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Query by Sketch-an Intensified Advancement in Image Fetching Using Abbreviated Images (Sketches)

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Abstract: In computer vision techniques and applications, CBIR (Content Based Image Retrieval) is used for image retrieval. In this study we present a method SBIR (Sketch Based Image Retrieval) implemented using sketch as query for retrieving general images and facial images, used in dialectic image finding. This method is based on content based image retrieval. Edge histogram descriptor, Histogram of oriented Gradients, SIFT, Surf are used for indexing the images. These descriptors are such that they can index both input and output images. Binary outlines are given as input and a set of similar shaped images are retrieved. After indexing the comparison between the input and output images is done by distance based search. The most similar images are retrieved and displayed according to their similarity. For better results reranking can also be done. Thus the system can filter database images using these descriptors and provide refined results.

Keywords: CBIR, content, gradients, histogram, retrieval, sketch

INTRODUCTION

As the usage of digital image database has become essential in various fields like medical, research, investigation etc., the images that we incorporates into the database and the complexity of image retrieval increases exponentially. The traditional and common method for annotating the images is done by insertion of keywords or captions depicting the feature of the image. In this case there are several difficulties especially redundancy is the main one which is same image that may have different captions and different images may have same keywords. This results in degradation in efficiency of image retrieval. So alternatively, we can efficiently search the images using the content of the image which is incorporated by the CBIR system as searching proceeds by extracting the features like color, shape, texture etc are extracted and comparison will be done between query and database (Hiremath and Jagadeesh 2007). In this content based image processing based on automatic interpretation of image content, currently huge number of tools, techniques and methods has been adopted for developing image retrieval system that includes indexing, matching, classification of images.

Semantic interpretation is essential for the efficient retrieval system which lags in the current technologies. In this semantic interpretation visual feature calculation can be substituted as quantitative parameters for the identification and retrieval of images. Thus the difficulty of retrieving images with homogenous content is surrogated with difficulty of retrieving images visually close to a target one in this CBIR system. In this image retrieval system the user's interaction can be improved using query by sketch and giving the user the ability to interact easily with the system by browsing the retrieved images (Folco, 2000). So in this study a system that retrieves the images using sketch as query is developed i.e., SBIR (Sketch Based Image Retrieval). SBIR systems were developed to overcome the limitations of previously well known approaches such as keyword or query-by-example based image retrieval methods (Szanto *et al*., 2011). In this system user will provide with a drawing area which is the base of this system. The obvious advantage over other existing CBIR systems is its ease of use and handle because the sketched images relate to human visual perception and account for fast representations of important characteristics of the target objects. This system is more resourceful and applied in many areas of image processing. In many cases human mind can easily recollect using figures and drawings. The application of this SBIR system is have more impact in criminal investigation field. This system also identifies tattoos, graffities and forensic images. The related application is mentioned in Jain *et al*. (2010). The analog circuits also can be searched by SBIR. QBIC and Visual SEEK systems are the initiative of this SBIR (Dom *et al*., 2002). The methods used in these systems for extracting features are variant to various rotations, translations and scaling. Recently many enhanced and complex visual features are evolved.

LITERATURE REVIEW

The related study discusses the usage of SBIR system in various fields.

SBIR using diffusion tensor fields: Based on tensorial feature extraction and Eigen features for searching shows efficient and matured image retrieval. In this method tensorial topology to extract ellipsoidal characteristics of

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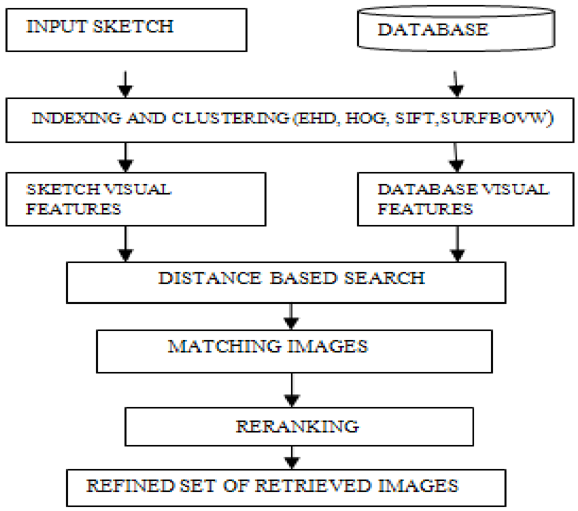

