

## **An Innovative Approach of Retrieval of People Images**

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### **Abstract**

This paper proposed a novel Region Based Retrieval approach to retrieve the relevant image for the query image apart from different postures and angles of humans. Content Based Image Retrieval (CBIR) is one of the most popular technique that is employed to access and compare the images of people in terms of Color and Texture features. The CBIR is applied on the images like Humans, Vehicles, Medical Images, Living Animals etc. that are too complex in nature. This has been motivated for the development of the proposed Region Based Retrieval Method (RBRM) matching approach that comprises of three consecutive steps. They are: Initially, an image is divided into three parts i.e. head, trunk and leg regions. Then color, texture and shape descriptors for each sub images are calculated and finally, the distance between query and database images are estimated using similarity measure. The proposed RBRM methodology is experimented on the images of humans using the modified Optimal Cost Region Matching (OCRM) similarity measure to find the most relevant image similar to the query image.

**Keywords:** *CBIR, Region Based Retrieval, Similarity Measure, OCRM*

### **1 Introduction**

With the recent advent of powerful computer hardware, one can now imagine the emergence of sophisticated and intelligent inspection systems connected in a network as computing nodes that share the same database, each connected to a camera. These systems need a person to keep track of cameras to view the same person with non-overlapping fields. In this context, CBIR [1, 2, 3] is preferable and popular to access and compare images of people in terms of Color and Texture features.

Some of the images like people images, vehicles, medical images, living animals etc., are too complex in nature as they show different image content and attributes in different parts of the image [4,5]. The image retrieval measures these types of images that are complex in nature. In order to address this problem, a novel methodology

is proposed to obtain the best relevant image by dividing the images into regions or sub images based on the attributes and content of the image. A region based matching technique is adopted for an efficient retrieval. Different regions of the image can have different similarity measure[6,19,20]. In this paper, an innovative Region Based Retrieval Method (RBRM) for retrieving similar images of people over different poses is proposed. The RBRM is experimented on the images of people using modified OCRM[6] similarity measure for finding the most relevant image which is similar to query image.

A brief introduction is given on the CBIR and the motivation for the proposed approach in this section. Section 2 discusses briefly the steps involved in the proposed methodology i.e., Region Based Retrieval Method. The Novel Matching Scheme of the proposed methodology is given in section 3. The Experimental results and its analysis discussed in section 4. Finally section 5 concludes the proposed approach with reduced complexity for retrieving the relevant image.

## 2 Region Based Retrieval Method (RBRM)

In the RBRM approach the people image is divided into three regions as head, trunk and legs. The upper part of the image (head) refers to the upper 15% of the image's height. The lower part (legs) refers to the lower 35% of the image's height. The middle part (trunk and hands), corresponds to the remaining area (50%) of the image. Each region is quantized to 166 bins[12,13]. Then, Color Feature Vector is extracted from each region of the people image. Similarly texture Feature Vectors are extracted using Haar wavelet transformation which represents the texture features. The modified OCRM similarity distance is used to calculate the distance between the query image and database sub images. Thus best image which is similar to the query image is retrieved.

### 2.1 Colour Feature Extraction

RBRM defines the dominant color feature vector which takes into account for the significant colors of the region. The feature vector is based on the observation that a small number of colors are usually sufficient to characterize the color information in an image region [7,12,13]. The feature vector used a perceptual color quantization algorithm [12,13,14,15] to obtain a small selection of colors for each region. The present study used a fixed quantification of the HSV space keeping in mind that RBRM is aiming for real-time execution. HSV allows a color analysis according to its natural components: hue, saturation and brightness. A non-linear non-separable quantizer with 166 bins is used (18 hues  $\times$  3 saturations  $\times$  3 values + 4 grays = 166 colors) in the present study for all images as given in equation 1 and 2 [12,13].

$$q = \begin{cases} 0 & \text{if } v \leq 0.1 \\ g(h, s, v) & \text{if } s < 0.1 \text{ and } v > 0.1 \\ f(h, s, v) & \text{otherwise} \end{cases} \quad (1)$$

$$g(h,s,v) = \begin{cases} 1 & \text{if } s < 0.1 \text{ and } 0.1 < v \leq 0.4 \\ 2 & \text{if } s < 0.1 \text{ and } 0.4 < v \leq 0.7 \\ 3 & \text{if } s < 0.1 \text{ and } 0.7 < v \leq 1.0 \end{cases} \quad (2)$$

