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A Novel Method For CBIR Using ACO-SVM With DTCWT And Color Features

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Abstract

Content Based Image Retrieval (CBIR) has been the major thing for looking associated content material on the net in the form of pictures, knowledge and so on. A retrieval approach which organization color and texture feature is future in this paper. In this research, implement a new technique for CBIR by ant colony optimization (ACO) and Support vector machine (SVM) with dual tree complex wavelet transform (DTCWT) and color features.In this work, has been used color or texture features for CBIR. In the increase of feature extraction, firstly extract texture feature using DTCWT for resolving the problematic of redundant CWT. After that, extract color feature using dominant color descriptor (DCD) on RGB and HSV color space for improving computation and efficiency. The experimental dataset contain 1000 images including horses, elephants, food, African people, etc. The equal dimension is calculated using weighted Euclidean distance (WED). For improving effectiveness of the system, used ACO for the greatest result and classify data using SVM. The performance analysis is based on precision and F-measure.

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Keywords: DTCWT,DCD, Color Statistics, Color Histogram, ACO, SVM.;

1. Introduction:

With the progress of the visual and multimedia applications and the increase of image data, the query founded image retrieval is becoming a challenging problem. This growth is contributed by the various sophisticated low cost hardware and easily available image editing software of the recent info detonation era, result in gin ease of production, storing and involvement of multimedia content material. In the early 1990s therefore of fast progress in

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net, enormous quantity of digital pictures created in means of technical, educational, scientific, manufacturing and different services are on hand to patrons [1].

CBIR extracts the features from pictures and uses them to file pictures, such as color feature, texture feature and shape feature.Searching or retrieving the connected pictures via querying photo's content is obliging to the usage of image database. CBIR is the improvement to searching and retrieving pictures from a record on the foundation of points which can be eliminated from the image themselves. CBIR algorithm contains two levels (1) feature extraction and (2) similarity measure. Features are extracted from entire image database and the feature vectors are stored. Making use of some similarity measure, these saved feature vectors are then matched with the function vectors of query photograph. The minimum distance (closest pics) outcome within the assessment are then retrieved. The system of CBIR [2] is showed in Fig. 1 listed here, DWT decomposition is permitted out for calculating the operate vectors[3].

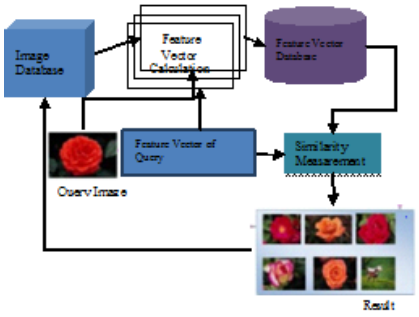


Fig. 1. Content based retrieval system

2. DTCWT

Though the conventional DWT technique is popular in various image applications, it is very complex to shift the input signal. The vigour of the wavelet coefficient vary vastly as the enter sign is shifted. To beat this situation the redundant CWT designed through Kings Bury is called DTCWT [4]-[5]. The DT-CWT decomposes a sign in phrases of the problematic shifted and dilated mother wavelet and it has been located to be peculiarly suitable for image decomposition and representation. DTCWT employs complex valued wavelet and scaling perform and they're given by way of

$$\varphi(t) = \varphi_r + \varphi_i(t) \quad (1)$$

$$\emptyset(t) = \emptyset_r + \emptyset_i(t) \quad (2)$$

where suffices r and i represent the real and imagined portions of the difficult wavelet functions and they Hilbert transform pair to each other

The formation of 1D dual-tree future by Kingsbury is presented in Fig.2. Within the new implement of DTCWT, there are 2units of filters used, 1 set of filters at stage 1 and the other set of filters in any respect larger phases. The filters past stage 1 have even size however at the moment are not strictly linear section and have a bunch extend of approximately 1/4. The compulsory prolong amendment of half of sample is completed by making use of the point in time turn around of the tree and filters in tree b. For this purpose DTCWT employs two actual DWTs, and complicated coefficients best show up when the two bushes are mixed [6]. Addition of the one dimensional DT-CWT to 2 dimensional are accredited out through independent filtering alongside rows and columns. If column or row filters each suppress terrible frequencies, nearest the 1st quadrant of the 2nd sign range is reserved [15]. The C-DT-DWT has twice as many wavelets as that of R-DTDWT. This provides 4:1 redundancy within the converted 2D signal. Given that tricky filters are able to take apart every one ingredient the 2nd occurrence gap, they provide real directional selectivity. The real and imaginary components of each complicated wavelet are leaning on the same approach, and the magnitude of each complex wavelet is an roughly circular bell-shaped operate. A suite of 6 elaborate wavelets will also be shaped by means of utilising wavelets as the real constituents and wavelets as the imaginary ingredients [7].

