Hybrid Wavelet Transformed Row/Column Mean Content based Image Retrieval with Image Tiling

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Abstract – One of the crucial problem of computer vision technique is search images in large databases. This problem is addressed with efficient Content Based Image Retrieval (CBIR) techniques. The research paper introduces three techniques validated with two different datasets in order to compare the retrieval efficiency and accuracy. Color and texture information extracted from image forms the feature vector. Initially the color information is extracted by process of separation of image into Red, Green and Blue planes. These individual planes are divided into 4 blocks and for each block row mean vectors are calculated. This system uses Cosine-Haar Hybrid Wavelet Transform(HWT) to generate the feature vectors of the query and database images. HWT transform is applied over a row mean vector of each block separately, which gives a set of feature vector of size 15 elements in the first technique. In the second technique first 60 coefficients are considered for feature vector formation. In the third technique after extraction of Red, Green and Blue components, they are divided into four parts. From each part separate row mean is calculated and HWT transform is applied on it and from each component taking 5 values each block. For each color component, the total feature vector of size 60 is created. Euclidean distance is used as similarity measure to compare the image features for image retrieval in proposed CBIR techniques. Two standard datasets namely COIL and Wang are used for the experimentation purpose. COIL dataset consist of 500 processed images in 10 different categories and Wang’s dataset consist of 1000 unprocessed images in 10 different categories. For checking the performance of the system average Precision and Recall values are calculated.

Keywords—Cosine-Haar Hybrid Wavelet Transform; Content Based Image Retrieval(CBIR); Feature Extraction; Energy Coefficients;

I. INTRODUCTION

Abundant images are being readily available in world to users because of extraordinary advancements in color imaging technologies[1]. Currently there is a rapid growth of image databases in all fields like astrology, military, medical, multimedia, geographical information system, photography, journalism, etc., Thus there is requirement of an effective and efficient technique process, indexed, store and retrieve the images. Multiple image extraction features are available like shape, size, color etc. Many images are available from various sources such as digital camera, digital video and scanners [2]. The CBIR i. e. Content based image retrieval is defined as an application of computer vision where relevant images are retrieved from the huge database on the basis of their content such as color, texture, shape and spatial layout[3].

This research focuses on color and texture information of the image. The color feature has widely been used in CBIR systems as they are its easy to extract and fast in computation. Color is also an inbuilt feature of an image and plays a vital role in image matching. There is theory for understanding the colors, color pallets and traits. This theory helps in the extraction of color features from images[4]. Research is focusing on color and texture information of image. Initially R, G, B planes are separated and then the image plane is decomposed into 4 blocks. In second phase Cosine-Haar HWT is applied to transform row mean vectors of each block [5]. This research paper is organized in various sections. Section II gives literature survey. Section III elaborates proposed CBIR Techniques. Section IV explains the
experimental environment along with platform, test bed, performance measure and similarity measures; Section V contains results with the discussion.

II. LITERATURE SURVEY

Color contents define the image. Proposed research paper emphasize on color content of images as a feature used for CBIR. Distribution of colors in an image defines color histogram of an image. It is represented as number of pixels belonging to particular color shade. Color Histogram gives representation the image in frequency domain of shades. Color layout is spatial distribution of colors for particular image. Color layout with color histogram characterizes the image. Reference image color traits are transformed to destination image by Color mapping. Color pallets will be matched to destination image and accordingly it will be colored in Color mapping. Thus Color content is the most crucial, decisive and imperative part of image.

Representation of image in transform domain has two advantages. First, division of the low energy and high energy contents of image which helps in reduction of feature vector size making the retrieval process faster. Second, data in transform domain mostly is independent of illumination and rotational variations of spatial domain data; which make retrieval system becomes more robust. These advantages of transform domain make it an imminent choice for feature vector size reduction in retrieval system.

From multiple orthogonal available transforms are Cosine and Haar with partial coefficients have shown better performance for Content Based Video Retrieval [6, 7]. The Wavelet transforms evolved from orthogonal transforms give higher energy compaction which results in minimization in feature vector size in image retrieval [8].

In many applications orthogonal transforms are proven better than respective wavelet transforms [9]. Hybrid Wavelet Transform is formed using two constituent orthogonal transforms. For image compression domain the hybrid wavelet transform are demonstrated better compared to their constituent transforms [10]. Moreover from combinations of multiple orthogonal transforms, hybridization of Cosine and Haar shows outstanding performance in image compression application [10].

The goal of any retrieval system is to deduct in feature extraction complexity and devising retrieval efficiency. This paper proposes the use of Cosine-Haar Hybrid Wavelet Transform with tiling for Content Based Image Retrieval to improve the overall efficiency of the system.

III. PROPOSED SYSTEM

The research paper proposes about three image retrieval techniques which are experimented on two different datasets to compute the retrieval efficiency as well as accuracy of each individual technique. Each technique generates a feature vector which is based on color and texture information extracted from an image and used for retrieval.

Block diagram of proposed Hybrid Wavelet Transformed Row/Column Mean Content Based Image Retrieval system using image tiling is as shown in Fig. 1. Content Based Image Retrieval consists of two phases as registration phase and query execution phase.