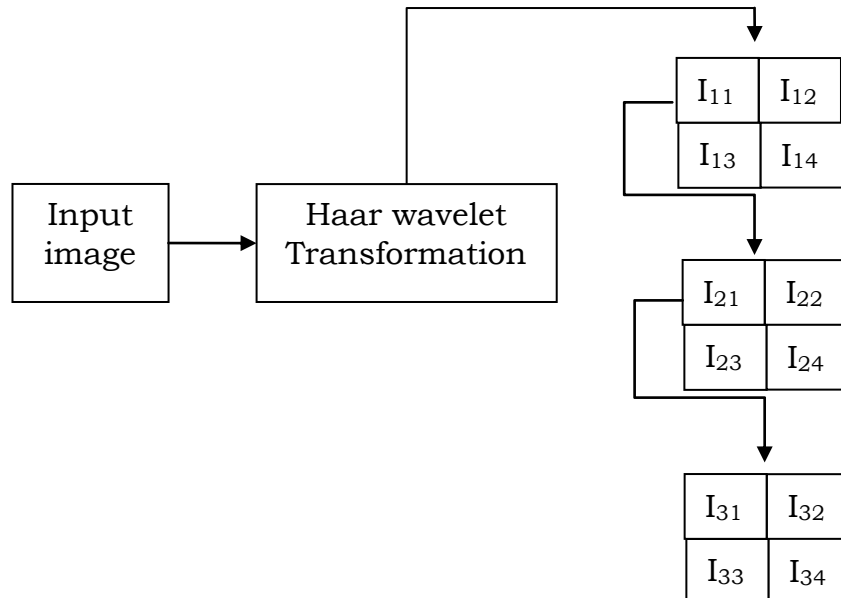
After the quantization step with the present approach, a small number of colors i.e. 166 bins will remain. The normalized color histogram is calculated on 166 bins. The resulting histogram bins are now related to the percentage of a color for a region. In this case, a color is considered as dominant if it covers more than five percent (5%) of the region area. The Feature color Vector  $F_{Cj}$  is then formed by the dominant pairs of color and percentage as shown in equation 3.

$$F_{Cj} = \{\{c_i, p_i\}, i = 1, \dots, N, p_i \in [0,1]\} \quad (3)$$

Where  $F_{Cj}$  is the feature color vector for region  $j$ ,  $N$  is the number of dominant colors of the region,  $c_i$  is color and  $p_i$  is percentage of  $i^{\text{th}}$  bin.

## 2.2 Texture Feature Extraction

In the next step, the RBRM approach extracts the texture features using wavelet transformation [8,16,17,18,21] for each and every region in the image. Wavelets are useful for hierarchically decomposing functions in a way that are both efficient and theoretically sound. The present study computes feature vectors using Haar wavelets because they are the fastest to compute and have been found to perform well in practice. The procedure for computing the wavelet transform  $W$  for a  $w \times w$  image  $I$  using non-standard decomposition [16] is illustrated in the algorithm 1. The present study used 2D Haar wavelet transform at third level as shown in Fig. 1 to obtain 10 sub images from the input image. The texture feature vectors are evaluated for all 10 decomposed sub images as given in algorithm 1.



**Figure 1:** The features (signatures) of sub image

The texture feature of RBRM approach  $f_r$  of the sub image is evaluated based on the equation 4 where  $C_{ij}$  is the representation of the intensity value of all elements of sub image of size  $i \times j$ .

$$f_r = \sqrt{\frac{\sum C_{ij}^2}{i \times j}} \quad (4)$$

### Algorithm 1 : Extraction of Texture Features using RBRM

#### Begin

1. Let  $j$  be the number of regions of the image.
2. Let  $I$  be the image of size  $w \times w$ .
3. Divide the image  $I$  into four bands  $I_1, I_2, I_3, I_4$  based on Haar wavelet of size  $w/2 \times w/2$ .
4. Compute texture feature vector for  $I_2, I_3$  and  $I_4$ .
5. Take the image  $I_1$  and divide it into 4 bands namely  $I_{11}, I_{12}, I_{13}, I_{14}$  of size  $w/4 \times w/4$ .
6. Compute texture feature vector  $f_{ij}$  for  $I_{12}, I_{13}, I_{14}$  wavelet sub image where  $t$  is  $I_{12}, I_{13}$  and  $I_{14}$ .
7. Take the  $I_{11}$  and divide it into 4 bands namely  $I_{111}, I_{112}, I_{113}, I_{114}$  of size  $w/8 \times w/8$ .
8. Compute texture feature vector  $f_{ij}$  for  $I_{111}, I_{112}, I_{113}, I_{114}$  wavelet sub images where  $t$  is  $I_{111}, I_{112}, I_{113}$ , and  $I_{114}$ .
9. Represent Signatures of Steps 3, 5 and 7 in the form as represented in equation 4.