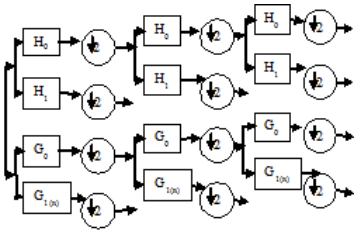


Fig 2: Dual-Tree Real data generating real and imaginary part of CWT.

3. Color Feature

Color features are the most intuitive and most dominant low-level image features which are very stable and robust in comparison with other image features such as texture and shape. Since, these features are not sensitive to rotation, translation and scale changes, they could be applicable for CBIR systems. In this work we have used the following color-based features.

i)Dominant Color Descriptor: DCD [8] grants a compressed clarification of the consultant colors in an image or image area. The fundamental target utility of similarity retrieval in enormous picture database, DCD extracts the aspects from an picture through using clustering the colors in an picture into a little wide variety of colors and is clear as

$$F = \{(c_i, p_i v_i), s\}. (i = 1 \dots N) \quad (3)$$

The descriptor includes the defined colors ci, their fractions pi , The now not required color alterations for each and every DC vi, and the optionally available spatial coherency s of DC The gap D2 (F1, F2) among the 2 descriptor can be computed as:

$$D^2(F1, F2) = \sum_{i=1}^{Ni} P_{li}{}^2 - \sum_{j=1}^{N2} P_{2i}{}^2 - \sum_{i=1}^{N1}\sum_{j=1}^{N2} 2a_{i,j}P_{1i}, P_{2j} \quad (4)$$

$$a_{i,j} = \left\{1 - \frac{||c_{1j} - c_{2j}||}{\alpha T||c_{1j} - c_{2j}||} < T_d \left|\left|c_{1j} - c_{2j}\right|\right| > T_d 0\right\} \quad (5)$$

where F1 = {{c1i, p1i}, i=1,..., N1} and F2 ={{c2i, p2i}, i=1,...,N2} are 2 DCD descriptors through N1 or N2 DC, separately. The DC and its percent value are signified by the aid of ci and pi. The addition of percentage is normalized to 1. The match coefficient, ai,j, is used to don't forget the nearness among the 2 DC c1i and c2j. Td is a threshold for picking out the assessment among 2 colors and α is used for adjusting the importance of color space.

a)*Color statistic features:*Usually images are used in the literature in both RGB or HSV space since these spaces are in bisection with one another. For each image, as the simplest statistic features, the 1st order (mean, denoted my M) and the 2nd order (SD, denoted by STD) are color data with respect to R, G, B, H, S and V channels and gray level image.As a result, fourteen features are generated per image.

*b)Color histogram features:*The histogram is a graph which shows to numeral of color values lessening in a number of decree ranges or bins. From image histogram, a set of features could be extracted which are named as color histogram features [8]. For each color channel such as R, G, B, H, S and V a color histogram graph is drawn with respect to bin size B (the number of intervals orr ange resolutions.

4. Similarity Measurement

Once features are removed, from the entire experimental images and the question picture, the match dimension turns into the important difficulty in CBIR. Similarity dimension is the approach of discovery the dissimilarity or correspondence among the many file portraits and the query picture by their aspects. The record image file is then arranged according to the climbing order of space to the query picture and photographs are retrieved from the record in line with that order. There are really quite a few techniques of calculating this distance, such on the grounds that the Minkowski-kind distance, quadratic kind distance[9,10,11] Mahalanobis distance, Kullback-Leibler divergence,

and Jeffrey-Divergence [12].

