I J C T A, 9(41) 2016, pp. 957-968 ISSN: 0974-5572

A REVIEW: MODIFIED QUERY BASED IMAGE RETRIEVAL

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***Abstract:*Many image editing tools available these days had led to the modification of the original images, but existing image mining systems cannot work with such types of images because it may have changed the image in terms of shape, color and texture information. The editing of image can be a complex operation which may include applying various filters, adding additional clipart, partial deletion of image which cannot be easily retrieved by the available image retrieval systems. Instead of using available methods for retrieving, different algorithms specifically for modified images have been proposed. This paper gives an idea for retrieving modified images while discussing the existing issues and is expected to be helpful to the researchers who are working in domain of modified image retrieval systems.**

Keywords— Content based Image Retrieval, Modified images, Feature extraction, Partially-duplicate images

1. INTRODUCTION

In this era of technology the use of digital images has increased a lot for purpose of sharing information, thus leaving us with large amount of images continuously generating every day. So when we want to search for a particular image based on the content of image, the task of searching such image becomes complicated while working with millions of images. By using Content Based Image Retrieval (CBIR) techniques a user can retrieve relevant images in context with the query given by the user from large amount of image database, with the increase in use of smartphone devices accessing Image editing applications and trending image sharing social networking sites has resulted in partial duplication and modification of the images. Thus most of the researchers are focusing on the efficient and effective techniques of retrieving such artificially modified images. Although available content based retrieval systems have shown good results in retrieving partial duplicate images, yet a lot of workneed to be donesothat for modified images also effective retrieval can be done.

Modified image search is to retrieve the image from the database which matches with all or some of the contents of query image. Figure 1 show some of the examples of artificially modified web images. The retrieved images may possibly be the images before modification of the query image followed by the altered versions of the query image. The modification of query image may include images edited by using various filters, adding fancy clipart, partial duplication of image, change of illumination, color, texture, transformation of image into painting or sketch, etc. Modified image search have wide application in copyrights checking, cyber-crime prevention.

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Fig. 1: Examples of artificially modified images

2. CONTENT-BASED IMAGE RETRIEVAL

Content-Based image retrieval is a technique which uses visual contents of images to extract images from databases containing large number of images according to users' given query as an image. CBIR has been popular research area since the year 1990. Nowadays, with increase in trend of digital imagingremarkable development has been observedin theoretical research field as well as in system development. Although, still there are many challenging research problems that are to be solved and new problems are getting encountered continuously, thus continue to attract researchers from multiple domain.

2.1. Image Representation and Pre-processing –

The actual representation of images are in terms of pixels. By using pixels the regions are represented in terms of its external characteristics and internal characteristics. External representation is chosen when focus is on shape features and internal representation is chosen when focus is on regional properties such as color and texture.Image pre-processing involves operation on image at lowest level of abstraction whose aim is to improve image data that reduces noise and enhances some image features for better retrieval of images

2.2. Feature Extraction –

Feature of an image can be defined as a function of one or more measurement that specify some quantifiable property of an object, and it is computed in such a way that it quantifies some important characteristics of the object. Features can be shape, texture, color, etc. used to denote contents of an image.

Feature descriptors are used to extract the feature vectors from the input images, they encode interesting information into series of numbers which are unique and that can be used to distinguish one feature from other feature. This information is invariant under image modification, so feature can be computed again if the image is transformed using some modification techniques. The example of such descriptor includes HOG [18], SIFT, ORB [27] SURF [26].

2.3. Similarity Matching –

As CBIR system compares the query image with the images in the database to retrieve similar images, it is necessary to choose suitable distance estimating method that should be fast to

compute and accurate, as the database contains large amount of images. The example of similarity measure is given,

$$\text{Euclidean Distance d(x, y)} = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2} \quad (1)$$

Where x denote the vector $(x_{1,}x_{2,\dots}x_n)$ which represent the query image and y denote the vector $(y_{1,}y_{2,\dots}y_n)$ representing an image from the database.

