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Image Retrieval Framework Based on the Content of Sketches

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Abstract: Query By Example (QBE) allows the end user specify an example as input for the search mechanism. With respect to digital image processing, CBIR (Content Based Image Retrieval) lets users specify an example image and retrieve images that match the features of given image. This phenomenon is known as CBIR and the main research area in the field of digital image processing. Most of the applications depend on annotations associated with images while searching for them. The performance of such systems is not satisfactory. The aim of CBIR is to retrieve images based on the image color, shape and texture. This paper aims at presenting the various problems and challenges that are related to building a CBIR system that is based on the free hand sketch. Describe possible solution with the help of existing methods to design and implement task oriented descriptors. This helps in filling the gap between the sketch image and also real time image. Experimental results on databases reveal that sketch based images allow an intuitive access to search applications. The SBIR technology can be used in many applications like crime prevention, digital libraries, photo sharing etc. Such system is very useful as it can detect criminals and anti social elements. Scrum methodology is used for the image processing. A prototype application is built to demonstrate the efficiency of the proposed application. The empirical results revealed that the proposed application is useful and can be used in real time applications.

Index Terms – CBIR, SBIR, digital image processing

I. INTRODUCTION

With advent of computers and the development of IT paved the way to process large volumes of data in a short span of time. However, the digital image processing or searching image database for a given image has become an essential task in many computer applications. For instance in hospital, doctor has to make search with an example. In other words this kind of search is also known as CBIR (Content Based Image Retrieval). In traditional CBIR, end user gives an image as input and gets output from the designated folder. The results include the images that match visual features of given input image. The Internet technology and image compression techniques[1] have led to large scale storage and retrieval of images in a convenient fashion. Annotated Images can be searched. However, that is not correct approach with respect to database containing huge amount of records in the form of images. To deal with such database, a novel approach is required. This approach is named "CBIR", the content based image retrieval. Human beings can easily remember visual qualities [2] of images or any objects for that matter. As human being is a type and remembers visual qualities of images easily. Using textual information images can be retrieved by using annotations or keywords.

Later on content based image retrieval has become very prominent as it is intuitive to end users. This is of two types. The input image can be given as colored image or a hand drawn sketch. When the user has drawing area that can be utilized in order to draw sketch and give it as input to the proposed application. In criminal investigation, CBIR systems play an important role. The identification of images, sketches is supported by CBIR systems. Such applications are found in [3], [4] and [5]. While searching research circuits graph from a big image database is another area of research [6]. For this to happen, user is supposed to draw a circuit sketch so as to obtain relevant images from database. Thus CBIR has been changed to SBIR (Sketch – Based Image Retrieval). This kind of work was introduced in QBIC [7] and Visual SEEK [8]. Images are classified into grids and the texture features and color are decided in the grids. The drawback of these methods is that they are not really invariant opposite rotation, translation and scaling. Fuzzy logic with neural networks is logic while image features [9].

II. PROPOSED SBIR

The aim of the proposed system is to build a new CBIR system that can work with hand drawn sketches. It does mean that the input is not a color image or photograph. Unlike CBIR, SBIR (Sketch Based Image Retrieval) uses a sketch as input and retrieves matching images based on the sketch. The gap between the color image and the hand drawn sketch is filled by using a pre-processing that transforms input image into some intermediary image. The query process can be iterated to get accurate results. The research in SBIR is increasing but as of now there is not system which has widely been used in the real world. The global structure of the proposed system is presented in fig. 1.

