorized via their color, shape, location and texture properties. Segmentation of region is achieved by a straightforward algorithm based on k-means clustering in feature space. As opposed to region-wise retrieval, images are retrieved as a whole with the help of region matching techniques which incorporate properties of regions within the image to measure similarity. This overall similarity approach is to decrease the influence of inaccurate segmentation.

N. Boujemaa, J. Fauqueur, M. Ferecatu, et al. (2001)5 "IKONA: Interactive generic and specific image retrieval", Ikona is prototype application designed for the IMEDIA, and developed at INRIA. Ikona system makes use of query-by-example approach for retrieving similar images and also integrates superior attributes like image signature and face recognition. It supplies hybrid text-image retrieval method and query modification with relevance feedback, mutually with a region-based approach in which the user is capable to choose an element from image and system searches images which are visually analogous to selected element.

Dharani, T et al. (2013) 8 "A survey on Content-based image retrieval", Writing overview was most essential for understanding and increasing significantly more learning about particular territory of a subject. In this paper, an overview on substance based picture recovery displayed. Substance Based Image Retrieval (CBIR) was a method which utilizes visual peculiarities of picture, for example, color, shape, composition, and so forth to hunt client obliged picture from expansive picture database as per client's appeals as a question picture. Author considered Content-based image retrieval viz. named and unlabeled pictures for breaking down effective picture for diverse picture recovery process viz. D-EM, SVM, RF, and so on. To deciding the proficient imaging for Content-based image retrieval, author execution writing survey by utilizing standards of Content-based image retrieval based unlabeled pictures. Furthermore provide for a few suggestions for enhance the CBIR framework utilizing unlabeled pictures.

Bo Li et al. (2013) 9 "A UIM/ICM based approach to content-based image retrieval", in this paper, two different positive and negative hypothesis had been used for Content-based image retrieval based on similarity measure and matching scheme. Large set of images had been used for development of UIM (Universal Image Model). Developed model had been used for calculation of various classes on the basis of model class that had been based on Bayesian adaptation of GMM. Mixture Components had been used as the adaptive versions on the basis of ICM (Image Class Models). In this paper, an approach had been developed that was based on closest Gaussian components of the background model and their respective components in positive classes. On the basis of these components matched images had been extracted from large dataset.

Pradeep et al. (2014) 12"Content-based image retrieval and segmentation of medical image database with fuzzy values", It was one of the most popular, research area of DIP. The visual content was used to search the image from the database. By using the method of fetching one can fetch it by using Gray-level-co-occurrence matrix (GLCM). This method allowed the fetching of the picture by using flexible queries on the database. Its main purpose was to get high accuracy of medical image obtained by retrieving techniques. After retrieving medical image, which can be further segmented to obtain the particular region of the medical image which was affected by any diseases.

3. APPROACHES USED

3.1 COLOR Features Based Approaches

RGB color model: The RGB color model is composed of the primary colors Red, Green, and Blue. This system defines the color model that is used in most color CRT monitors and color raster graphics. They are considered as the "additive primaries" since the colors are added together to produce the desired color. The RGB model use the Cartesian coordinate system. Notice the diagonal from (0,0,0) black to (1,1,1) white which represents the grey-scale.

HSV color model: The HSV stands for the Hue, Saturation and Value. The coordinate system is a hexagon. The Value represents intensity of a Color, which is decoupled from the color information in the represented image. The saturation and hue components are related to the way of human eye perceives color resulting in image processing algorithm.

Color Moments: The color distribution of the image is characterized by its moments. First, second and third central moment of each of the color channels is stored as a color feature.

Hue: Hue represents the dominant wavelength in light. Hue is the term for the spectrum colors. Hue is expressed from 0º to 360º. It can represent hues of red starts with 0º, yellow starts with 60º, green starts with 120º, cyan starts with 180º, blue starts with 240º and magenta starts with 300º.

Histogram: Histogram can be used for color feature extraction. Color histogram can be representing as a distribution of colors in image. Histogram can convert image in one domain to another i.e. RGB color space to other space. In General convert

RGB color space to HSV space. They can calculate by below

steps:

Step 1: convert RGB space to HSV space.

Step 2: quantified the image.

Step 3: calculate the feature value.

3.2 TEXTURE

GLCM (Gray Level Co-occurrence Matrix): A statistical method of examining texture that considers the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix. The GLCM functions characterize the texture of an image by calculating how many pairs of pixel with specific values and in a specified spatial relationship occur in an image.

Local Binary Patterns (LBP): LBP as a means of summarizing local gray-level structure. The LBP operator takes a local neighborhood around each pixel, thresholds the pixels of the neighborhood at the value of the central pixel and uses the resulting binary-valued image patch as a local image descriptor. It was originally defined for 3 × 3 neighborhoods, giving 8-bit integer LBP codes based on the 8 pixels around the central one. The resulting strictly negative values are encoded with 0 and the others with 1; A binary number is obtained by concatenating all these binary codes in a clockwise direction starting from the top-left one and its corresponding decimal value is used for labeling. The derived binary numbers are referred to as Local Binary Patterns or LBP codes.