2.4. Performance Measure –

For any retrieval system the experimentation is done to measure how efficient the proposed retrieval technique is, based on some measures. The technique is generally evaluated based on precision and recall, as they involve simple calculations and results given from these measure can be easily evaluated, equations are given as follows,

$$\text{Precision} = \frac{Number\ \ of\ Relevant\ \ images\ \ Retrieved}{Total\ \ images\ \ Retrieved} \quad (2)$$

$$\text{Recall} = \frac{Number\ \ of\ Relevant\ \ images\ \ Retrieved}{Total\ Relevant\ \ images\ \ in\ database} \quad (3)$$

Peak signal-to-noise ratio (PSNR) is usually used to measure the quality between the original image and the compressed image. Higher PSNR denotes the better quality of reconstructed image. PSNR is calculated using Mean Square Error (MSE) which denotes the cumulative squared error between original image and compressed image, while PSNR denotes the peak error, lower MSE denotes the less error.

$$\text{MSE} = \sum_{M,N} \frac{[\mathrm{I}_1(m,n) - \mathrm{I}_2(m,n)]^2}{M*N} \quad (4)$$

Where, M and N are the number of rows and column present in input images and R in PSNR denotes the maximum fluctuation in the data type of input image.

$$\text{PSNR} = 10\left(\log_{10}\frac{R^2}{MSE}\right) \quad (5)$$

Compression ratio of image is used as a metric to evaluate the performance of the technique. Compression ratio can be defined as the ratio of size of original image to the size of compressed image.

$$\text{Compression Ratio} = \frac{Original\ \ Image\ \ Size}{Compressed\ \ \ Image\ \ Size} \quad (6)$$

2.5. General framework of CBIR using modified query –

The general flow of image retrieval system using modified image as query is given in Figure 2 where we can see original image is modified which is given as a query to the system and the expected output is to retrieve the original image. To extract feature usually local descriptor occupy dominant position like SIFT [29] and their variants.Local descriptors effortlessly solve the issue of space and similarity matching time consumption to some extent. The extent of modification is not known, so using local features descriptor gives less efficient output in context to modified image. Global descriptor can contribute a lot in evaluating the visual similarity present in modified query images.The HOG[18] descriptor is one of the global descriptor which is advantageous over other descriptors as it operates on local cells and also it is invariant to geometric and photometric transformation so it is unaffected by modification to certain extent.

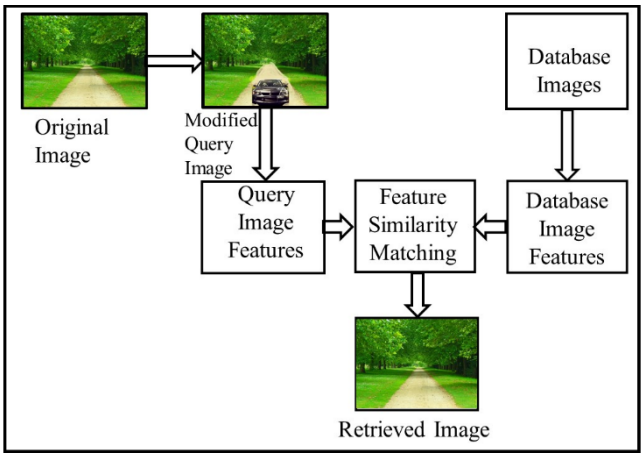

Fig. 2: General Framework of CBIR using Query as modified image

3. RELATED WORK

Researchers in field of computer vision have made significant progress on feature extraction technique to be imposed on modified images dealing with extraction of significant feature so as to match the image even after transformation of image occurs.

An image completion algorithm which operates on huge database of images is presented by James Hayes *et al*. 2007 [2]. The algorithm can fill the missing area in the image by searching similar region in the image from the available database such that they are seamless. Gist scene descriptor is used which performs well at grouping semantically similar scene. This method works better as an efficient web-based application.

