Content Based Image Retrieval Based On Spatial Constraints Using Lab view

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Abstract - *Searching of relevant images from a large database has been a serious problem in the field of data management. Text based search methods doesn't meet the user requirement in most cases. Content based image retrieval (CBIR) involves searching of relevant images based on the features extracted from a query image. The process involves extraction of image features such as color, texture, shape, or spatial information. For better image retrieval, spatial information may be considered as a feature to be extracted. Spatial relationships between the images are compared and a corresponding match score is generated using Similarity Match (SIM) algorithm. This proposed algorithm provides both scale and rotational invariance in images.*

INDEX TERMS – *Feature descriptor, Edge list, spatial orientation graph, Symbolic representation, SIM Algorithm.*

I. INTRODUCTION

Content-based image retrieval (CBIR), also known as Query By Image Content (QBIC) and Content-Based Visual Information Retrieval (CBVIR) is the application of computer vision techniques to the image retrieval problem. Content Based Image Retrieval system is the system of retrieving images from the database based on the similarity measured between images in the database and query image. The features can be in the form of keywords to describe the image, or the visual features such as color, texture, shape etc.

In crime prevention, the police use visual information to identify people or to record the scenes of crime for evidence. Over the course of time, these photographic records become a valuable archive. Whenever a serious crime is committed, they can compare evidence from the scene of the crime for its similarity to records in their archives. This is an example of identify rather than similarity matching though since all such images vary over time. The CBIR is capable of searching an entire database to find the closest matching records. The results of crime prevention are also discussed in this paper.

II. PROBLEM STATEMENT

Retrieval based on color texture and shape does not provide any information about the spatial location of the feature. In most of the cases the retrieval becomes irrelevant. In order to overcome this, the features are retrieved based on its spatial location.

III. WORK FLOW

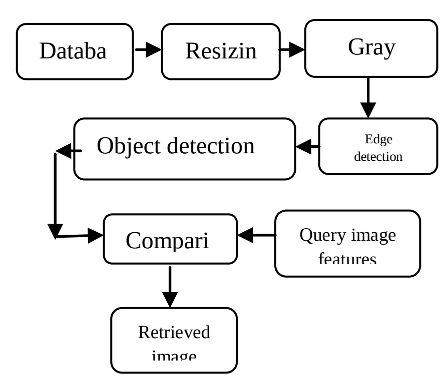


Figure1: Block Diagram

IV. STEPS INVOLVED

A. *Fetching Image From Database*

A sample of 70 images is used for testing the working of this algorithm. The database images are shown below.

Figure 2: Database Images

Images stored in the database are to be transferred to Labview for processing. Initially Labview and MS-Access are connected together after which the images are sent to Labview for further processing and which is shown in figure 3.

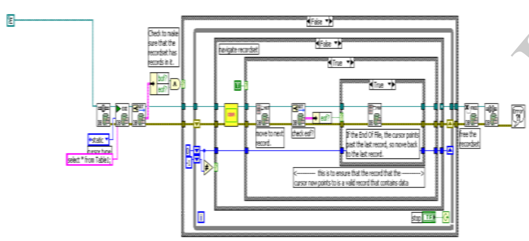


Figure 3: Block Diagram – Data insert in database

B. *Resizing*

Images consume large amount of memory space. Since the database stores many images, huge amount of memory space is occupied. To save memory space the images are resized using down sampling. The method preferred for this process is bilinear interpolation. This process will reduce the processing time, thereby increasing the speed of operation and is done in Labview environment as shown in figure 4. The result obtained after resizing is shown in figure 5.

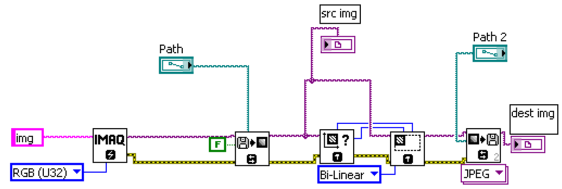


Figure 4: Block Diagram – Resizing

Original image **Resized image**

280KB **189KB**

Figure 5: Original and resized images

C. Grayscaling

The spatial features of edges in the images are considered. Hence a gray scale image is preferred than a color image, to reduce processing complexity. The block diagram of gray scaling using LabVIEW is shown in figure 6. The result of the original image to gray scale image is shown in figure 7.

