A Study of Water Reflection Element in Content Based Image Retrieval Using Phase Congruency Edge Detection

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ABSTRACT
With advances technologies of Internet and new digital image, the volume of digital images produced by scientific, educational, medical, industrial, and other applications has increased dramatically. The paper was inspired by symmetrical study about an image and also we tried to apply edge detection using Phase Congruency method that proposed by Kovesi. We tried making comparative study on edge detection to extract edge information from the single images in database. Secondly, were applied this edge element of symmetry studies about water reflection into Content Based Image Retrieval (CBIR) using geometrical moment and symmetry measures. Then the results from image segmentation are further grouped into regions representing by water reflection and all moment value were clustering using Gustafson Kessel Algorithm and Relevance Feedback as intelligence part of our system learning method.

Keywords
Content-based image retrieval, edge detection, phase congruency, gustafson kessel algorithm, relevance feedback, symmetry, water reflection

1. INTRODUCTION
The several improvements Content-based image retrieval (CBIR) has receiving great popularity in past decades and until now. With the increasing of computer usage, the number of digital images is increase rapidly. CBIR and efficient technique also have been applied to process the target images by presenting the content of interest in a query. CBIR systems use features that can be extracted from the image files, for searching a database of images, rather than relying on manual key in indexing or text descriptions. Early work on image, techniques that were developed was based on textual annotations of the images rather than visual features of the images. Images were organized by topical or semantic hierarchies to facilitate easy navigation and browsing.

The visual content of the image is described through annotations provided by users such as metadata text or keywords. This description is used for image retrieval processes. In this approach of manual classification, extracted keywords are managed through a conventional database which provides support for object retrieval. All the CBIR system can be divide into commercial systems and experimental systems such as QBIC, Virage, VisualSeek and Photobook, along with specific applications, such as medical information systems, face recognition and images management that belong to this CBIR framework. Search engines like Yahoo and Google does have image searches among their services options. But, we clearly seen that the images retrieved by Google have no related to the concept queried by the user. The alternative is to make use of the contents of the image itself rather than the text it is surrounded to represent and index the image based on color, shape, texture, and spatial layout are the typically used contents. Usually the visual contents of the images in the database are extracted and described by multi combination of feature vectors. The most important thing in CBIR is the introduction learning system such of Relevance Feedback (RF).

The system will return a set of images in response to a user’s query. The user is then required to indicate to the system which of the images supplied to him is actually relevant. Based on the user’s reaction, the system refines its search. In our experiment we briefly concentrate on image pre-processing using the best edge detection method to detect water reflection element in single image and then adopt this clustering and this feedback technique into our CBIR system.

The remainder of this paper is organised as follows, Section 2 reviews previous work, Section 3 describes the image pre-processing, in Section 4 & 5 we discuss about images clustering and in Section 6 we presents experimental results and discusses the performance of the method. Finally in Section 7 presents our conclusions.

2. RELATED WORKS
Symmetry detection is a well-studied field in computer vision, and comprises a significant body of work spanning over 30 years. Here we present a brief review of symmetry detection focusing on water element than content in landscape images. We uses edge detection method as pre-processing features, and also provide an introduction to the symmetry detection problem in CBIR As also know that human eye is more sensitive to changes in areas having more edges as compared to those with lesser or no edges (smooth areas) and hence we will use this information to assign a weight accordingly.

In general the edge detection literature has concentrated on the detection of step edges. This is typified by the work of Sobel [12], Canny [15], Marr and Hildreth [13], and many others. A very limited amount of work has been done on the detection of other kinds of features. Some exceptions to this are the line detection work of Canny [15], the detection of peaks and roofs [16], the detection of steps and bars by Wang and Jenkin [17], and the catalog of feature [18, 19].

3. IMAGE PRE-PROCESSING
Images contain a wide variety of edge types, many of which are somewhere between a step and a line, shape and textures. In the
generic CBIR process, the first step is to extract features from the stored images. The main development of these features took place in the field of computer vision and also human visual perception. In some cases an effort is made to choose features that coincide with theories of how the human visual system works, such as the use, of extracted descriptors that commonly called “visual features”. The result of feature extraction is a set of numerical features. An image is represented by these features, and these are used to index the entire collection using moment invariant.

3.1 Median Filter
Median filters were using in order to reduce the noise on the images. Median filter controls the strength of the function by specifying the size of the nearest neighbourhood of surrounding pixels. It is particularly effective in the presence of both bipolar and unipolar impulse noise. We used that value to calculate the median value and this operation will minimize the blurring of the image.

3.2 Edge Detection
Edges can extract from the pixel domain and these extractions are useful to determine the amount of geometrical information that can be embedded in the image. We need an algorithm that accurately extracts the edge information from the image and by accurate we mean something that not only shows, as many edges as there are present but also differentiate between real edges and spurious edges, which may occur due to noise and texture [1].

In order to perform this we will make use of an algorithm implemented by Peter Kovesi [3] that has been proved to extract edges better than most other edge detection algorithms. One of the better algorithms returning many more edges with good accuracy in determining spurious edges is based on the phase congruency of feature detection [2].