5. Ant Colony Optimization(ACO)

ACO is a population recognized meta experiential method which is prompted with the aid of the performance of ants. It is used to discover answers for quite a lot of optimization issues. In ACO, Artificial ants incrementally construct an answer via adding components to a partial resolution underneath development [13], [14]. The problem of function choice may also be specified as follows: specified to customary set, F, of n facets, locate subset S, which includes m aspects (m<n,S∈F), such that the organization accurateness is maximize. Within the 1st iteration of ACO, every ant will arbitrarily decide upon a function separation of m elements. Most effective the first-rate k-best subsets, k < na, Perhaps used to replace the pheromone trial and have an result on the characteristic subsets of the subsequent new release. Within the 2nd following iterations, every ant will begin with m - p facets which can be arbitrarily select from the beforehand chosen k-excellent subsets, the place p is an integer that levels among 1 and m-1. On this manner, the elements that represent the high-quality k subsets could have further threat to be show within the subsets of the following new release. For a given ant j, these points are people who accumulate the satisfactory compromise among pheromone trails and nearby value with admire to Sj, the place Sj is the subset that entails the points which have prior been chosen by way of ant j. The USM is used for this motive is printed as:

$$USM^{sj}{}_i = \{\frac{(\tau_i)^{\eta}(LI_i{}^{sj})^{\alpha}}{\sum_{g\&s_j}(\tau_g)^{\eta}(LI_g{}^{sj})^{\alpha}} \qquad \text{If I } \not\subset \text{ S}_{\text{j}}$$

where, LI_i^{sj} is the local significance of feature f_i given the subset S_j . The parameters η and α manage the outcome of pheromone path strength and neighbourhood feature value respectively. LI_i^{sj} is measured with the aid of the MIEF measure and define as

$$LI_i^{sj} = I(C, f_i) * \left[\frac{2}{1+\exp(-\alpha D_i^{sj})} - 1\right] \qquad (6)$$

Where

$$D_i^{sj} = \min\left[\frac{H(f_i) - (f_i, f_s)}{H(f_i)}\right] * \frac{1}{|s_j|}\sum_{f_i es_j}\left[\beta\left(\frac{I(C,\{f_i,f_s\})}{I(C,f_i)+I(C,f_s)}\right)^{\gamma}\right]$$

The factorsγ,β,α are constants, H(f) is the entropy of f_i , $f_i, I(f_i, f_s)$ is the relate statistics amongst f_i and fs , I(C,fi) is the joint knowledge among the many class labels or fi and $|S_j|$ is the predominant of sj.

6. Proposed Work

1. Consider color query image ‘I’ as an N X M size of an image.
2. Consider color query image ‘I’ as an N X M size of an image.
3. Firstly query image is decomposed using one level DTCWT. There are two approximations and six wavelet parameters are founded. Assign 4 threshold values for real and imaginary parts. It is estimated using:

$$T_{real} = 0.001 \times \sqrt{c_{r1}^2 + c_{r2}^2 + \cdots c_{rn}^2}$$

$$T_{imag} = 0.001 \times \sqrt{c_{i1}^2 + c_{i2}^2 + \cdots c_{in}^2}$$

   where c_r and c_i represents real and imaginary constituents of the approximation coefficients at the first level respectively.
4. Apply DCD, every color is partitioned into a set of partitions it is also known as coarse partition. DCD is applied on HSV and RGB color space.
5. The first order (imply, denoted my M) and the second order (ordinary deviation, denoted through way of STD) are colour files with respect to R, G, B, H, S and V channels and gray level image.
6. Apply HSV Histogram by transfer 8 levels each to hue, saturation and value provide a quantized HSV gap with 8x8x8=512 histogram bins.