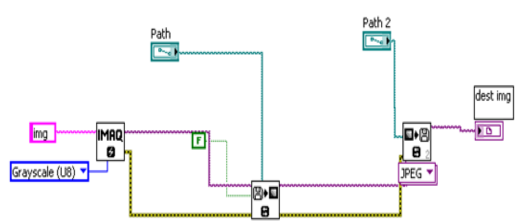
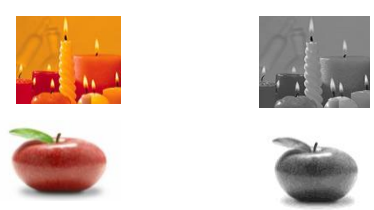


Figure 6: Block Diagram – Grayscaling



Original images **Gray scaled images**

Figure 7: Gray scale conversion

D. Edge Detection

Edge detection is used for detecting the discontinuities in gray level, which helps to find the number of objects present and also facilitates to calculate the Centroid of each object. For edge detection Canny Edge Operator is used. The block diagram of Edge detected using LabVIEW is shown in figure 8. The edge detected images using canny detector is shown in figure 9.

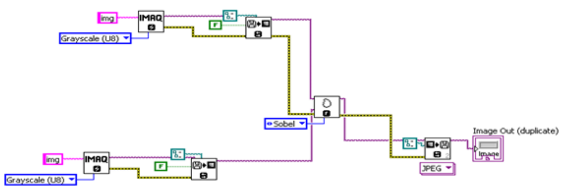
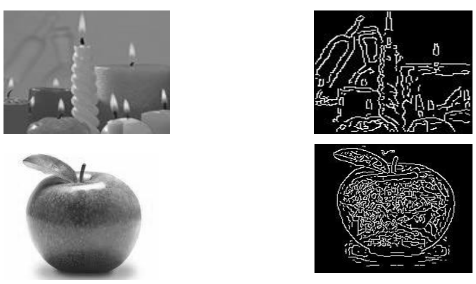


Figure 8: Block Diagram – Edge detection



Original images **Edge detected images**

Figure 9: Canny edge detected images

E. SIM – Similarity function for symbolic images (An Algorithm for Retrieval by Spatial Constraint)

After applying the preprocessing steps of resizing, gray scaling and edge detection to the images, SIM algorithm is implemented.

1) Object detection and Centroid calculation

To obtain the objects in database image and query image, edge detection is performed. For each edge detected image, the number of objects present in the image is detected and the Centroids of each detected objects are calculated. The block diagram of object detection using LabVIEW with object calculation is shown in figure 10.

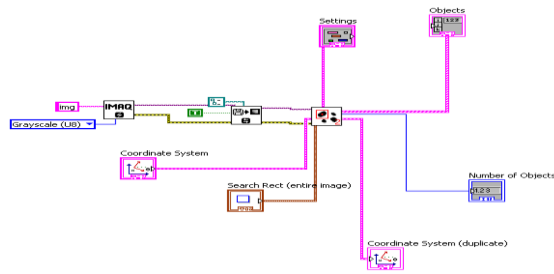


Figure 10: Block diagram – Object detection

2) Spatial Orientation Graph

Spatial orientation graph is a technique for representing spatial relationships among objects present in the images.

An edge in the spatial orientation graph is a line connecting two centroids of the objects and the weight associated with the edge is the distance between the centroids. The collection of all such possible edges for an image constitutes the edge list for that image.

3) Forming The Edge List

The number of edges in the edge list for any image is

$$(n\ (n-1))/2$$

Where n is the number of objects in the image.

Consider two images *S*1 and *S*2 and suppose if we compute the similarity of *S*2 with respect to *S*1. The image *S*1 is referred as the query image and the image S2 is referred as the database image. Let E^{qr} and E^{db} denote the edge lists corresponding to *S*1 and *S*2.

If all the edges of E^{qr} are present in E^{db}, then maximum possible similarity is assigned to *S*2. Assuming a maximum possible similarity of 100.00, each edge in E^{db} that is also present in E^{qr} contributes a value of 200 / **(n (n-1))** towards the similarity. Fewer the number of edges contributing to the similarity value, lower the similarity value obtained.

4) Effects of angle between the edges

The angle θ is defined as the smaller of the two angles between the line segments as shown in figure 6. θ depends on orientation, vertex and edges.

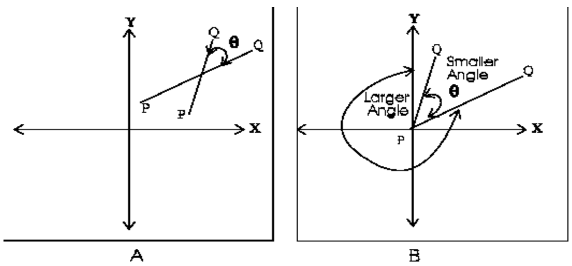


Figure 11: Orientation Graph

The edges common to E^{qr} and E^{db} do not have the same slope or orientation. Depending upon the degree by which the corresponding edge orientations differ, the contributing factor from an edge toward the similarity value has to be modified.