Fig. 1: System framework

features and an efficient hierarchical image clustering methodology for fetching similar images from large repository are used. Time duration is minimum and new images can be added easily added in this hierarchy (Arjan and Sang, 2010)

GF-HOG descriptor: GF-HOG descriptor is used in BoW in which SBIR system is not used previously for retrieving images. In this descriptor scale selection and image salient measures usage increases the efficiency of it. John *et al*. (2010)

Semantic sketch based interface: This approach uses episodic memory for image fetching. To avoid the lack of information matching between query and database, exemplars are selected from a set of object instances provide with tags given by user and bounding boxes. Then targeted image is fetched by ranking using exemplar matching algorithm. Bo *et al*. (2010)

In all these fields the comparison is performed between two extreme images. That is the input sketch will just be a binary image and database images are multi colored images. So we have to apply pre processing transformation to minimize the information gap between sketch and database image (Rovid *et al*., 2006). The fuzzy logic and neural networks also can be used in the SBIR. In such cases the identification of weights for image visual features is the intention of the asset.

Proposed system: Figure 1 depicts the flow image retrieval in the proposed system.

Input sketch: The input ie the query image will be the binary outline of the image that is needed to be search. This system works for Jpeg images.

Database: This system is experimented with the Flick 160 database, Wang database and Microsoft research Cambridge object recognition image database.

Wang database: Wang database contains 1000 images from Corel database. It can be used in common stock photo retrieval tasks. It contains 10 classes with 100 images per class. These classes are used for estimating the relevance. While searching it is suspected that the searching is within same class of query image so the 99 images are considered to be relevant and the images in the other classes are considered to be irrelevant.

Microsoft research cambridge object class recognition image database: The database contains weakly labeled, high resolution images 1000 in number. It has 3 parts:

- Pixel-wise labeled image database v1 (240 images, 9 object classes)
- Pixel-wise labeled image database v2 (591 images, 23 object classes)
- Pixel-wise labeled image database of textile materials.

The database system should be maintained because it involves various operations like storage of visual features, image retrieval and data manipulation (Keysers *et al*., 2007).

Indexing and clustering: This is the first step for the retrieval process. The following algorithms can be used as descriptors for feature extraction.

Edge histogram descriptor: The descriptor represents the five edge distributions in an image namely vertical,

1	-1
1	-1

1	1
-1	-1

$\sqrt{2}$	0
0	$-\sqrt{2}$

2	-2
-2	2

Fig. 2: Example for 4-4 filter coefficients

horizontal, 45 and 135ºC and non-directional edges (Hong-Ying *et al*., 2011). It proceeds as follows:

Step 1: Divide the image into k_k non-overlapping cells
Step 2: 5-BIN histogram is computed for each edge distribution in a cell.

This algorithm results in a feature vector of size 5k^2

Step 3: Filter co-efficient can be applied for calculating the edge density. The blocks whose coefficients are greater than defined threshold are selected (Nandagopalan *et al*., 2008). The example for filter coefficient is given in the Fig. 2.
Step 4: The edge density can be done using the Eq. (1):

$$f = \frac{1}{a_r} \sum_{x=x1}^{x2} \sum_{y=y1}^{y2} e(x, y) \tag{1}$$

x1, y1-top left of the sub image
x2, y2-bottom right of the sub image,a_r -region area

Histogram of oriented gradients descriptor: This descriptor is very efficient for detecting human faces and objects also:

Step 1: From image interesting locations ie points are detected by Harris Detector that based on auto-correlation matrix which describe image's local template.
Step 2: After finding the interesting points Gradient Orientation Histogram is calculated for 16×16 pixel region around each point. Its proceeds as follows:

- Divides the region into 4×4 sub-region and calculates 8-bin gradient orientation h (k) for each sub one. k = 0 to 7
- h (k) results in a feature vector with 128 dimension (Velmurugan and Santhosh, 2011).