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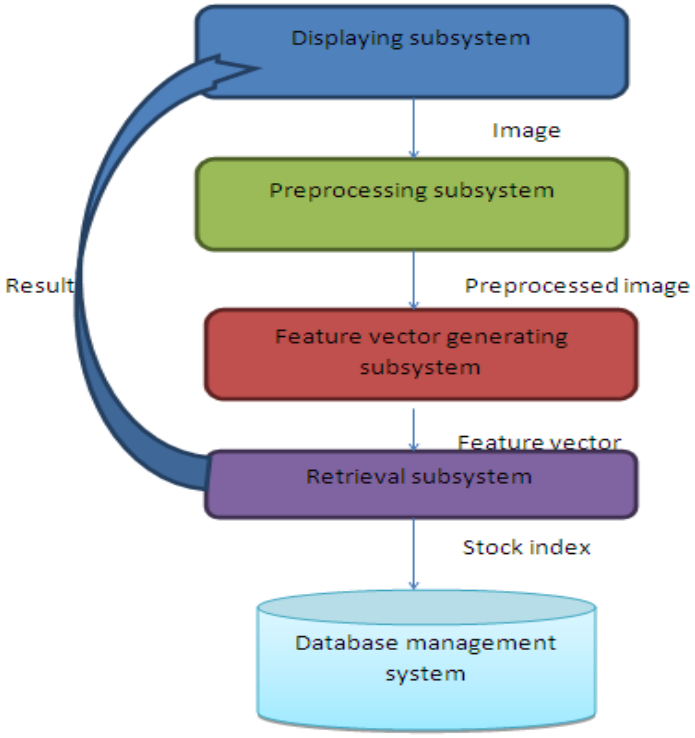

Fig. 1 – The overall structure of the system

As seen in fig. 1, it is evident that the process is iterative to improve accuracy of SBIR. First of all a display sub system allows end user to choose a sketch as input. This input image is given to pre-processing sub system. The preprocessing sub system transforms the input image into an image that can be used to process query. The pre-processing fills the gap between the images in the database and the hand drawn sketch. The pre-processed image is given to feature vector generating system that extracts feature vector and the feature vector is given to retrieval sub system. The retrieval sub system then interacts with database and retrieves images that match the input image. Then the result is shown in the displaying sub system. This process can be continued until the required images come in the query process. The database management system in fig. 1 is responsible to store images on which queries are made. The queries are essentially content based. In this case, that is sketch rather than a photograph. The pre-processing steps are visualized in the following figure.

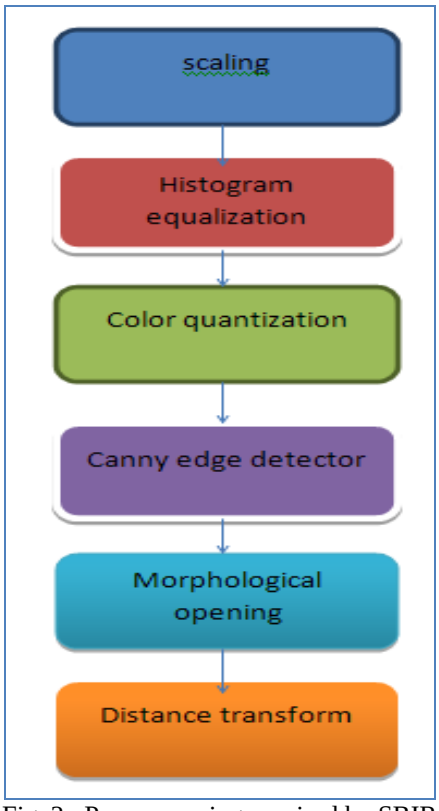

Fig. 2 –Pre-processing required by SBIR

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The hand drawn sketch and images or photographs stored in databases are having much difference. This has to be filled using pre-processing. The preprocessing starts with scaling of input image. After scaling, the image is subjected to histogram quantization and color quantization. The result is given to canny edge detector. Then the resultant image is subjected to morphological opening and finally distance transformation is carried out. The result of this is an image which is improved by transforming it into some form that can be used to search the images in the database. The data flow model of the proposed system from the user point of view is presented in fig. 3.

