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Wavelet Generation and Comparison Technique for Ranking of Relevant Images

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***Abstract* – This Paper represents a traditional Haar Wavelet generation and comparison technique by pair wise averaging of Pixel values of an Image along . While comparing two images we need to first extract the feature vectors of an image. Wavelet is one of the feature representation technique which acts as an identity or signature of an image. For comparing two wavelets, here we describe a Technique that is robust to rotation of image and ranks Images efficiently according to similarity with query image.**

***Keywords* -Wavelet, Feature Vector, Ranking, Signature.**

I. INTRODUCTION

Today, Research in image processing have grown widely in many areas [3]. Many algorithms and Techniques has been developed for processing many aspects of image such as color, shape, size, depth etc [4]. These aspects are generally called as features of an image. For knowing the contents of an image we first need to extract features of an image. Many feature extraction algorithm and techniques are evolved for this purpose. Wavelet is also one of the feature representation

scheme which act as an signature or identity of an image [1]. Wavelets are excellent signal compression schemes [2] ,[5], means features of image are represented in an abstract way. Magical advantage provided by an wavelet is, we can again reconstruct an original image from compressed one. Here in this paper we will first take an overview of wavelet generation mechanism which is already present and then see how to compare this computed wavelet for an effective ranking of relevant images.

II. METHODOLOGY

A .General Overview of System

First we will see general architecture for wavelet generation and comparison. Here in this step before wavelet generation , image is first resized to smaller dimension (say 100*100 pixels). This is done to avoid additional overhead of pixels during wavelet formulation. For instance if take 400*600 size image then number of pixels will be 240000, which is very large amount. Handling such a large volumes of pixel for wavelet

generation requires large amount of time and additional space overhead for storing these pixel.

Next, Compute the wavelet of resized image using Haar wavelet transform [1] and store it into database. Database will contain name of an image and its generated Signature. Database could be a Relational Database System or traditional file system where each file represents individual atomic wavelet of single image. But traditional file system generates update and delete anomalies, hence relational Database should be preferred.

Once we are ready with Database consisting of wavelets, user can now give an image as an Query 'Q', to proposed system. After accepting Query image 'Q' system will first resize the image 'Q' and generates its wavelet as done before for Database images.

In next step system will compare wavelet of Query image 'Q' with wavelets of Database images Say (I). where I={I1,I2,I3,….In}., i.e. 'n' number of images. As mentioned earlier wavelets are robust to Rotation of an image, our comparison algorithm will rank effectively the images even in rotated form.

Ranking Function used here ranks top 'K' images with query image. Where 'K' acts as a threshold or maximum number of output results displayed to the user.

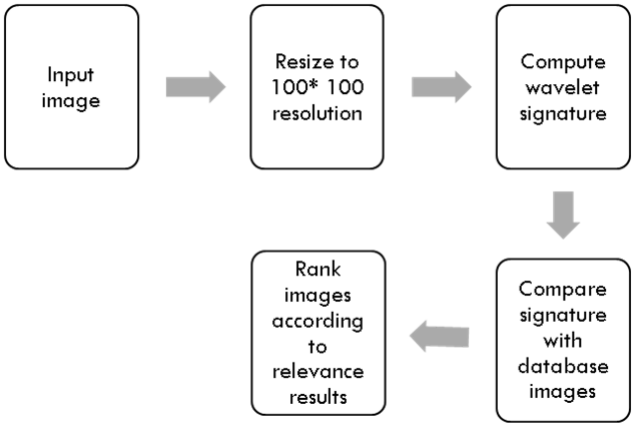

Fig 1. Block Diagram of System.

Above figure gives general idea for working of wavelet computation and its comparison for ranking of relevant images. Note that in second block i.e. resizing image, we have resized query Image 'Q' to 100*100 pixels, its not necessary constraint for this particular resolution.

But, as discussed earlier large image size generates large amount of pixels, handling and storing such large quantity of pixels become time consuming and tedious job. In contrast, image should not be resized to very smaller resolution, as this will trim the useful detailed features of an image.

B. Method for Wavelet Computation

In this sub section we will see method for wavelet computation which is already described in [1].