Scale invariant feature transform: This was invented by invented by (Lowe, 2004) and his students at UBC and which has been very popular.

Step 1: Key point detection and localization: Identify key points for SIFT framework by calculating maximum/minimum of DoG at multiple scales. This results in too many key points which can be reduced further by localization which eliminates points such as low contrast or poorly localized along an edge by comparing to the nearby data for accurate location, scale and ratio of principal curvatures.

Step 2: Interpolation of nearby data for accurate position:

- Interpolated location of the extremum is calculated for enhanced matching and stability.
- Discard low contrast key points
- Eliminate poor edge responses

Step 3: Orientation alignment: Assign orientation for each key point based on local image gradient directions for attaining invariance to rotation as the key point descriptor can be represented relative to this orientation and therefore achieve invariance to image rotation (Lowe, 2004)
Step 4: Key point descriptor: After aligning orientation for each key point a descriptor vector have to be calculated. This descriptor should be highly distinctive and partially invariant for remaining variations like illumination, 3d view point etc.,

Speedup robust feature descriptor: (Herbert *et al*., 2008) invented this descriptor in 2006. The idea for this descriptor is partly obtained from Scale invariant feature transform. 2D Haar wavelet responses and integral images are efficiently used as basis for this SURF descriptor (Herbert *et al*., 2008).

After extracting the features from the images clustering can be done using K means algorithm.

Input and database visual features: By using above mentioned descriptors for each image in database indexed file will be created and stored in the database. These descriptors also extract visual features from the input or query which we are going to give in a sketch format.

Distance based search: After extracting the visual features of both input and database images the sketch visual features will be compared to each image's visual features belong to database by distance based search. The Minkowski distance of order p between two points:

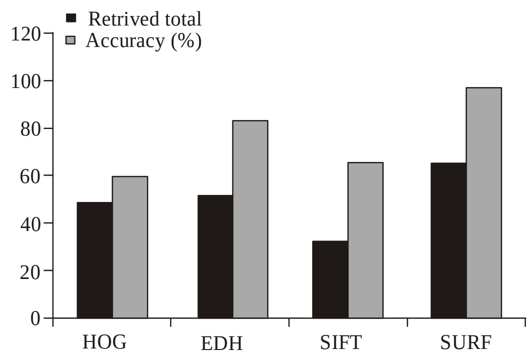

Fig. 3: Accuracy of retrieval

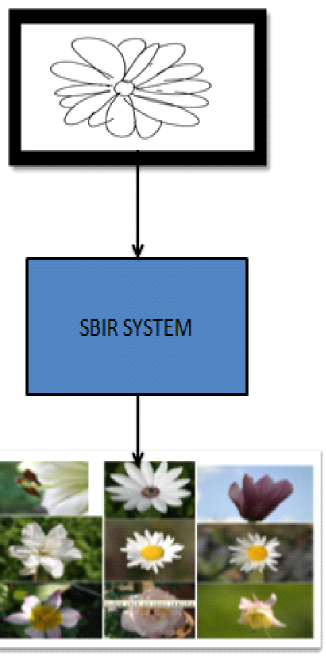

Fig. 4: Result set

P = $(x_1, x_2, \ldots \ldots x_n)$ *and* = $Q = (y_1, y_2, \ldots \ldots y_n) \in R^n$

is defined as:

$$\left(\sum_{i=1}^{n} \left| x_i - y_i \right|^p \right)^{\frac{1}{p}}$$

The Minkowski distance is a metric as a result of the Minkowski inequality.

Histogram Intersection Distance can also be used as a metric for this searching (Raj and Shih-Fu, 2004).

Matching images: The similar images that are retrieved by the similarity search are displayed according to their similarity.

Reranking: This is an optional process. If there is a need to re index the images which are already indexed by some other descriptor this step allows it the user for re indexing. This reduces the time for indexing the image with new descriptor. It also refines the result set also.

EXPERIMENTAL RESULTS

This system is tested with the above mentioned databases. The accuracy of the similarity between the query and retrieved image is taken as performance measure. The accuracy rate and range of similar images retrieved is given in Fig. 3. Among the algorithms that are tested in this system SURF descriptor has higher accuracy rate.