Andrea Frome*et al*. 2007 [3], proposed a technique which addresses the problem of visual category recognition by learning the distance function between image to image and it satisfy the property that the distance between the images belonging to same category should be less as compared to the distance between images belonging to different category. In object recognition Patch based feature vector are commonly used for calculating image to image distance function

Daniel Hauagge*et al.* 2012 [4], present a technique which extract the local features from images which consist of architectural scenes which is based on detection and representation of local symmetries. The significant property of various urban images is that, they are invariant to large visual changes than lower level features, so new features are computed based on it. The features are calculated by using simple measures of local bilateral and rotational symmetries.

The problem of searching an image before its modification is addressed by the Chao Zhang *et al.* 2015[5]. To extract the features they used variant of HoG as the descriptor because the computational complexity of original HOG is high and it is limited to some changes. They extract HoG feature in compressed way thus reducing the dimension.

O. Harmanci*et al*. 2010[6], presents an efficient method for near-duplicate image searching. They proposed an algorithm which follows the same pattern of extracting local features around repeatable scale invariant interest points. The proposed algorithm uses local

features to detect cropped or modified images and its parts. It uses content adaptive hash lookups to search.

Zhipeng Wu *et al.* 2012[7], presents a modified method of bundling the local visual words into groups and applying simple relative ordering geometric constraint to the bundle by improving the bundled feature with an affine invariant geometric constraint. As they provide good results with transformations such as flipping or rotation of image. Hu Shenjie, 2012[11] presented an image retrieval technique which is based on extraction of region by saliency analysis. In addition to that, method [7] was improvised by restricting visual words detection in the region by using affine invariant constraints, which implement the area ratio invariance property of transformation to generate affine invariant matrix for bundled visual words. AndrzeySluzek 2013[15], addressed the problem of matching images on basis of individual keypoints only, without analysis or verification of configuration constraints by proposing description of keypoint incorporating keypoint bundles using affine invariant, thus accepting wide range of distortion.

Liang Li *et al.* 2011[8], proposed a novel technique to retrieve partial duplicate images based on Contented-based Saliency Region (CSR). To retrieve CSRs they designed a relative saliency ordering constraint to capture weak saliency relative layout among interest points in CSR. The content of CSR is presented with Bag-of-visual words (BOW). Liang Li *et al.* 2013[13], addressed some of the challenges existing in available retrieval system by introducing visual attention analysis so that non-salient regions from an image can be filter out, thus helping to remove noise also. Another challenge of generating saliency regions containing rich visual content was addressed by re-filtering the saliency regions by using a visual content analysis algorithm.

Zong Wu *et al.* 2009[1], present a technique in which local group of bundled SIFT features of an image are formed such that every group is different than every single feature, resulting simple and robust application of geometric constraints. Shuqiang Jiang *et al*. 2010[9], proposed a method which uses a rotation invariant Local self-similarity Descriptor to extract the internal geometric layouts in the local texture around interest points and combined with SIFT resulting in a multi descriptor of images.A modified method of retrieval using invariance weight of SIFT and SROA geometric consistency which is based on bundled feature is proposed by Zhi li *et al*. 2012[10]. Invariance weight of a SIFT feature is calculated by counting the number of SIFT feature in the modified image space. The method shows that the performance of retrieval and SROA geometric constraint become efficient by using invarianceweight of SIFT features. Shiliang Zhang *et al.* 2013[12], proposed a technique which improves the histogram based descriptors like SIFT that are not feasible to be used on mobile platform because of computational complexity by using a binary local descriptor called Edge-SIFT from binary edge maps of orientation-normalized and scale image patches . They also proposed a fast similarity matching method.Lingyang Chu *et al.* 2013[23], proposed a rotation invariant partial duplicate image retrieval method, that retrieves the partial duplicate images by matching the SIFT features. Their method is based on the Combined-Orientation- Position (COP) consistency graph model, consisting COP consistency and consistency graph model, which efficiently rejects the spatially inconsistent noisy features by accurately detecting the group of feature that matches with the highest average COP consistency.