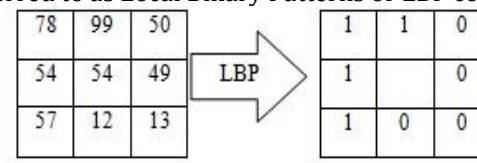

Fig 1: LBP codes Extraction

Gabor Transform: This wavelet proved very important texture analysis Gabor wavelet proved very useful texture analysis and is mostly adopted

in the literature. Present an image retrieval method based on Gabor filter. In present days texture features are found by calculating mean and variation of the Gabor filtered image. Rotation normalization is accomplished by a circular shift of feature elements therefore all images have the same dominant direction. Mostly the image indexing and retrieval are organized on textured images and natural images.

Local Ternary Patterns (LTP): LBP's have proven to be highly discriminative features for texture classification and they are resistant to lighting effects in the sense that they are invariant to monotonic gray-level transformations. However, because they threshold at exactly the value of the central pixel ic they tend to be sensitive to noise, particularly in near-uniform image regions, and to smooth weak illumination gradients. Many facial regions are relatively uniform and it is legitimate to investigate whether the robustness of the features can be improved in these regions.

Ternary codes have been extracted from the image on the basis of different mask moving on image different regions. Uniform patterns have been extracted from the image.

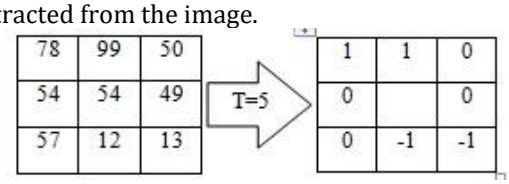

Fig 2: LTP codes Extraction

This figure represents ternary codes that have been extracted from a single patch of the image using T=5 as user defined threshold value. These codes have been divided into two different codes that are upper binary code and lower binary code. These two different codes have been extracted foe all the patches of the image. These codes have been concatenated to develop a feature vector.

Distance Transform based Similarity Metric: This method gave excellent results on the FERET dataset. However, subdividing the face into a regular grid seems somewhat arbitrary: the cells are not necessarily well aligned with facial features, and the partitioning is likely to cause both aliasing and loss of spatial resolution. Given that the overall goal of coding is to provide illumination- and outlier-robust visual correspondence with some leeway for small spatial deviations due to misalignment, it seems more appropriate to use a Hausdorff-distance-like similarity metric that takes each LBP or LTP pixel code in image X and tests whether a similar code appears at a nearby position in image Y, with a weighting that decreases smoothly with image distance. Such a scheme should be able to achieve discriminant appearance- based image matching with a well-controllable degree of spatial looseness.

3.3 SHAPE

SIFT Algorithm: Jonghyon Yi, proposed that Scale-invariant highlight change (or SIFT) is a calculation in PC vision to distinguish and depict neighborhood includes in pictures. The figuring was circulated by David Lowe in 1999. Applications join article affirmation, robotized mapping and course, picture sewing, 3D showing, movement affirmation, highlight taking after, individual ID of untamed life and match moving. Channel key purposes of things are at first isolated from a course of action of reference pictures and set away in a database. A thing is seen in another picture by only differentiating each highlight from the new picture to this database and finding candidate organizing highlights considering Euclidean division of their highlight vectors. From the full course of action of matches, subsets of key centers that yield to the thing and its region, scale, and presentation in the new picture are recognized to channel out extraordinary matches.

SURF Algorithm: SURF that is a (Speeded up Robust Feature) is an approach that has been used for extraction of shape based features from the images. This approach is fast approach that is scale and rotation invariant. This approach computes features very fast so that processing of the algorithm decreases time complexity of overall system. It uses Integral images to improve the speed. The key points are detected by using a Fast-Hessian matrix. The descriptor describes a distribution of Haar-wavelet responses within the interest point neighborhood. The performance of SURF has been increased by using an intermediate image representation known as the Integral Image. The integral image is computed rapidly from an input image and is used to speed up the calculation of any upright rectangular area.

- Hessian Matrix has been used for SURF feature extraction so that various location points can be predicted on the image. In this process a matrix has been used for collection of the interest points so that points and localization can be easily extracted from the neighborhood values. On the basis of these values various features from the image that provide information about shape based features has been extracted.
- In this phase of SURF feature extortion, image has been divided into different sub groups so that localization points from all the regions of the images can be easily extracted. The location points that have been extracted from the images sub regions have been undergoes process of wavelet transformation so that these

transformation coefficients can be used for development of feature vector. The responses of the Haar-wavelets are weighted with a Gaussian centered at the interest point in order to increase robustness to geometric deformations and the wavelet responses in horizontal dx and vertical directions dy are summed up over each sub-region. Furthermore, the absolute values |dx| and |dy| are summed in order to obtain information about the polarity of the image intensity changes.

Each pixel is associated to a specific histogram bin only on the basis of its own color, and colo

4. CONCLUSION

CBIR has been used in various applications of digital image process for extraction of relevant information. Information that has been used for image retrieval is based on content available in the images. Color based features provide information about the color saturation available in the image. This information provides data about mixing of various colors at different pixels. Shape based descriptor provide information about key points available in the image that represents shape of the content available in the images. Key points have been matched for shape based image extraction. Texture based descriptor has been used so that information can be extracted about texture content available in the images.

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