7. Follow RGB Histogram by assigning 8 levels each to red, green and blue give a quantized RGB space with 8x8x8=512 histogram bins.
8. Initial Stage: Take population size, maximum number of iteration, node assignment and random initialization for nodes pheromone.
9. Obtain the new population of ants.
10. Mark the random feature to every ant and mark that 'visited' function.
11. Repeat step 8-10 until all ant is visited
12. If the ant is 'non visited' feature then select the highest probability feature which is determined using below equation and assign the 'visited ' feature

$$P_t^k(t) = \begin{cases} \dfrac{|\tau_i(t)|^Y |\eta_i|^\delta}{\sum_{u \epsilon jk} |\tau_u(t)|^Y |\eta_u|^\delta} & if\ i \epsilon j^k \\ 0 & otherwise \end{cases}$$

Where $\gamma$and $\delta$are pheromone value and the heuristic expertise weights respectively, $J^k$is the set of non-visited facets and $\tau_i\ (t)$and η_iIs The Pheromone worth or experiential popularity related to function I respectively

13. Repeat 11 except the ant attain to its threshold as following:

$$Ant\_Threshold = \varphi * exp - \frac{FN}{N + \omega * exp^{Accuracy}}$$

Where FN denotes the chosen characteristic cardinality making use of the ant thus far, N characterize the total elements, φ and ω are the variables that control the outcome of feature dimension.

14. Calculate feature pheromone deposited by ants as following:

$$\Delta Pheromone(i,k) = \alpha.Accuracy_k + \beta.\left(\frac{Features\ Number - Features\ Number(k)}{Features\ Number}\right)$$

The place $\Delta pheromone(i,k)$is an amount of pheromone deposit by ant *k* on feature *i*, $Accuracy_k$is CBIR system

The Accuracy of features is calculated using ant k, Features Number and FeaturesNumber (k) denotes the total Points and the total features within the path of ant (k). α and β are the variables that manipulate the weight of approach presentation. And length of characteristic subset.

15. Compute pheromone update as following:

$$Pheromone_1(t+1) = (1-p).pheromone_1(t) + \sum_{k=1}^{m} \Delta pheromone(i,k) + \Delta\big(pheromone(i, BestAnt)\big)$$

16. Condition is stop until every one ants follow the similar path and its go to step 14 else go to step 9
17. The ant with maximum CBIR system accuracy hasthe best solution.
18. Repeat step2 to step16 on a query picture in the record.
19. Determine the similarity matrix of question image and image record using Weighted L1 distance.We have used weighted L1 distance which is the most predictable metric for calculating the lack of involvement between two vectors. Given two vectors *Q* and T, where

$$\mathrm{d(Q,T)} = \mathrm{w_i} \sum_{\mathrm{m}} \sum_{\mathrm{n}} \mathrm{d_{mn}\ (Q,T)}$$

Where

$\mathrm{d_{mn}} = \frac{\left|\left(\mu^{\mathrm{Q}}_{\mathrm{mn}} - \mu^{\mathrm{T}}_{\mathrm{mn}}\right)\right|}{\left|\mu^{\mathrm{Q}}_{\mathrm{mn}}\right| + \left|\mu^{\mathrm{T}}_{\mathrm{mn}}\right|} + \frac{\left|\left(\mu^{\mathrm{Q}}_{\mathrm{mn}} - \mu^{\mathrm{T}}_{\mathrm{mn}}\right)\right|}{\left|\mu^{\mathrm{Q}}_{\mathrm{mn}}\right| + \left|\mu^{\mathrm{T}}_{\mathrm{mn}}\right|}$, $\mathrm{w_i}$ is weight percentage of pixels in image

20. Repeat the steps from 2 to 9 for all the images in the database.
21. Classify the images using SVM classifier.
22. Calculate precision,f-measure, execution time and recall of retrieved pictures.

Precision (P) is represented as the percentage of the quantity of related retrieved pictures to the quantity of photographs with in the database.

$$P = \frac{No.\ ofrelevantimageretrieved}{Totalnumberofimageretrieved}$$

$$Recall = \frac{No.\ ofrelevantimageretrieved}{numberofimageinthedatebese}$$

$$F_{measure} = 2 \times \frac{Precision \times Recall}{Precision + Recall}$$

8. Result Analysis

In this section used of Matlab 2012a for performance measurement. In this work, the proposed technique is performed by conducting experiments on Corel-1000 database. This database, including african, flowers, elephant, beach, horses, dinosaur, building and food images. All categories contain 100 images with size of 384*256. The experiment checked by different number of returning images which varies from 10 to 20. Calculate distance using weighted L1 distance.