This method is invariant to image contrast, unlike most methods. Phase congruency is described as a dimensionless quantity that provides the information that does not change with image contrast and this is used to determine the principal 6 magnitudes of moments of phase congruency. An edge would be one where the maximum moment of phase congruency is large. More information on phase congruency and extraction of edges using phase congruency can be found in [1, 2, 3]. We are concerned on determining as many edges and corners in image pre-processing because of dealing with clustering an image, we must find all similarity that we can get thru single image and compare it into whole image database.

3.3 Symmetry Detection
Symmetry detection has a long history in computer vision dating back to early 70’s. It has found use in numerous applications, including: facial image analysis, vehicle detection, reconstruction, indexing of image databases, classifying regular patterns, object detection in medical imaging. An important aspect of symmetry is the periodicity that it implies in the images of the object that one is looking at. Accordingly it is perhaps natural that one should use a frequency based approach in attempting to recognize and analyze symmetry in images. Generally, there are three types of symmetry: reflective symmetry, rotational symmetry, and translational symmetry. In this paper, we study on reflective symmetry on center of inversion or inversion point. All features are matched by an equivalent feature on the opposite side of mirror plane as the inversion point that show in figure 2.

The inversion operation, \( i \), takes every point in an object to an equidistant point on the other side of the centre of inversion. It can be easier to understand if you think of the centre of inversion as the point \((0,0,0)\) then the inversion operation takes every point \((x,y,z)\) to \((-x,-y,-z)\). For example, a dumb bell is symmetric under inversion in its centre of gravity. We use phase congruency edge filter and fixed thresholds for symmetric edge detection.

3.4 Geometrical Moment
Geometrical moments commonly used as image features. Many researches on CBIR have used geometrical moments for images recognition and the researcher will use the geometrical moments to provide an alternative series of expansions in representing shapes of images objects. Moments are derived from raw measurements and can be used to achieve rotation \( \{R\} \), scale \( \{S\} \), and translation \( \{T\} \) (or position) invariant [Hu moment].

The geometrical moment invariant involved a series of calculation, which is based on pixel values in whole image. We need to find the width and the height of the image to perform this
operation. After that, the beginning location of the store pixel values will be determined and the system can start reading the pixel values by each row and column till it cover all resolution of the current images.

4. GUSTAFSON-KESSEL CLUSTERING
We were using the Gustafson-Kessel (GK) algorithm that assigning each cluster to its centre and covariance. The GK algorithm is also data scale independent, i.e., if the data in any dimension are multiplied by a constant than the relative coordinates of the cluster centers and the matrix of membership degrees are identical. Moreover the convergence of this algorithm is ensured, but locally only [e].Our study is based on studying symmetric pairs of features that are then grouped into the image that water reflection element or not.

5. RELEVANCE FEEDBACK
The Relevance Feedback (RF) framework is learning method nearly to all CBIR current systems. The user will comment on or indicates which images are in the set are relevant and irrelevant with a query images that given to the system. The system then takes the user's suggestion and tries achieving optimal retrieval performance [9]. The RF techniques also allow users to grade the retrieved images by answering a given query. The weights are updated during the RF iterations and the relevance weights features are the basis to redo queries. The RF learning system takes full advantage of adjusting about concerning the user’s view and needs during retrieval process. [8]

6. EXPERIMENTS
6.1 Geometrical Moment result
The pre-processing method was implemented in Matlab, and feature points were detected and descriptors computed using matlab code made available by the authors of these methods [1].

Table 1. Examples of different values in geometrical moment for edge detection process

<table>
<thead>
<tr>
<th>Geometrical Moment Value</th>
<th>0.00385268</th>
<th>0.003958066</th>
<th>0.0052348034</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using Sobel Operator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using Phase Congruency</td>
<td>0.07756885</td>
<td>0.048941859</td>
<td>0.0576631055</td>
</tr>
</tbody>
</table>

Geometrical moment value results are shown in Table 1. The images are taken from the test data used in our experiments. Note that the result have been cropped and resize in 400x400 pixel for processing and visualization purposes. In all the images shown, the object's symmetry lines are the strongest in phase congestion [1]. However at times, background image over shadow foreground symmetry. From the experiment, we clearly can see each image have their own unique value of geometrical value and this pre-processing will help us to clustering the image effectively.

6.2 Image Retrieval Result
We have randomly selected one of the 1000 images as query, and other 999 remaining. These clustering results provides an indication of the robustness and generality of symmetry on landscape image that content water element using geometrical moment and phase congruency. We cluster each image with geometrical moment value and phase congruency. This image moment will be clustering using GK Algorithm and query mechanism based on the RF to define his/her ‘information need’ by providing an example image. After submission of the query, the CBIR system compares the features of the query image with those of others in the collection. Based on some similarity measure, the system ranks the images of the top-n preview to the user. Then the retrieved images are displayed in this list. For every image in the retrieved list, the user is enabled to indicate whether a certain image is relevant to his/her query (positive feedback), or not (negative feedback). In the feature extraction phase, images are decomposed into visual features. During query processing the user is initially required to express his/her information need via some. The RF part makes use of the user’s judgment of the relevance of the images in the retrieved set and after all the retrieval process are returns.

7. CONCLUSION
From the experiments, we have found that several improvement and future works that can be done to make the prototype system more adaptable with user requests. In future, we plan express more on pre-processing water reflection image based on moment in our CBIR system to test the accuracy of phase congruency retrieval results. We also want to adapt the symmetric properties into clustering process.

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9. REFERENCES


