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IMAGE RETRIEVAL IN SEGMENTED IMAGES THROUGH RELEVANCE FEEDBACK MECHANISM

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ABSTRACT

Image processing is a method to convert an image into digital form and perform some operations on it, to extract the essential features from it. Image segmentation is one of the application in image processing to divide an image into sub images in such a way that pixels in the sub images share similar properties(color, texture). Digital image processing is the only practical technology for pattern recognition. The images are extracted using image retrieval systems. Content-based image retrieval is one of the best form of image retrieval method. In this paper, we focus on the reduction of semantic gap between low level and high features using Relevance Feedback mechanism. RF mechanism can be implemented by taking user's feedback. Finally the similarity between original image and the resultant image using minimum ratio.

Keywords: Image Segmentation, Pre-processing, Pattern extraction, Relevance Feedback mechanism, K-medoid Clustering, Minimum Ratio.

I. INTRODUCTION

Image Segmentation [1] is the process of dividing an image into sub images used to locate objects in a particular sub region which is of user's interest. The pixels in the same sub image share similar features like color, texture etc. using various segmentation techniques. Here uses k-medoid algorithm for performing segmentation. Before performing segmentation on images, perform some pre-processing (filtering) techniques on images to remove the noises from the image.

Earlier uses Text-Based Retrieval Systems. Since it requires large amount of human effort. As a result of this, Content-Based Image Retrieval (CBIR) Systems came into existence. CBIR uses the technology of searching images in the database using keywords, tags or descriptions related with that image. "Content" in this context refers to color, textures, or any other information that can be extracted from the image itself. In CBIR [3] the images are represented by low level features (color, shape, texture) and are easy to extract, where as high level features are represented by human intelligence and is difficult to extract. The difference between low level features and high level features called as semantic gap. Relevance Feedback mechanism reduces the semantic gap [7] between high-level and low-level features which is implemented based on users feedback. The main idea behind relevance feedback is to obtain the results from a query using keywords or tags and the user decide whether the obtained result is relevant or irrelevant [6]. If the result is an irrelevant image, repeat the process until the final image should be closer to the given query. Otherwise, retrieve the pattern from the relevant image.

At the final stage, the pattern is extracted using one of the low-level feature and similarity checking is done with the original image using one of the similarity metrics. Here similarity checking is done with the help of Minimum Ratio.

The paper is organized as follows. Section II is the related work of various authors. Section III, IV, V, VI, VII, VIII, IX describes different proposed methodology. Section X gives the experiment result. Section XI follows the conclusion.

II. RELATED WORK

In [2], the author proposes a novel based content based image retrieval system along with relevance feedback mechanism to narrow the gap between features and the human semantics to improve the retrieval accuracy. The experiments are conducted on Corel image databases. The efficiency system is calculated using Precision and Recall. A maximum precision value of 92% and recall value of 10% for one of the class. All the other classes provide precision in the range 60–80% and recall in the range 7–20%.

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The authors [3] presents Content Based Image Retrieval CBIR) system that uses multiple feature fusion to retrieve images and time is compared for each and combination of various features and also for improving the retrieval results in terms of its accuracy relevance feedback is suggested.

In [8], the author proposes a method for tumor detection in brain MR images. If it is a mass tumor then *K*-Means algorithm is enough to extract from the brain cells. If there is any noise are present in the MR image it is removed before the *K*-Means process. The noise free image is given as a input to the *K*-Means and tumor is extracted from the MRI image.

The authors in [17] proposes a new content based image retrieval(CBIR) system combined with relevance feedback and the online feature selection procedures. A measure of inconsistency from relevance feedback is explicitly used as a new semantic criterion to guide the feature selection. Experimental results show that the proposed method obtains higher retrieval accuracy than a commonly used approach. The authors in [13] provide an overview of the technical achievements in the research area of relevance feedback (RF) in content-based image retrieval (CBIR).

III. PROPOSED METHOD

The proposed model involves six modules. Each module is described in the following subsections.
1. Dataset Preparation
2. Image Pre-processing
3. Segmentation using K-Medoid Algorithm
4. Feature Extraction (color, medoid , shape)
5. Relevance Feedback
6. Similarity Checking

Database consists of different images belonging to different classes. An Image preprocessing/filtering is applied to the image using Gaussian filter to remove the noise. Segment the image to 3 clusters (predefined) using K-Medoid algorithm. From the formed clusters, extract one of the low-level features. The system asks whether the user is satisfied with the formed results in the form of keywords [1, 11]. If he gets satisfied, extract the pattern in the formed cluster using shape feature. If he is not satisfied with the results, check in which cluster the pattern lies and segment that cluster using K-Medoid algorithm and extract another low-level feature. This process is repeated until the results get refined. The last step is to check the similarity between the extracted pattern and the original image using minimum ratio to ensure that the information in the image doesn't get lost till the final stage.

A. DATASET PREPARATION

Dataset of different images belonging to different classes were downloaded from internet sources.

B. IMAGE PREPROCESSING

Image preprocessing helps in bringing out the important features from the image thereby increasing the contrast, brightness, quality by removing the noises using any one of the filtering techniques. Here uses Gaussian filter to remove the noise.