Qian Zhang *et al*. 2013[14], proposed a novel technique for retrieving partial duplicate image by using tree partition voting min hash (TmH) which partitions interest points in image depending on their photometric or geometric properties by using spatial partition tree data structure which are used to find partial duplicate image by using partition min-hash technique[28].

S.N. Bhojane*et al.* 2015[16], proposed a method in which the special information of image is retained by using orientation of visual word and position is used to make a COP (Combined Orientation and Position) coordinate which help in matching. Thus making the method robust to scaling or rotation resulting in high precision rate and better retrieval.

Mohammad Omari *et al*. 2016[17], presented compression technique which involves group of similar photos or images compressed together instead of doing single compressions. They applied blurring over the original images so that better compression ratio can be gained. Also, codebook are generated by using sub-images in order to produce index file with reduced size than the original images. Their results achieved better compression as compared to peer techniques like PNG and JPEG.

Yang Lin *et al.* 2014[19],feature point based technique for partial-duplicate image retrieval systems, common issue of false matching is solved by applying geometric contexts inconsistent matches are filtered so they presented a modified method called $\ell 1$ -norm global geometric consistency. Firstly squared distance matrices of all the matching feature points are generated, which are invariant to translation and rotation for partial-duplicate images. Then scale difference is computed by solving one-variable $\ell 1$ -norm error minimization problem, which shows that large sparse errors are related to the locations of inconsistent matches. The issue of minimization is solved by Golden section search method thus leading to show higher precisions than geometric verification methods which detect inconsistent matches. Its speed is also comparatively higherthan local geometric consistency based techniques.Li Yang *et al*. 2014[20], proposed another improved technique for the issue of feature point based retrieval of partial-duplicate image with the false matching with a novel global geometric consistency, which is based on the low rankness measure of squared distance matrices of feature points, help to detect false matches. By converting a squared distance matrix into a low rank matrix,the problem of false matching is solved,with global geometric consistency, and a sparse matrix, the mismatched feature points are modeled resulting in building Robust Principal Component Analysis model. LRGGC (Low Rank Global Geometric Consistency) is simple and effective,thus LRGGC is more accurate than existing geometric verification basedmethods.

Eli Shechtman*et al*. 2007[21], presented a method to measure similarity based on matching internal self-similarities between visual entities of images or videos. Local self-similarity have the internal layout which is correlated across images, even though patterns are different in images or video leading to those local self-similarities. Local self-similarity descriptor captures internal self-similarities thus addressing local and global geometric inconsistencies which lead to capability of matching visual data.

Aude Oliva *et al.* 2006[22], proposed an approach for the representation and the understanding of the scene gist depending on scene-centered, instead of object-centered primitives. They also showed that by mean of global image features the structure of a scene image can be estimated, which provides a statistical gist of the spatial layout properties of the scene.

AbhinavShrivastava*et al.*2011[24], proposed a method to find visually similar images even if they look little different. Proposed approach performs well on multi-domain visually similar task such as matching photographs taken from camera to paintings or sketches. Their work is based on estimating relative importance of the various features in query. By using tools available for object detection they built visual domain independent approach.

JanhaviShirke*et al.* 2016[25], presented a review on the available techniques for analysis of a natural scenery image, asambiguity in nature remains in captured images while consisting the ambiguity is a challenging task under the domain of image classification. A particular scene image can also belong to many categories at a time makes classification task much more difficult leading to classification errors. Binary classification cannot capture this ambiguity while classifying the scene image into different classes so by using Fuzzy classifier this problem can be solved by considering fuzzy membership with non-mutually exclusive classes of categories.