The greater the difference in edge orientations, the higher the reduction in contributing factor. If the angle between two corresponding edges in E^{qr} and E^{db} is θ, then contributing factor from this edge pair is

$100(1+\cos\theta)/(n(n-1))$

When $\theta = 0$, the contributing factor is

$200/(n(n-1))$

When $\theta = 180$, the contributing factor is 0.

5) Similarity Match

A SIM [2] returns a real number R based on the match between the images.

SIM= $\{(E^{qr}, E^{db})\}$ ----> R

Assume, Similarity as 0.0 and n_1 as the number of objects in the query image.

For each edge e_i in E^{qr}, find the corresponding edge e_j in E^{db}

If the corresponding edge is detected, calculate the angle θ between e_i and e_j. The similarity score can be calculates using

$$Similartiy = Similarity + \frac{100.0}{n_1(n_1-1)/2}\left(\frac{1+\cos(\theta)}{2}\right)$$

The similarity score between the images is sent to the corresponding column in the database.

F. Matching Results

After the match score was being sorted in descending order, the corresponding images are displayed in the LabVIEW. The block diagram of matching process is shown in figure 12 using LabVIEW.

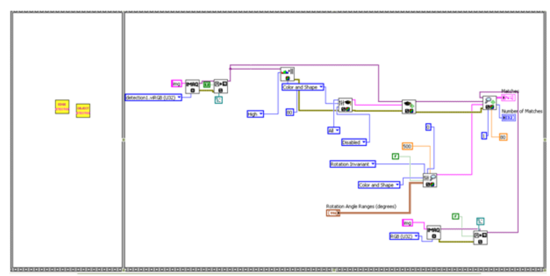
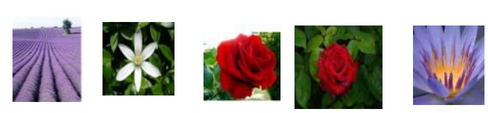


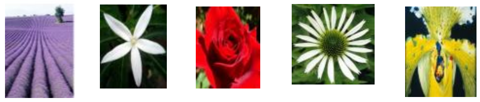
Figure 12: Block diagram – Matching process

Figure 13 shows the matching score results of test images. The score value varies between 0 to 1000. For perfect match, a value of 1000 is resulted. For no match between images, 0 is returned. Based on the number of matches between the images, intermediate values are returned.

Data base image



Query image



SCORE	**1000**	**944.3**	**943.6**	**817.9**	**0.00**

Figure 13: Results of test images

The block diagram of retrieval image is shown in figure 14 using LabVIEW. Figure 15 shows the retrieved images, for the query image from the database.

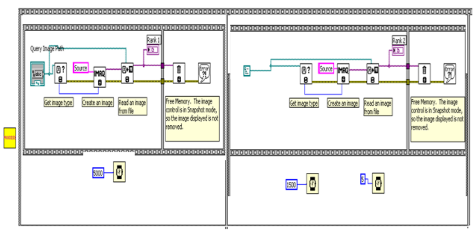


Figure 14: Block diagram – Image Retrieval

QUERY IMAGE **RETRIEVED IMAGES**

Figure 15: Retrieved images from the database

G. Application - Crime Prevention

The CBIR technique using spatial information is tested for a specific application of crime prevention with a database containing 50 human face images in Portable Network Graphics (PNG) format and the results obtained are shown in figure 16. Gray scaling is not needed for binary images. The result of the retrieved query image from the database images are shown in figure 17.

QUERY IMAGE

TEST IMAGE

SCORE	**987.67**	**882.00**	**632.47**	**0.00**

Figure 16: Results of test images

QUERY IMAGE **RETRIEVED IMAGES**

First 3 matches

Second 3 matches

Next 3 matches

Next 3 matches

Figure 17: Retrieved images

V. CONCLUSION

The spatial similarity computation is based on exact match. SIM algorithm offers best retrieval of images using spatial constraints.

This work can be further extended by including some other feature along with the features used in the proposed system, to describe the image. By adding more features, the performance of the system will be improved. Also the accuracy of obtaining the retrieved images from large database or web will result into increase in the retrieval efficiency of the system.

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