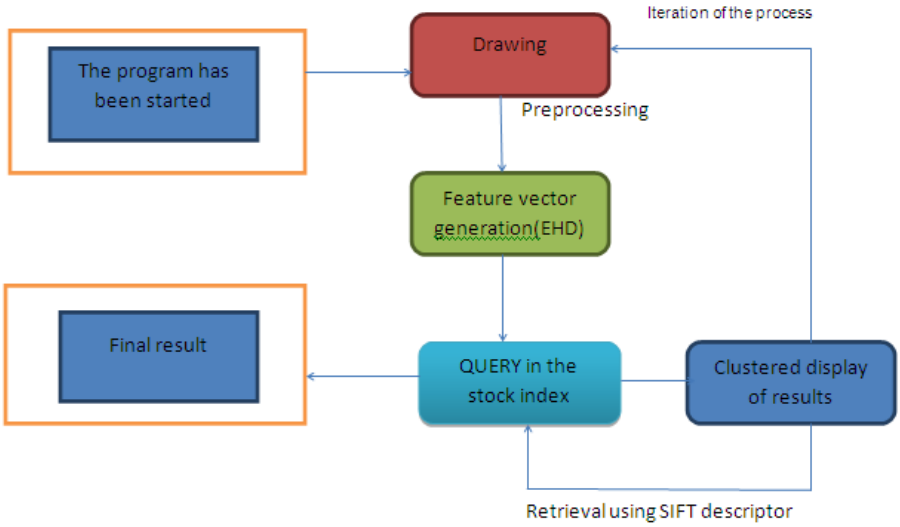

Fig. 3- Data flow model from user point of view

As soon as the proposed prototype application is started, it will be ready to allow drawing. The drawing is done by end user as input is supposed to be a sketch rather than a color image or photograph. Once drawing is completed, the pre-processing job starts. The result of pre-processing is given to feature vector generation job which in turn return feature vector. Then the image retrieval process takes place. Now the final result is presented to end user.

III. EXPERIMENTS

The proposed system has been implemented using an application that facilitates end user to give sketch as input and get images that matches it to be retrieved and presented in a user-friendly manner.

Environment

The environment used for experiments include a PC with 2 GB RAM, 2.X GHz processor with Windows 7 OS. The software used is JSE 6.0, and NetBeans IDE.

Image DB

Flickr 160 database contains freely available images. They are downloaded from Internet. The mages are used in the experiments in this paper. Sample images of Flickr database are shown in fig. 4.

Fig. 4 – Sample images from Flickr 160 database

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Microsoft Research Cambridge Object Recognition Image Database is also used in the experiments of SBIR. Some of the sample images of this database are shown infig. 5.

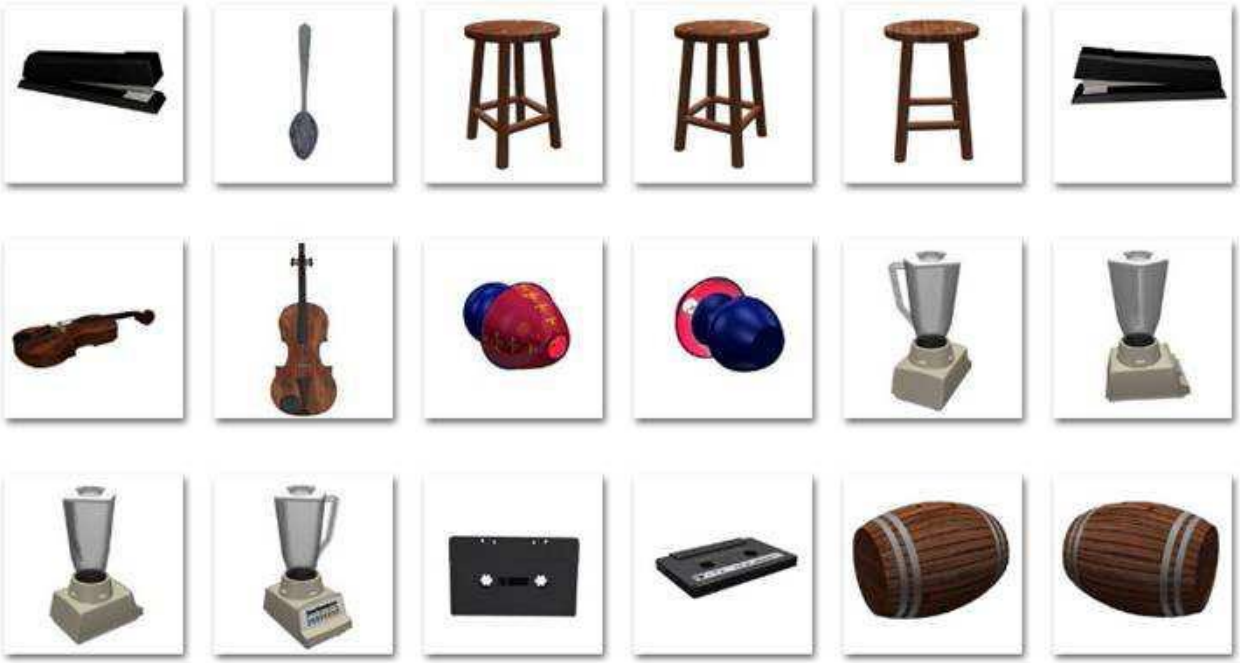

Fig. 5 – Sample images from Microsoft Research Image Database

Some wang database images clustered by color are in the experiments. These images are not like other images as they are clustered by color.