Table-1: Summarized Literature Survey

Sr. No.	Reference No. Concerned Author(s)& Year	Concept used	Performance Evaluation Parameter	Database Used	Claims by Concerned Author(s)	Our Findings
1	[1] Zhong Wu, QifaKe, Michael Isard, and Jian Sun,2009	Bundling Features into local groups	Mean Average Precision	One million Web Images	Computationally less expensive and improved precision rate	More modification in image result in incorrect result
2	[2]James Hays Alexei A. Efros,2007	Image completion algorithm	Maximum Response Time	Flickr Images	Generate a diverse set of results for each input image	Patch have resolution mismatch or blurring
3	[3] Andrea Frome, Yoram Singer, Fei Sha, Jitendra Malik,2007	Learning Globally-Consistent Local Distance Functions	Average	Caltech101 dataset	Learns distance functions that are globally consistent in that they can be directly compared	Color Feature part in performance is less
4	[4] Daniel Cabrini, Hauagge Noah Snavely,2012	Local Symmetry Features	Mean Average Precision	Notre Dame and Painted Ladies	Featuresbased on simple measures of local bilateral &rotationalsymmetries computed using local image operations	Complex pairs of images not retrieved

5	**[5] Chao Zhang, Takuya Akashi,2015**	**Variant of HOG**	**Mean Reciprocal Rank &Mean Average Precision**	**SCVM, INRAI Holidays, SUN2012, PASCAL VOC 2012**	**Invariant to rotation and complex modification**	**Use of spatial information will improve the retrieval**
6	**[6]O. Harmanci, I. Haritaoglu, 2010**	**Content Adaptive Hash Lookups**	**Recall Rate**	**Scanned Images from Magazines &Newspapers**	**Full or partial image searches by query are successfully performed**	**Second pass required for irrelevant matches**
7	**[7]Zhipeng Wu, Qianqian Xu, ShuqiangJiang, Qingming Huang, Peng Cui, Liang Li,2012**	**Affine Invariant Geometric Constraint**	**Mean Average Precision**	**Internet Partial Duplicate Images**	**Affine invariant matrix improves the original geometric matching step in bundled features.**	**Good retrieval results with rotation or flipping of images**
8	**[16] S. N. Bhojane, P. R. Futane,2015**	**Fast Visual Word Generation Technique**	**Mean Average Precision**	**Holidays dataset, Internet Partial Duplicate Images**	**Feature quantization errors are minimized and high descriptive power of visualCombined Orientation &Position**	**Use of color information improved retrieval accuracy**
9	**[17]Mohammed Omari, SouleymaneOuledJaafri, Nasreddine Karour,2016**	**Picture Group Compression**	**Peak signal-to-noise ratio, Compression Ratio**	**Images taken from mobile camera**	**Shows better results compared to JPEG and PNG Compression Techniques.**	**Classification phase works better when large number of similar images exists**
10	**[19] Yang Lin, Chen Xu, Li Yang, Zhouchen Lin, Hongbin Zha,2014**	**L1-Norm Global Geometric Consistency**	**Mean Average Precision, Average Time**	**Holidays dataset, DupImage dataset, MIRFlickr1M dataset**	**Higher precision than othergeometric verification techniques in detecting inconsistent matches**	**Feature point remain invariant under transformation and rotation**

4. DATASETS

Experimentation of proposed methods for various modified image based retrieval systems, uses datasets from which some are made specifically for such systems, which are as given below:

4.1. Holidays Dataset –

The Holidays dataset [30] contains set of images which includes some of personal photos taken on holidays. The other ones were included on purpose to check the robustness to different modifications like rotations illumination changes and blurring, etc. The dataset contains a very huge variety of scene type images such as water, natural, man-made and fire effects, etc. and images are taken in high resolution. The dataset includes 500 image sets, each representing a distinct object or scene. In each group the first image is the query image and the other images of the group are the correct retrieval outputs.

