# Four Walsh Transform Sectors Feature Vectors for Image Retrieval from Image Databases

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***Abstract*—The work of this paper presents the new idea of using Walsh transform to generate the feature vector for content based image retrieval. The complex Walsh transform is conceived by multiplying Sal functions by j and combining them with Cal functions of the same sequency. The angle is calculated by taking tan inverse of sal/cal in the range of 0 to 360 degrees which is divided into 4 sectors. The mean of real and imaginary values of these sectors in all three color planes are considered to design the feature vector of 24 components all together. The algorithm proposed here is worked over database of 270 images spread over 11 different classes. The Euclidean distance is used as similarity measure. Average precision and recall is calculated for the performance evaluation. The overall average of cross over points of precision and recall is above 50%.***

***Keywords*— CBIR, Precision, Recall,** **Walsh Transform**

## I. INTRODUCTION

The earliest use of the term content-based image retrieval in the literature seems to have been by Kato, to describe his experiments into automatic retrieval of images from a database by color, texture and shape features. The term has since been widely used to describe the process of retrieving desired images from a large collection on the basis of features (such as colors, texture and shape) that can be automatically extracted from the images themselves. The typical CBIR system [1-6] performs two major tasks. The first one is feature extraction (FE), where a set of features, called image signature or feature vector, is generated to accurately represent the content of each image in the database. A feature vector is much smaller in size than the original image, typically of the order of hundreds of elements (rather than millions). The second task is similarity measurement (SM), where a distance between the query image and each image in the database using their signatures is computed so that the top ―closest images can be retrieved.[7-9]

## II.SIMILARITY MEASURES

Many Current Retrieval systems take a simple approach by using typically norm-based distances (e.g., Euclidean distance) [10-17] on the extracted feature set as a similarity function. The main premise behind these CBIR systems is that given a good set of features extracted from the images in the database (the ones that significantly capture the content of images.) then for two images to be ―similar their extracted features have to be close to each other.

## III. ALGORITHM

The proposed algorithm makes novel use of Walsh transform to design the sectors to generate the feature vectors for the purpose of search and retrieval of database images.The complex Walsh transform is conceived by multiplying all sal functions by j and combining them with real cal functions of the same sequency.Thus it is possible to calculate the angle by taking tan inverse of sal/cal. Thus we get the angle in the range of 0-360 degrees. Following are the steps followed to separate these points into four quadrants of the complex plane.

The Walsh transform of the color image is calculated in all three R, G and B planes. The complex rows representing sal components of the image and the real rows representing cal components are checked for the sign change according to the quadrants lying in. The sal and cal walsh values are assigned to each quadrant. The logic is as follows:

| Sign of Sal | Sign of Cal | Quadrant Assigned |
|---|---|---|
| + | + | I (0 – 90 Degrees) |
| + | - | II ( 90 – 180 Degrees) |
| - | - | III ( 180- 270 Degrees) |
| - | + | IV ( 270 – 360 Degrees) |

The mean of sal and cal values lying in the sectors in the range 0-90 , 90-180,180-270 & 270-360 degrees are taken as individual components to generate the feature vector of dimension 24 considering three R,G,B Planes. Euclidean distance measure is used to check the closeness of the query image from the database image and precision recall are calculated to measure the overall performance of the algorithm

## IV. RESULTS AND DISCUSSION

The sample Images of the database of 270 images of 11 different classes such as Flower, Sunset, Barbie, Tribal, Puppy, Cartoon, Elephant, Dianasour, Bus, Parrots, Scenary is shown in the Fig 1