#### End

Based on texture feature  $f_r$ , the present study evaluates the texture feature vector  $f_{ij}$  for each of the region  $j$  (head, trunk and leg) of the wavelet sub image  $t$  where  $t$  ranges from 1 to 10.

### 2.3 Similarity Measure

The similarity measure modified OCRM [6,19,20] is applied on the proposed RBRM approach as to compare the query image with database images. The principle of the modified OCRM similarity measure is the computation of the distance between the extracted colour and texture features of the query image with those of the images in the database. Once all the distances are computed, the algorithm ranks the images of the database from the nearest to the farthest depending on the query image.

### 3 Novel Matching Scheme of RBRM Approach

One of the important features of the proposed RBRM scheme is, it divides the people image into three regions. Based on the weights of these three regions, a novel comparison scheme between query image and database (target) image is adopted.

Each image is divided into three regions and each region is divided into ten wavelet based sub images.

The novel RBRM matching scheme matches texture features and color features of the query and database images. Initially it matches the head region and retrieves the ten relevant images. From these ten relevant images of database, the leg region of the query image is compared and nearest four images are obtained. From the four images of database, texture feature and color feature of the trunk query region is compared and the most relevant image is returned. This entire scheme is given in algorithm 2.

### Algorithm 2: RBRM Approach between Query and Database image

#### Begin

1. Divide the query image into three regions such as Head (H), Trunk (T) and Leg (L). Depending on the part they should derive the color and texture features
 
$$F_{cj} = \{\{c_i, p_i\}, i = 1, \dots, 166, p_i \in [0,1]\}$$

$$F_{tj} = \{\{w_i\}, i = 1, \dots, 10, \}$$
 Where j represents Head, Trunk and Leg parts
2. Extract color features for the Head part of the query image as given in equation 3.
3. Extract texture features for the Head part of the query image as given in equation 4.
4. Compare the similarity measures for the step 2 and 3 using modified OCRM approach and extract top ten images from the people database as specified below.
 
$$D_{OHC}(Q_H, T_H) = d_c(F_{ch}(Q), F_{ch}(T))$$

$$D_{OHT}(Q_H, T_H) = d_T(F_{th}(Q), F_{th}(T))$$

$$S_H(Q_H, T_H) = \alpha \cdot D_{OHC}(Q_H, T_H) + (1-\alpha) D_{OHT}(Q_H, T_H)$$
5. Extract color and texture features of the Leg region of query image and compare them with the extracted (output) ten people images leg region obtained from step 4.
 
$$D_{OLC}(Q_L, T_L) = d_c(F_{cl}(Q), F_{cl}(T))$$

$$D_{OLT}(Q_L, T_L) = d_T(F_{tl}(Q), F_{tl}(T))$$

$$S_L(Q_L, T_L) = \alpha \cdot D_{OLC}(Q_L, T_L) + (1-\alpha) D_{OLT}(Q_L, T_L)$$
6. Extract color and texture features of the Trunk region of query image and compare them with the extracted (output) four people images Trunk region obtained from step 5.
 
$$D_{OTC}(Q_T, T_T) = d_c(F_{ct}(Q), F_{ct}(T))$$

$$D_{OTT}(Q_T, T_T) = d_T(F_{tt}(Q), F_{tt}(T))$$

$$S_T(Q_T, T_T) = \alpha \cdot D_{OTC}(Q_T, T_T) + (1-\alpha) D_{OTT}(Q_T, T_T)$$
7. The best one is identified which is similar to the query image.

#### END

Here  $\alpha$  represents the relative importance of the two feature vectors. Here the parameter  $\alpha$  is 0.7.

### Experimental Results and Analysis

The efficiency of the proposed RBRM matching approach is tested on the people database of 1000 images that are collected from Google, FGnet database and 174 images of graduate computer science engineering students, of Gudlavalleru Engineering College, affiliated to JNT University Kakinada, INDIA, with the assistance of Digital Camera. The Fig. 2 shows some of the images of GEC students. The results of the proposed scheme are discussed for images #1148 and #1153.