![Proposed Content Based Image Retrieval System](image)

Figure 1. Architectural framework Proposed Content Based Image Retrieval System

CBIR system consists of two phases.
1. Registration Phase: In this phase features of database are extracted and saved back for future reference.
2. Query Execution Phase: This module follows the same steps of feature extraction as followed in registration phase and the extracted features of query image are compared with saved features from database. Then most relevant results are returned as relevant retrieved.

In proposed system following three techniques are used to generate feature vector of an image. Calculated feature vectors are stored at secondary storage called as feature vector table which will be used further for computation of precision and recall values.
For these three techniques initially RGB planes are separated from the original image.

**A. FIVE COEFFICIENTS PER TILE**

In this proposed method following steps are followed

1. Red, Green, Blue planes are considered as a tile. Row mean of respective row from each tile is calculated and stored at a row mean vector \([11]\).
2. Cosine-Haar Hybrid Wavelet Transform is applied on a row mean vector of each tile to obtain Energy Coefficients.
3. First five high energy coefficients per tile are considered as a feature vector.

Thus the feature vector size becomes 15 features per image.

**B. TWENTY COEFFICIENTS PER TILE**

In this proposed method follow the same feature extraction method as given in Single coefficients per tile. But it considers first twenty high energy coefficients from each red, green and blue for formulation of feature vector of an image.

**C. FOUR TILES, FIVE COEFFICIENTS PER TILE**

In this proposed method following steps are followed

1. Red, Green, Blue planes are considered as a tile.
2. Each tile is divided into four subtiles.
3. Row mean of respective row from each sub tile is calculated and stored at a row mean vector.
4. Cosine-Haar Hybrid Wavelet Transform is applied on a row mean vector of each tile to obtain Energy Coefficients.
5. First five high energy coefficients per tile are considered as a feature vector.

Thus the feature vector size becomes \(5 \times 4 \times 3\) i.e. 60, sixty features per image.

**IV. EXPERIMENTAL ENVIRONMENT**

Two standard datasets are used in experimental environment namely – Wang and COIL dataset. The implementation of the discussed CBIR techniques is done in MATLAB. Sample images from both the datasets are show below in figure 2 and figure 3. All these techniques are applied on two types of images that are processed images and unprocessed images. Wang’s dataset consist of all unprocessed images having different background, whereas COIL database consist of processed images having only black background.

**Similarity Measure**

Various similarity comparison distances are used to generate the similarity measures. Some of them are absolute difference, Sorensen and Euclidean distance. For a proposed system Euclidean distance is used as performance evaluation matrix for given algorithms.

The Euclidean distance or Euclidean metric is the ordinary distance between two points that one would measure with a ruler, which is given by using...
Pythagorean formula. Euclidean space becomes a metric space by the use of these formula. Earlier literature refers to the metric as Pythagorean metric. The Euclidean distance between points \( p \) and \( q \) can be defined as the length of the line segment connecting them point \( p \) and \( q \).

**Performance Evaluation Metric**

To check the effectiveness of the proposed CBIR techniques, accuracy is used as statistical comparison parameters. The definitions of these two measures are given by following equations no 1 and 2.

\[
\text{Accuracy} = \frac{(\text{Number of relevant images retrieved})}{(\text{Total number of images retrieved})} \tag{1}
\]

**V. RESULTS AND DISCUSSIONS**

Table I shows accuracy values of all three techniques when they applied on Wang’s coil dataset.

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Five coefficients per tile</th>
<th>Twenty coefficients per tile</th>
<th>Four tiles, Five coefficients per tile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wang</td>
<td>0.6000</td>
<td>0.5134</td>
<td>0.6071</td>
</tr>
<tr>
<td>COIL</td>
<td>0.8900</td>
<td>0.9064</td>
<td>0.9932</td>
</tr>
</tbody>
</table>

It shows that Wang dataset which is an unprocessed dataset the Four tiles, Five coefficients per tile works best with cross over value as 0.6071. Similarly for the processed dataset i.e. COIL dataset Four tiles, five coefficients per tile works best with value as 0.9932.

Figure 4 clearly shows for both standard datasets, Four tiles, five coefficients algorithm supersedes the other two algorithm.

Thus with given three proposed algorithms namely-Five coefficients per tile, twenty coefficients per tile and Four tiles, five coefficients per tile values with best performing COIL dataset are as 0.89, 0.9064, 0.9932 respectively

**VI. CONCLUSION**

In the current era of digital and networking, the content based image retrieval has become very vital because of the numerous applications needing it. The CBIR system mainly focuses on the efficient and effective with accurate retrieval of relevant image from huge corpus of real time databases. The proposed system in the paper presents the performance improvement if image retrieval techniques using Cosine Haar Hybrid Wavelet Transform using higher energy Coefficients with image tiling. The proposed technique is experimented with the help of two standard image datasets. In all three CBIR proposed algorithms are evaluated with similarity measures as Euclidean distance.

With the data set of Wang and COIL best performing algorithm is Four Tiles, Five Coefficients per tile. As in the proposed algorithm higher energy coefficients are extracted and then it has given the tiling effect of discrimination. Thus Cosine-Haar Hybrid Wavelet Transform with tiling effect boosts the performance of Content Based Image Retrieval System

**References**