Fig. 6 – Sample images from

Prototype Application

The proposed SBIR has been implemented using SWING API of Java programming language. The SWING API is used to build only graphical user interface. The image processing API provided by Java community is used to implement the functionality for SBIR. The application has been tested with various image databases available over Internet and as mentioned in the prevision sections.

Evaluation and Results

The performance of the proposed system is evaluated using a well known technique known as precision and recall. Precisionand recall is well known bench mark approach followed to know the accuracy of CBIR/SBIR. The formulae for precision and recall are:

precision = relevant hits (Q) / all hits (P) (1)
recall = relevant hits (Q) / expected hits (Z) (2)

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The precision gives information with respect to relative effectiveness of SBIR/CBIR while the recall gives information about the absolute accuracy of the proposed CBIR/SBIR. Fig. 6 shows the effect of threshold value change using EHD method.

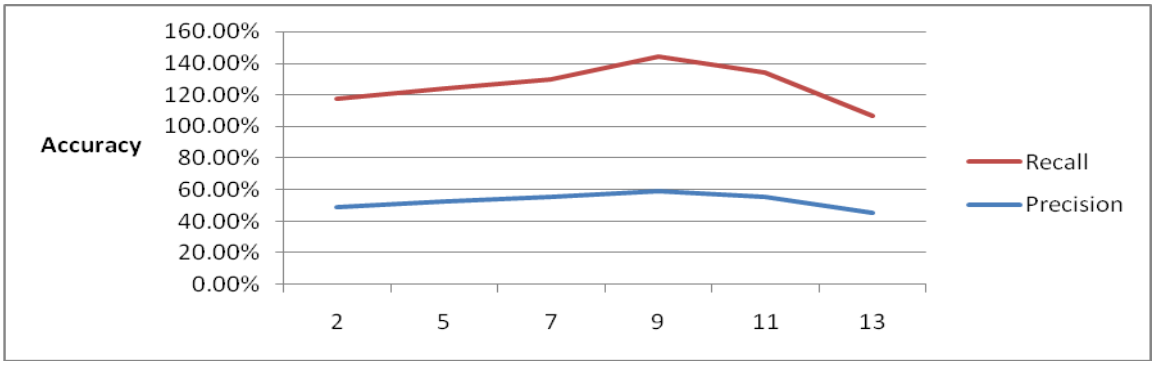

Fig. 7 - Effect of threshold value change using EHD method (block size 10)

As seen in fig. 7, the precision and recall results are presented using different threshold values. The effect of threshold value changes are shown in terms of precision and recall values plotted in the graph.

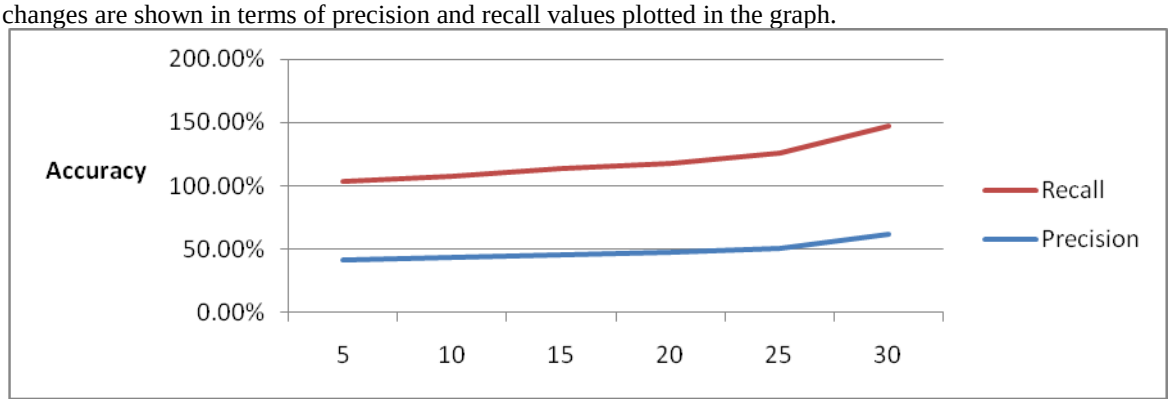

Fig. 8 - Effect of change in block size using EHD (threshold is constant 2)

As can be seen in fig. 8, the precision and recall values are plotted that reflect the effect of changes made to block size.