Example for the result: The miniature of the proposed system is given in Fig. 4. It predicts the input, processing and result set of the output. As per execution, this system takes approximately 3 sec for each image to be indexed. The precision value of the system can be calculated if the length of the retrieval list and number of relevant hits are known.

CONCLUSION AND FUTURE WORK

This system performs the comparison of accuracy of four algorithms namely HOG, EHD, SIFT, SURF in image retrieval using sketch based query. The system is more interactive with user when compared to the traditional CBIR because the user's input image can simply be the outline of the required image. Reranking reduces the time consumption and it also refines better result set. In future the interactivity can be increased more by developing a user drawing area in the interface. This system can also be extended to videos also. For efficient human face retrieval SIFT can be used in combination with Multiscale Local Binary Pattern (MLBP) and Local-Feature-based Discriminant Analysis (LFDA).

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REFERENCES

Arjan, K. and M.Y. Sang, 2010. Query-by-sketch based image retrieval using diffusion tensor fields. 2nd International Conference on Image Processing Theory Tools and Applications (IPTA), 7-10 July, Germany, pp: 343-348.

Bo, Z., L. Cailiang, W. Changhu, W. Dong, Z. Lei and L. Xiaobing, 2010. Robust semantic sketch based specific image retrieval. IEEE International Conference on Multimedia and Expo (ICME), 19-23 July, Beijing, China, pp: 30-35.

Dom, B., D. Lee, D. Petkovic, D. Steele, H. Sawhney, J. Ashley, J. Hafner, M. Flickner , M. Gorkani, P. Yanker, Q. Hiang and W. Niblack, 2002. Query by image and video content: The QBIC system. IEEE Comput., 28: 23-32.

Folco, B., 2000. Content-Based Image Retrieval Using Hand-Drawn Sketches and Local Features: A Study on Visual Dissimilarity. S.N., Fribourg.

Herbert, B., A. Ess, T. Tuytelaars and L.V. Gool, 2008. SURF: Speeded up robust features. Computer Vision and Image Understanding (CVIU), 110(3): 346-359.

Hong-Ying, Y., W. Xiang-Yang and Y. Yong-Jian, 2011. An effective image retrieval scheme using color, texture and shape features. Comput. Standards Interf. 33: 59-68.

Hiremath, P.S. and P. Jagadeesh, 2007. Content based image retrieval based on color, texture and shape features using image and its complement. Int. J. Comput. Sci. Sec., 1(4): 25-35.

John, C., B. Mark and H. Rui, 2010. Gradient field descriptor for sketch based retrieval and localization. 17th IEEE International Conference on Image Processing (ICIP), 26-29 Sept., Guildford, UK, pp: 1025-1028.

Jain, A.K., J.E. Lee and R. Jin, 2010. Sketch to photo matching: A feature-based approach. Proc. SPIE, Biometric Technology for Human Identi-cation VII, 7667: 766702-766702.

Keysers, D., H. Ney and T. Deselaers, 2007. Features for image retrieval: An experimental comparison. Inform. Retriev., 11: 77-107.

Lowe, D.G., 2004. Distinctive image features from scale-invariant key points. Int. J. Comput. Vis., 60: 91-110.

Nandagopalan, S., B. Adiga and N. Deepak, 2008. A universal model for content-based image retrieval. Proc. World Acad. Sci. Eng. Technol., 36: 659-662.

Raj, K.R. and C. Shih-Fu, 2004. Image Retrieval with Sketches and Compositions. Department of Electrical Engineering, Columbia University New York, 10027.

Rovid, A., A.R. Varkonyi-Koczy, G. Ohashi, H. Nakahara, T. Hashimoto and Y. Ogura, 2006. Edge detection based image retrieval method by sketches. Proceeding of the International Symposium on Flexible Automation, pp: 1-4.

Szanto, B., P. Pozsegovics, S. Sergyan and Z. Vamossy, 2011. Sketch4match-content based image retrieval using sketches. 9th IEEE International Symposium on Applied Machine Intelligence and Informatics.

Velmurugan, K. and S. Santhosh Baboo, 2011. Image retrieval using harris corners and histogram of oriented gradients. Int. J. Comput. Appl., 24(7): 6-10.