4.2. DupImage Dataset –

In Internet Partial-Duplicate Image Dataset [31] there are images which are divided into 10 different variety named as American Flag, Mona Lisa Smile, KFC Logo, Rockets Logo, Starbucks Logo, Exit Sign, etc. each group containing 200 images. All the images in the group are manually generated by the available templates on the website like [33] and many more.

4.3. Caltech101 Dataset –

Caltech101 dataset [32] contain pictures of objects divided into 101 categories. Each category consist of around 40 to 800 images. Some categories consist of 50 images. The images were collected in September 2003 by, Marco Andreetto, Fei-Fei Li and Marc Aurelio Ranzato. The size of every image in dataset is about 300 x 200 pixels.

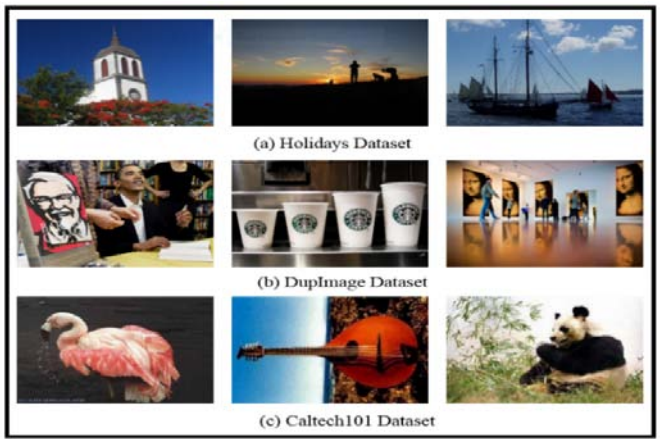

Fig. 3: Sample images taken from: (a). Holidays Dataset (b). DupImage Dataset (c). Caltech101 Dataset

5. ISSUES IN MODIFIED IMAGE RETRIEVAL SYSTEMS

Modified images or Partial duplicate images may contain large non-duplicate regions or small duplicate regions with complex random transformation performed such as rotation, scaling, flipping, applying filters which lead to the following challenges while retrieving images when given modified images as a query, issues can be taken into consideration for better retrieval of partially duplicate images and suitable solutions can be traced out as follows,

Large number of noisy features from the modified regions, this problem occurs, due to large amount of noisy features are extracted which hampers the matching of features for efficient retrieval. So as to address this issue appropriate technique can be implemented which rejects the noisy features and suppresses the effect of modification on the image.

Small number of representative features from the regions which is unmodified, this issue occurs as number of representative features become less, so the choice of feature extraction technique in modified images becomes a crucial task. Feature extraction technique should be selected in such a way that it extracts those features which remains constant after transformation also, such as SIFT and affine invariant geometric constraint which are scale invariant as it retains its feature after image is rotated or flipped.

Extent to which modification can be done is uncertain.There can be various way in which modification is done, depending upon it the feature extraction technique need to be selected but possibility of modification to be of one type is less so features should be extracted using Multi-descriptors to extract different types of features including color features, texture features so that any type of change in image like illumination changes, rotation changes, etc. can be taken into consideration.

These are the challenges many image retrieval systems (CBIR) encounters since most of them fail to distinguish the representative features from a large number of noisy features.So different researchers worked on different problems so as to increase the accuracy of retrieval.

CONCLUSION AND FUTURE SCOPE

Partial Duplicate Image Retrieval (PDIR) is attracting many researchers due to increase in trend of editing of images. This paper gives an idea about retrieval of modified images depending upon types of images such as artificially modified web images, partially deleted images, images consisting local symmetries, various approaches to overcome the difficulties encountered while retrieving such images are provided by different authors.

Further improvement in technique of feature extraction such that it can work on multiple features by taking into consideration color and affine- geometric constraints, improvising technique that can eliminate the noisy feature present in modified image can improve the precision and recall providing better retrieved images.

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