Based on the algorithm 2, the result of the ten retrieved relevant images of the head region for the query image #1148 are shown in Fig. 3. The Fig. 4 shows the relevant images that are obtained by comparing the leg regions of the query image with the leg regions of the image retrieved as shown in Fig. 3. The image in Fig. 5 is the best relevant retrieved image obtained by comparing the trunk region of the query image with the trunk regions of the images retrieved as shown in Fig. 4. The Fig. 6, 7 and 8 shows the top ten, four and final retrieved images for the query image #1153 based on algorithm 2.

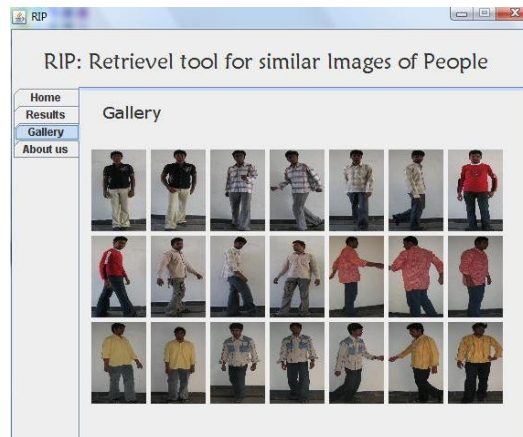


Figure 2: The gallery of sample images of image database

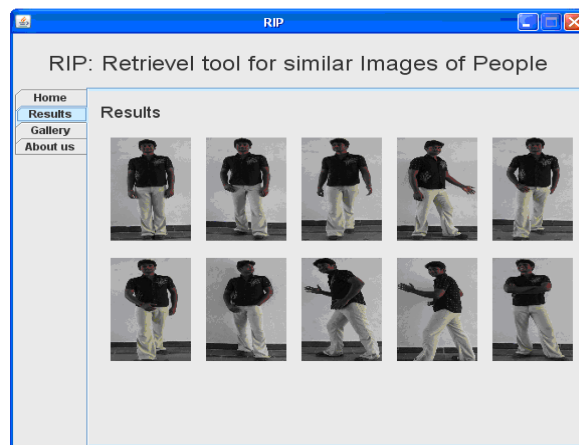
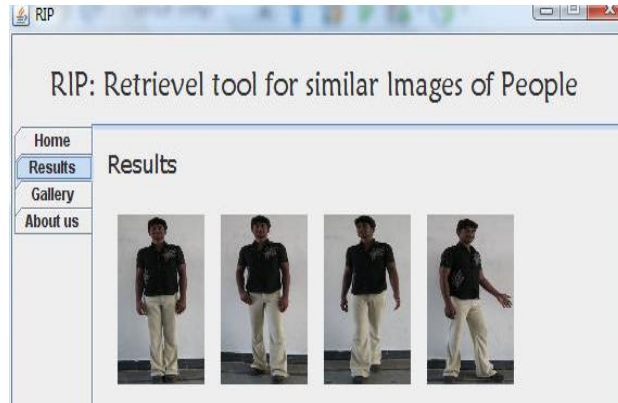
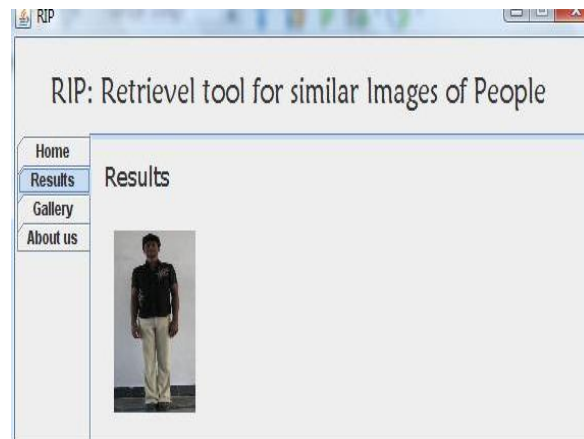


Figure 3: The results of the ten retrieved relevant images for query image #1148



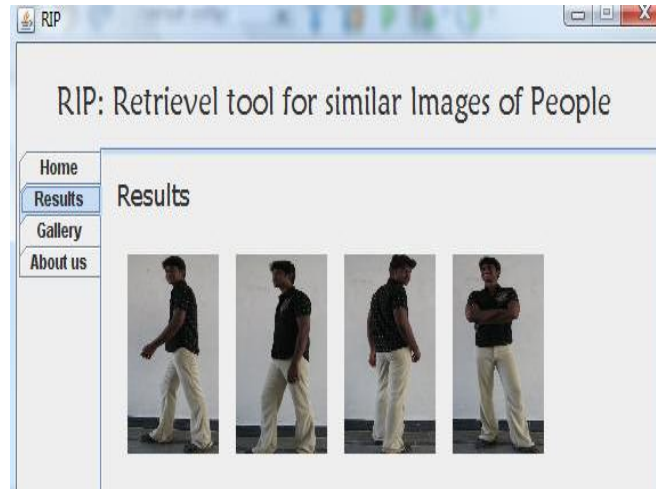
**Figure 4:** The results of the four retrieved relevant images for query image #1148 obtained from Fig.4