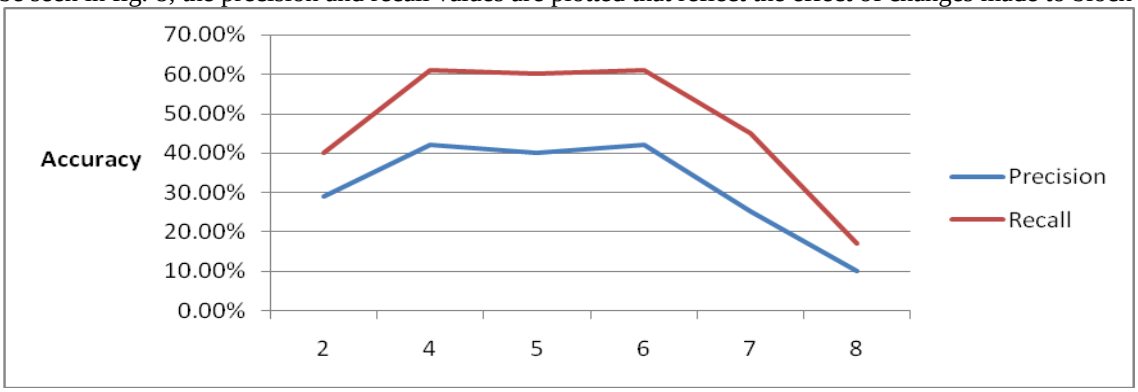

Fig. 9 - Effect of Block Size Change using HOG (No. of bins is 9)

As seen in fig. 9, the effect of block size change using HOG with number of bins 9 is visualized in terms of precision and recall values.

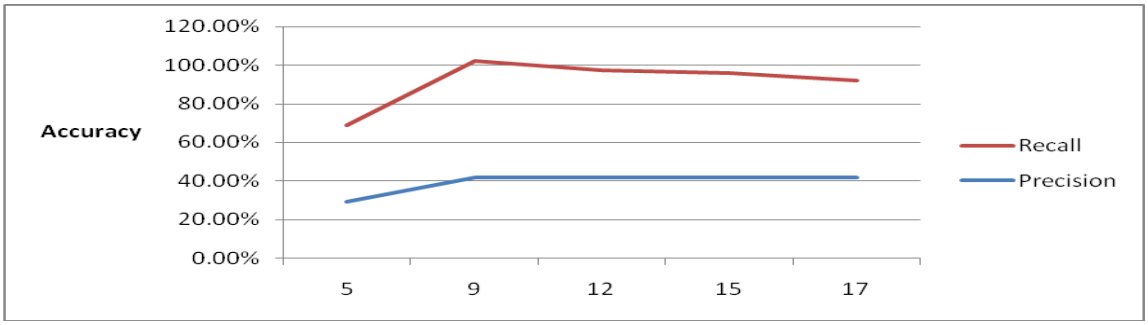

Fig. 10 - Effect of changing number of bins using HOG method (block size is 5)

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As seen in fig. 8, the effect of block size change using HOG with number of bins 9 is visualized in terms of precision and recall values.

IV. CONCLUSION

This paper proposed a new scheme to design, implement and test an application by name sketch-based image retrieval system (SBIR). The proposed application is highly interactive in terms of retrieval of images as part of user query. With respect to robustness of the proposed method, some degree of noise might be allowed. Drawn image is given as input and the output is the color images that are real. As drawn images can't be compared with color images directly a distance transform step has been introduced. Improvement of edge detection technique and simple smoothing are required. The HOG and EHD implementations are compared. HOG is better than ECG. When user gives an image as input, the proposed applications returns one or more images of that kind based on image features.

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