Suppose we are given with Image 'I' and its pixel into one dimensional array, as I={1,5,4,7,3,…..n} then we compute wavelet as by doing pair wise averaging of pixels. In first iteration wavelet size will get reduced to half as we are doing pair wise averaging, each pair average will result to one value. This first iteration is referred as 'k' th resolution. In next iteration again Pair wise averaging of values are done to produce next 'k-1' th resolution. At this stage size of wavelet is one forth of original wavelet. This process continues until we get an unit average value of all the pixels. Side by side during pair wise averaging process a concept called detailed coefficient is calculated. As we know wavelets are excellent compression scheme, in process of pair wise averaging some information gets lost. Role of detailed coefficient is to save this lost information. In more general way detailed coefficients helps to reconstruct image back into original form.

Example-

Given I=[2,2,5,7]
We obtain wavelet transform (I')=[4,2,0,1].

Resolution	Averages	Detail Coefficient
2	[2,2,5,7]	
1	[2,6]	[0,1]
0	[4]	[2]

Table 1. Calculating wavelet transform [1].

In table 1 Detail Coefficient 0, is obtained by subtracting 2 in resolution 1 from any of number from first pair in resolution 2. i.e. (2-2) = 0. Similarly Detailed Coefficient 1 is obtained as (6-5) = 1.

At last final wavelet is generated as by taking overall average as first number and all Detailed coefficients as remaining number.

Procedure to calculate wavelet

k ← no of pixels in array
count ← k.
while(count>1) do
i←0.
While(i<count/2) do
Average[i] ← (I[2*i]+I[2*i+1])/2;
Difference ←I[2*i]-Average[i];
Count ← count/2
End while
Count ← count/2
End while.

C. Comparison of Wavelets

Given a wavelets of image I1 and wavelet of query image Q as Q'. Then comparison block in fig 1 tries to identify similarity between these two images. This task is accomplished by taking difference between values of corresponding i th location of two wavelets I1 and Q'. Now this difference values can be stored into one array and the we add up all the difference vector to produce single value. This value helps in comparing two images.
For all images in database we calculate this difference vector and image whose difference value is lowest positive number ,that image is more similar to Query image 'Q'. This is because if there is less dissimilarity between images, this means two images are more similar to each other. i.e. less difference, the images are more similar.

Another factor need to be considered for comparison is Average value of wavelet, which is stored into first location of wavelet. If average values of two wavelets are same the that image are similar. The two images might be exactly same or one might be straight one and second in rotated form.

In this way wavelets are robust to Rotation of images because it considers average value.

Image1 Query image Image2



Coeffi cients	Differ ence
20	10
30	10
30	0
25	15
20	10
Add	45

Coeffi cients
10
20
30
10
10

Coeffi cients	Differ ence
60	50
70	50
50	20
10	0
20	10
Add	130

More Relevant Less Relevant

Fig 2 . Comparison of wavelets

In fig 2, we can see that Image1 is more relevant to query image 'Q' than Image2. This is because sum of difference of Image1(45) is less than sum of difference of Image2(130) .

In general way we can write sum of difference as below,

$$Sod = \sum_{i=1}^{k} (Qi - Di) \quad (1)$$

where,

k – number of Detailed coefficients in a wavelet.
Qi- Detailed coefficients of query image.
Di- Detailed coefficients of Database image.
Sod- Sum of Difference.

D. Ranking of Relevant Images.

In above sub section we saw sum of difference is used as a similarity measure to calculate similarity between to images. For ranking purpose we use this same sum of difference value to rank images similar to query image. As we discussed above Image whose sum of difference value is less, that image is more similar to the query image 'Q'.

For ranking purpose we first calculate Sum of difference values between Query image 'Q' and all database images 'I', where I={I1,I2,….In}. Then sort these values into its ascending order sequence. This will give most relevant image at the first and the least relevant at the last. For sorting purpose we can use stable sorting algorithm with O(n log n) complexity.

User may also enter a threshold value, indicating he is interested in top 'K' relevant images. Only top 'K' images are displayed to user.

Procedure for Ranking

Input: Query image wavelet and all database image wavelet.

Output: Ranked images relevant to query image.

Star t:
While (number of images in database) > 0 do
DifferenceArray[]← (Qi – Di)
end while
Sod []← ∑ (Qi – Di)
Sort Sod[] in Ascending order
Stop.

III. CONCLUSION

In this paper we saw wavelet generation and comparison technique. Using Wavelets we have many advantages as they are robust to scaling, translation, and rotation of Image. Also image format is not an constraint for this system. It supports any image format for wavelet generation. Wavelets also supports reconstruction of an image back into the original form.

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