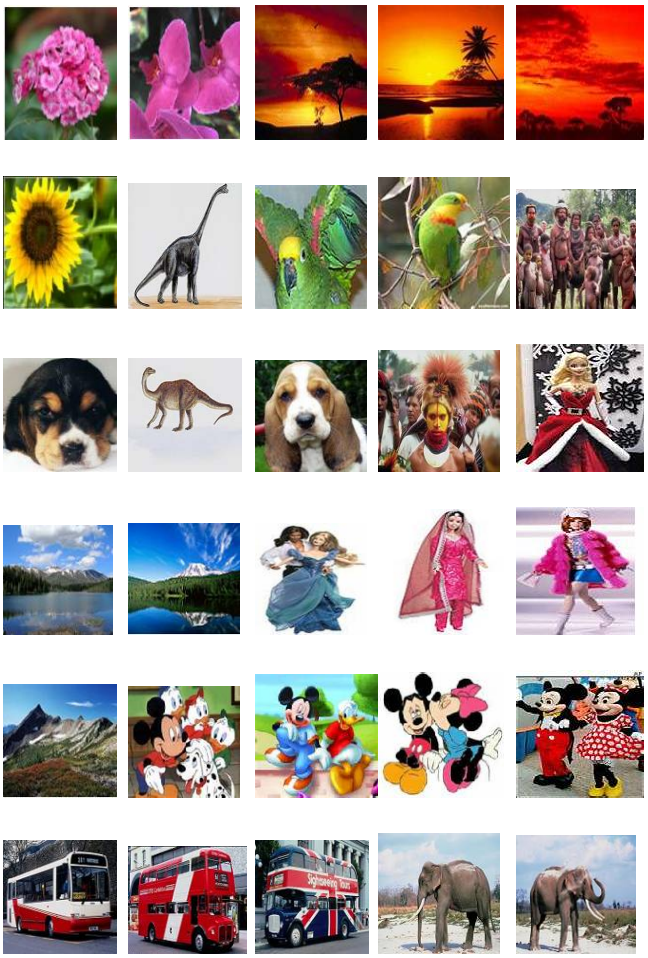

Fig. 1 Sample Image Database

Once the feature vector is generated for all images in the database a feature database is created. A query image of each class is produced to search the database. The image with exact match gives minimum Euclidean distance. To check the effectiveness of the work and its performance with respect to retrieval of the images we have calculated the precision and recall as given in Equations (1) & (2) below:

$$\text{Precision} = \frac{\text{Number of relevant images retrieved}}{\text{Total Number of images retrieved}} \quad (1)$$

$$\text{Recall} = \frac{\text{Number of Relevant images retrieved}}{\text{Total number of relevant images in database}} \quad (2)$$

Fig. 2 : Query Image (Bus)

Fig 3. Images Retrieved against the Query Image Shown in Fig. 2.

The Bus image shown in the Fig. 2 is taken as the query Image to search the given image database. The algorithm proposed to design the feature vector for each image in

database and the query image to search the database produces the good result as it can be easily seen in the Fig. 3 where first 19 images retrieved are of same class. There is only one image of Tribal class among first 20 images retrieved. Average Precision and Average Recall Performance of these retrieved images is shown in the Fig 4.The following graphs Fig.4 – Fig.8 show average precision and average recall of 5 randomly selected images of Bus, Dinosaur, Elephant, Sunset and Barbie classes plotted against the numbers of images retrieved. The overall average precision and recall graph is shown in Fig.9