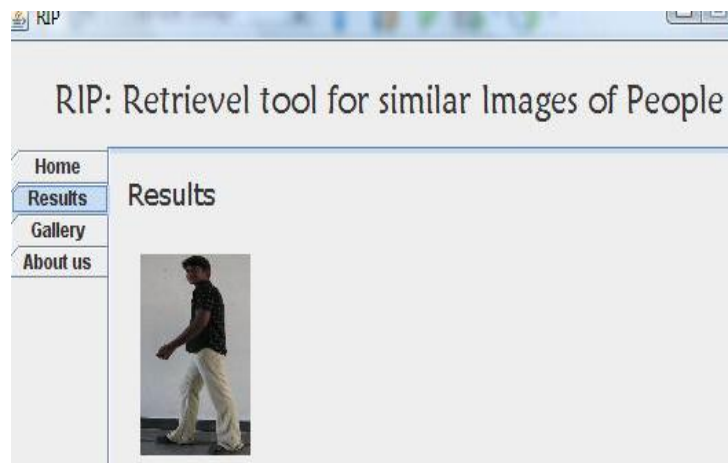
**Figure 5:** The results of the best relevant image for query image #1148 obtained from Fig. 4



**Figure 6:** The results of the ten retrieved relevant images for query image #1153



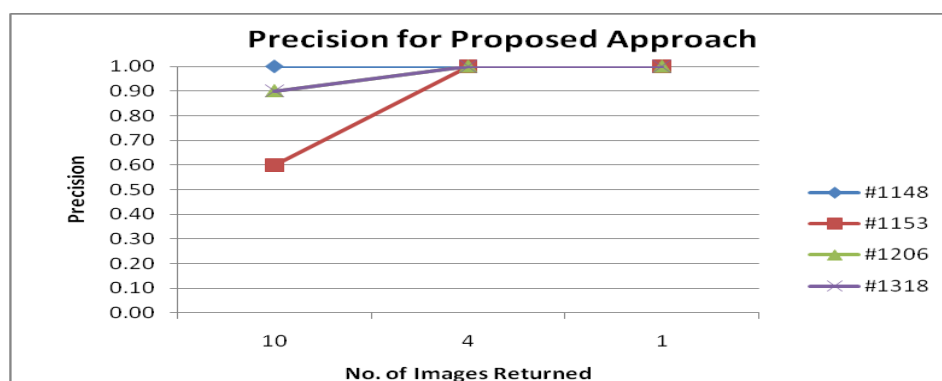
**Figure 7:** The results of the four retrieved relevant images for query image #1153 obtained from Fig. 6



**Figure 8:** The results of the best relevant image for query image #1153 obtained from Fig. 7

**Table 1:** Retrieved relevant images for TOP 10, 4 and 1 for various images

for top	Image #1148	Image #1153
10	10	6
4	4	4
1	1	1



**Figure 9:** The precision for the retrieved relevant images for various query images #1148 and #1153.

Thus, from the retrieved relevant image for the given query images, it is clearly evident that the proposed RBRM matching approach initially retrieves the relevant 10 images from the complete image database by only comparing the head regions. Then, top 4 images are retrieved by only comparing the leg regions of the query image with already obtained 10 relevant images. Finally, the best relevant image is retrieved by comparing the trunk regions of the query image with the secondly retrieved 4 images. The obtained results for all the query image and its associated regions are tabulated in Table 1. Fig. 9 represents the graph for the precision rate Vs No. of images retrieved based on Table 1. Thus, it is observed that the novelty of the RBRM approach is attained by achieving 100% precision rate.

## Conclusions

The Region Based Retrieval Methodology (RBRM) is an approach that is employed to retrieve most relevant images from large databases. The color, texture and shape descriptors of every sub images are considered and used for the matching purpose. The novel matching scheme introduced in the proposed Methodology eliminates the overall complexity of the system by partitioning the query image region wise and comparing it with the database images. The experimental results of the Proposed approach proved that the precision rate obtained is 100% accurate even with database of human with different angles and positions. This methodology is also transformation invariant.

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