Fig 3. Data set images

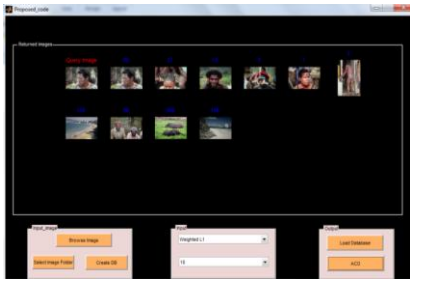


Fig 4. Results on African Images

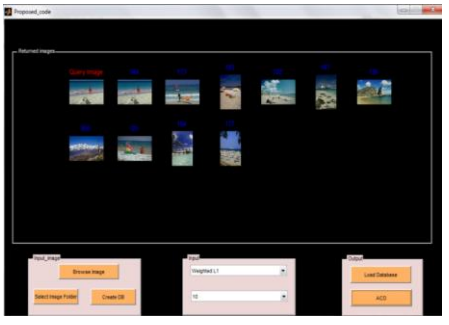


Fig 5. Results on Beach Images

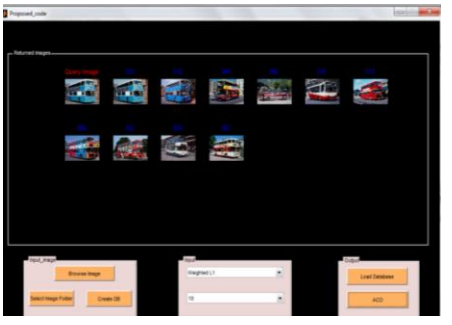


Fig 6. Results on Bus Image

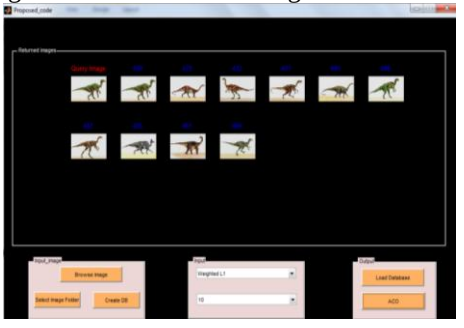
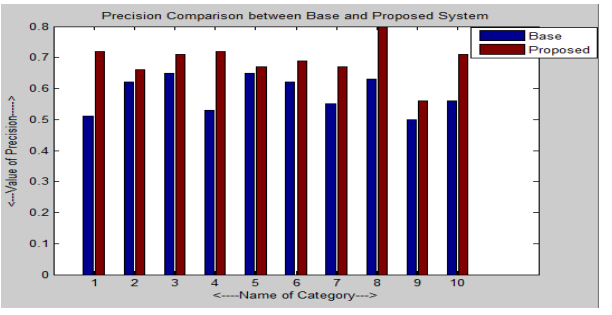


Fig 7. Results on Dinosaur Images



Graph1: Shows the Comparison of base [15] and proposed system precision

Table I: comparison of base and proposed Precision Method results on different Images

Category	Base Precision	Proposed Precision
African	.51	0.72
Beach	0.62	0.66
Building	0.65	0.71
Bus	0.53	0.72
Dinosaur	0.65	0.67
Elephant	0.62	0.69
Flower	0.55	0.67
Horse	0.63	0.80
Mountain	0.50	0.56
Food	0.56	0.71

Table II.Comparison of Base and Proposed F-Measure results on different Images

Category	Base F-measure	Proposed F-measure
African	0.3246	0.3314
Beach	0.3483	0.4908
Building	0.3279	0.3097
Bus	0.2667	0.4205
Dinosaur	0.3850	0.4172
Elephant	0.3295	0.4878
Flower	0.3051	0.3699
Horse	0.3626	0.4186
Mountain	0.3684	0.4943
Food	0.3590	0.4022

9. Conclusion

In this work , a novel method for CBIR using ACO and SVM with DTCWT is implemented and color points Color features stem from DCD, which is color quantization in RGB or HSV domain and statistics and histogram of images. Using ACO, skipped irrelevant and redundant features and selects the most important aspects among whole feature set Results show that our proposed CBIR plan has higher precision and F-measure in comparison with base system for different image categories. For future works, other optimization algorithm use for best path and reduce time execution.

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