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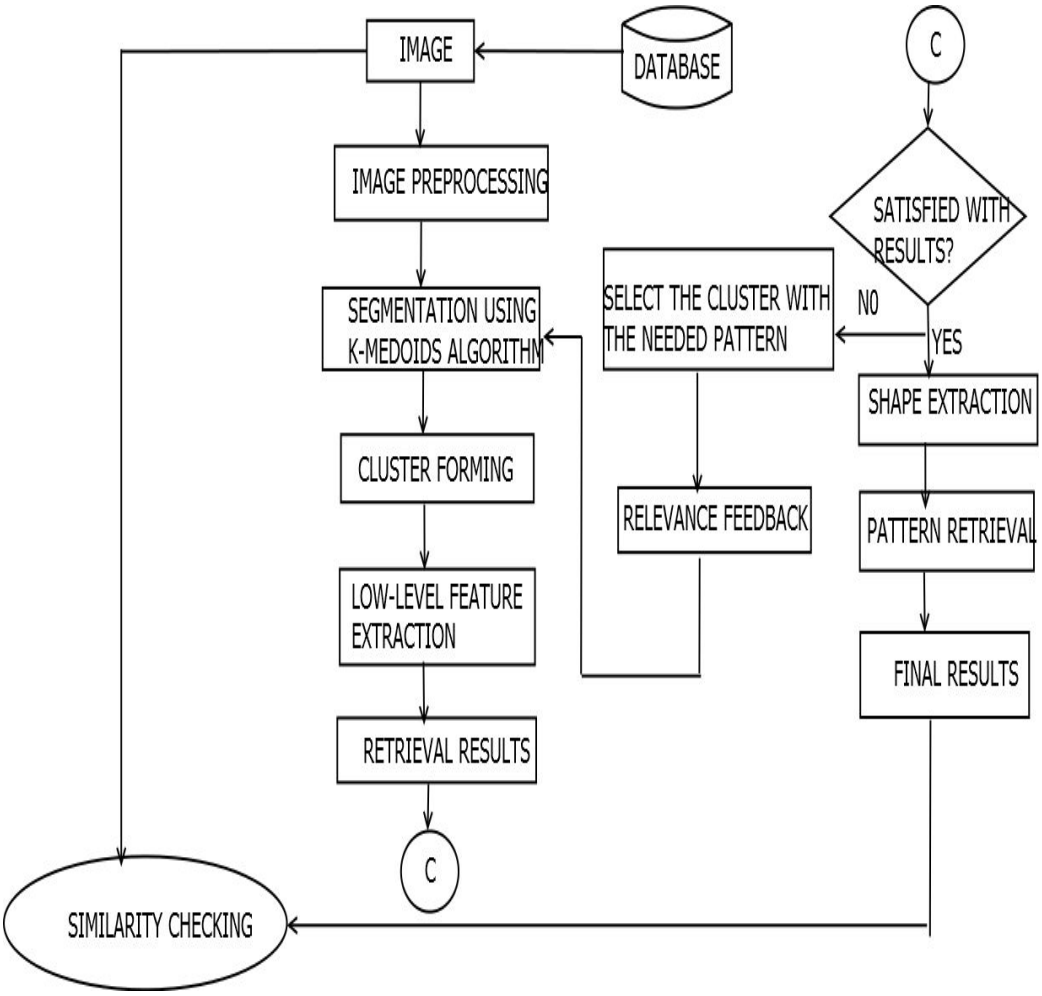

Figure 1: Architecture of Proposed Method

IV. SEGMENTATION USING K-MEDOID ALGORITHM

K-Medoid [5] is an unsupervised learning algorithm. Groups data to form new categories (i.e., clusters). The main principle behind this is to maximize intra-class similarity & minimize interclass similarity. The algorithm for K-Medoid works as follows:

1. Randomly define the number of clusters and medoid location.
2. Associate each data point to the closest medoid using Euclidean distance.
3. When no more data points is there to process, calculate the new medoid by minimizing the absolute distance between the points and the selected medoid
4. Repeat the step 2 and 3 until no change in medoid location.

V. FEATURE EXTRACTION

The extracted features should carry enough information about the image and easy to compute in order for the approach to be feasible for a large image collection and rapid retrieval. The features should relate well with the human intelligent characteristics since users will finally determine the suitability of the retrieved images. Color, medoid and shape are features considered for content image description.

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1. Color:-

The best and the most prominent visual feature to identify an image is color. Color is a subjective human sensation of visible light depending on intensity and a set of wavelengths associated with the electromagnetic spectrum which is defined on a selected color space. A color space is a model for representing color in terms of intensity values. It specifies how color information is represented. The basic technique which is used is based on the technique of color histogram. Color histogram of each image is calculated and then stored in the database which represents the proportion of pixel of each color within the image.

2. Medoid

Medoid specifies the center of mass of a region. The first element is the horizontal component(x-coordinate) and second component is the vertical component(y-coordinate) of center of mass.