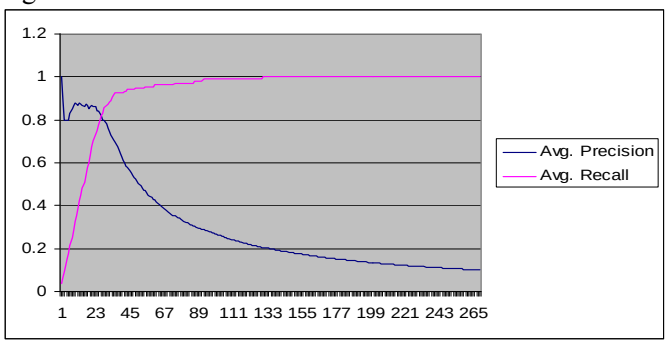


Fig 4. Average Precision and Recall performance for Bus class of image

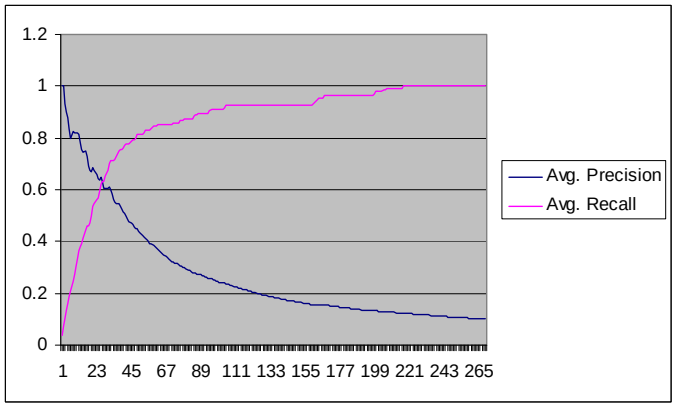


Fig 5 Average Precision and Recall performance for Dianasaur class ofImage

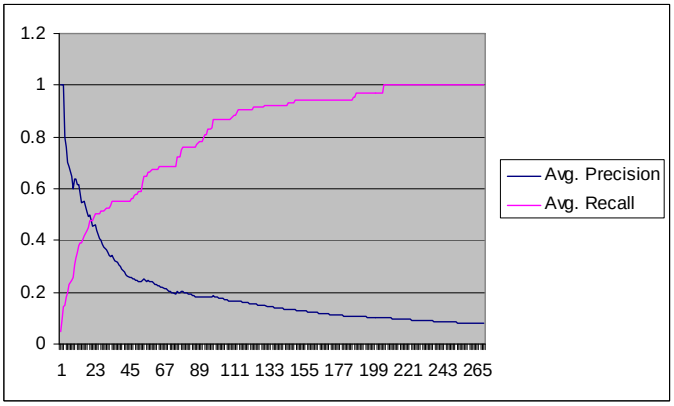


Fig 6 Average Precision and Recall performance for Elephant class of images

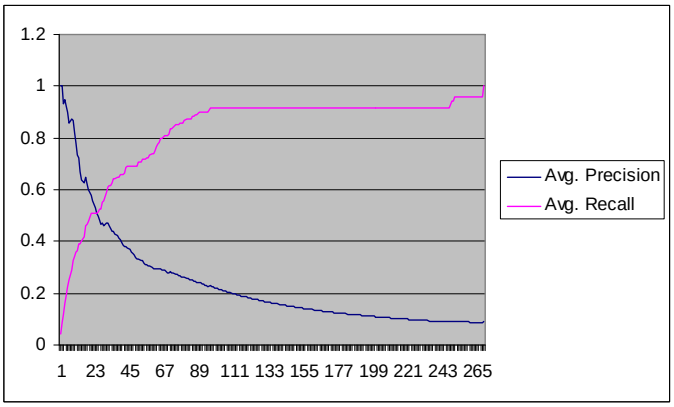


Fig 7 Precision and Recall Performance for Sunset class of images.

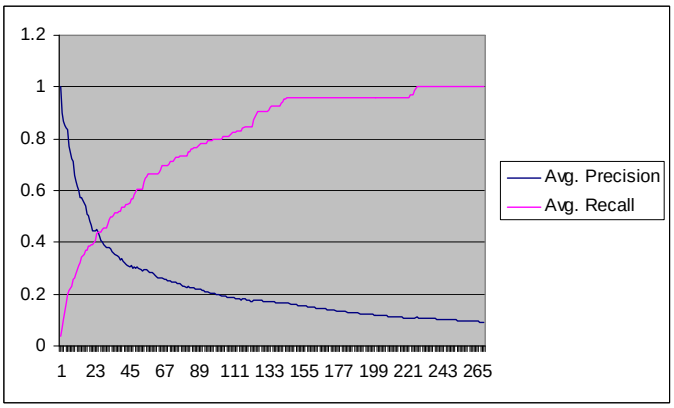


Fig 8 Precision and Recall Performance for Barbie class of images.

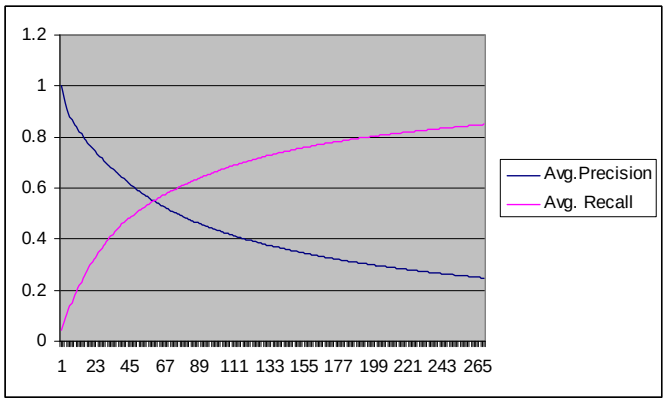


Fig 9 Overall Average Precision and Recall Performance for Average Precision and Recall of all classes of images.

## V.CONCLUSION

The Innovative idea of using complex Walsh transform sectors of the images to generate the feature vectors for the purpose of image search and retrieval i.e. content based image retrieval is proposed. The proposed algorithm was experimented on a database of 270 images having 11 different classes. The average precision and recall cross over points are plotted as shown in Fig. 4-8. The average crossover precision and recall of 5 images of each class shows the good retrieval rate well above 50%.The overall average precision and recall performance of each class gives good outcome of cross over of precision and recall well above 50% as shown in Fig. 9. It may be noted that the buses of drastically different color as compared to the query image are also retrieved indicating that these Walsh functions are sensitive to shape, which was not possible when FFT sectors[8-10] were considered.

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