3. Shape

Select the cluster with specified pattern. Identify points in the cluster where the pattern lies by positioning the cursor with the mouse. Thus, receives unlimited number of points, returns the x and y coordinates in vector format. Create a binary ROI (Region of Interest) mask with the returned coordinate positions. Subtract the original image and the mask to return the specified pattern from the cluster.

VI. RELEVANCE FEEDBACK

Relevance Feedback [4,5] is an online processing which tries to study the user's intentions. With the intention to bring user in the retrieval loop to reduce the 'semantic gap' between low-level and high-level features in the form of keywords, query, and example.

The main idea of relevance feedback [20] is to shift the burden of finding the right query formulation from user to the system . In order to make this true, the user has to provide the system with some information, so that system can perform well in answering the original query. To retrieve the image from the database, first extract feature vectors from images (the features can be shape, color, texture etc), and find the similarity between the extracted pattern and original image. The search is usually based on similarity rather than on exact match, and the retrieval results are given to the user. Then user gives the feedback in the form of 'relevance judgments' expressed over the retrieval results [9,10]. The relevance judgments evaluate the results based on a three value assessment. These three values are relevant, irrelevant, don't care.

If the user feedback is relevant, then feedback loop stops and extract the pattern using shape parameter. Otherwise it continues until user get satisfied with results (Figure 2).

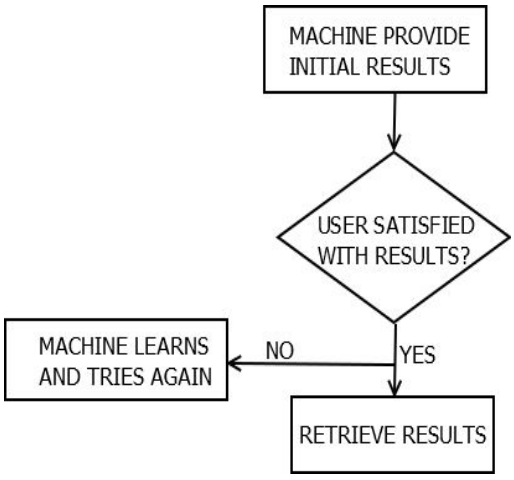

Figure 2: Flowchart for Relevance Feedback

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VII. SIMILARITY CHECKING

Similarity between the original image and extracted pattern is calculated using similarity checking parameter, Minimum Ratio. If image is $Y = \{y_i : i = 1,2...n\}$ is the extracted pattern of original image $X = \{x_i : i = 1,2 .... n\}$, then $r_i = \min\left\{\frac{y_i}{x_i}, \frac{x_i}{y_i}\right\}$ and calculate $m_r = \frac{1}{n}\sum_{i=1}^{n} r_i$. m_r measures dependency between X and Y .If similarity exists between original image and extracted pattern, the value will be more closer to 1.

VIII. EXPERIMENTAL RESULTS

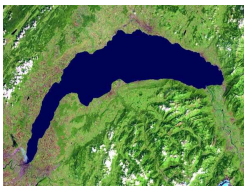

Figure 3: Original Image

Figure 4: Images after first iteration with feature vector medoid

Figure 5: Images after second iteration with feature vector RGB range

Figure 6: Extracted Patterm

The original image is shown in figure 3. Here, we tries to retrieve lake from original image which is in blue color by giving different feedback in the form of a query. For this, first segment original image into 3 clusters(predefined) by

performing *K*-Medoid clustering with a constant cluster size of 3 and extracted first feature vector i.e., cluster coordinate from all 3 clusters and the output is shown in figure 4.

After performing first iteration, the searched pattern is found in cluster3. The machine asks the user whether user gets satisfied with the results. Since this is an irrelevant image and user is not satisfied with first feature extraction and again proceed with the second feature extraction by segmenting the cluster3 into three clusters using *K*-Medoid clustering [23] and refine the results by performing relevance feedback with RGB as the next feature in second feedback shown in figure 5.

After performing the second feature extraction, identify the cluster with the pattern lies. Here the blue colored lake lies in cluster1 and extracted using shape parameter shown in figure 6. Finally, a similarity checking is done between original image and extracted pattern and a minimum ratio of 0.9863 is obtained which shows high similarity.

Table 1: Results for Minimum Ratio

Original image	**Minimum Ratio value**
Lake	0.9863
Island	0.9991

Table 1 shows the minimum ratio values for the two datasets: Lake, Island. In all the two datasets, the patterns are extracted using two features: medoid and RGB value at each level of iteration according to the user's satisfaction level using relevance feedback mechanism to reduce the semantic gap [26] between the features. It asks for the user's decision whether to continue with the segmentation. Here in all above two cases, the user is not satisfied at the first level and hence move on to second level. Even though the patterns are extracted from the original image by extracting the features, there shows a high similarity value of more than 0.9 in all the datasets. The value nearer to 1 implies high similarity between the extracted pattern and original image.

IX. CONCLUSION

The results obtained shows that even though features are extracted from the image, similarity exists between original image and extracted pattern. Here implemented Relevance Feedback mechanism for making the results refined and to reduce the semantic gap between the features. Moreover, implemented K-Medoid algorithm for segmentation.

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