



Searching Large Image Databases using Color Information

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Overview



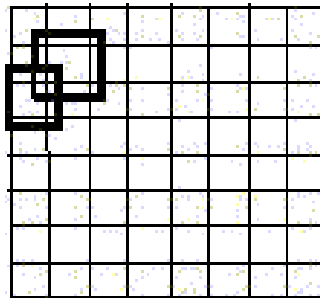
- CBIR Systems motivation
- Feature Extraction
- Similarity Metric
- Clustering
- Query Results (DEMO)
- Performance Results

Feature Extraction



Color as low-level feature representation:

- Closely related to human visual perception
 - HSV color model
- Encode the spatial distribution of features in images



- fixed partitioning scheme
 - each image divided into $M \times N$ overlapping blocks
 - 3 separate local histograms (H,S,V) are calculated for every block
-
- Compact to provide efficient storage and retrieval
 - The location of area-peak for every local histogram determines the value of the corresponding histogram.

Feature Representation

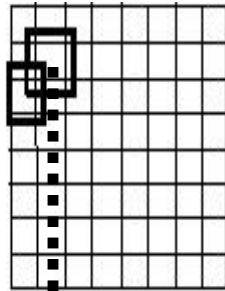


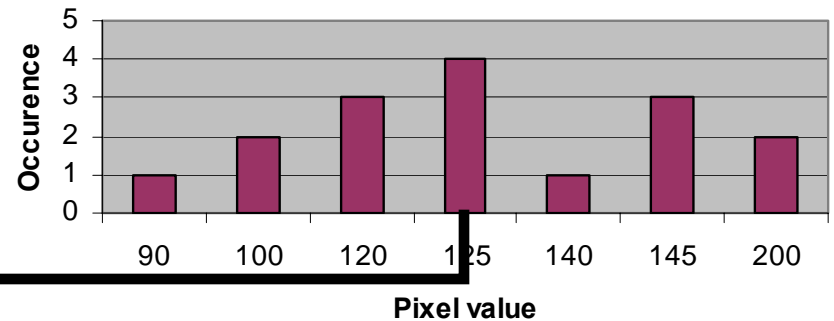
Figure 1: The fixed partitioning scheme with overlapping blocks.

Hue Component

120	120	125	145
100	90	125	145
120	100	125	200
145	200	125	140



Block Histogram



$[e_{11} e_{12} \dots 125 \dots e_{m1} e_{m2} \dots e_{mn}]$

Feature Example



Two examples of original images and their approximations:

0006.tif



Block decomposition



0075.tif



Block decomposition



Similarity Metric



$$S(q_i, t_i) = \frac{1}{1 + a * D_h(h_{q_i}, h_{t_i}) + b * D_s(s_{q_i}, s_{t_i}) + c * D_v(v_{q_i}, v_{t_i})}$$

$$D_h(h_{q_i}, h_{t_i}) = \frac{1 - \cos^k\left(\left(\frac{1}{256}\right) * \|h_{q_i} - h_{t_i}\| * \frac{\pi}{2}\right)}{2}$$

$$D_s(s_{q_i}, s_{t_i}) = \frac{\|s_{q_i} - s_{t_i}\|}{256}$$

$$D_v(v_{q_i}, v_{t_i}) = \frac{\|v_{q_i} - v_{t_i}\|}{256}$$

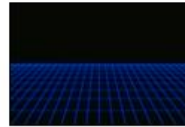




Cluster: 1
Size: 3
0400.tif



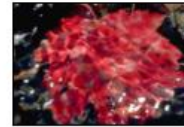
Cluster: 2
Size: 35
0473.tif



Cluster: 3
Size: 3
0583.tif



Cluster: 4
Size: 22
0819.tif



Cluster: 5
Size: 1
0651.tif



Cluster: 6
Size: 25
0811.tif



Cluster: 7
Size: 22
1176.tif



Cluster: 8
Size: 15
0516.tif



Cluster: 9
Size: 4
0748.tif



Cluster: 10
Size: 36
1363.tif



Cluster: 11
Size: 10
1020.tif



Cluster: 12
Size: 5
0956.tif



Cluster: 13
Size: 41
0565.tif



Cluster: 14
Size: 41
0426.tif



Cluster: 15
Size: 2
1262.tif



Cluster: 16
Size: 21
1151.tif



Cluster: 17
Size: 87
0175.tif



Cluster: 18
Size: 15
1190.tif



Cluster: 19
Size: 61
0722.tif



Cluster: 20
Size: 65
0891.tif



Cluster: 21
Size: 17
0695.tif



Cluster: 22
Size: 60
1118.tif



Cluster: 23
Size: 23
0848.tif



Cluster: 24
Size: 80
0427.tif



Cluster: 25
Size: 4
1029.tif



Cluster: 26
Size: 19
1327.tif



Cluster: 27
Size: 31
1135.tif



Cluster: 28
Size: 92
0135.tif



Cluster: 29
Size: 7
0233.tif



Cluster: 30
Size: 91
0384.tif



Cluster: 31
Size: 90
0144.tif



Cluster: 32
Size: 66
0524.tif



Cluster: 33
Size: 58
0987.tif



Cluster: 34
Size: 49
0108.tif



Cluster: 35
Size: 7
0845.tif



Cluster: 36
Size: 139
0387.tif



Cluster: 37
Size: 35
0777.tif

Sample Query Results



QUERY
1401.tif



0.848664
0905.tif



0.847321
0908.tif



0.818248
0548.tif



0.811797
0891.tif



QUERY
1402.tif



0.868633
0891.tif



0.857618
1191.tif



0.845677
0617.tif



0.843640
0549.tif

Sample Query Results



QUERY
1432.tif



0.669856
0016.tif



0.628479
0285.tif



0.619573
0280.tif



0.597873
0108.tif



QUERY
1404.tif



0.653803
0751.tif



0.638399
0261.tif



0.610734
1067.tif



0.607231
0570.tif

Sample Query Results



QUERY
1572.tif



0.660019
0195.tif



0.631971
0144.tif



0.623826
0143.tif



0.618435
0145.tif



QUERY
1485.tif



0.726675
0203.tif



0.707779
0839.tif



0.686669
0426.tif



0.671368
0022.tif

Sample Query Results



QUERY
1609.tif



0.689062
0484.tif



0.664921
0354.tif



0.660633
1258.tif



0.660394
0492.tif



QUERY
1602.tif



0.859885
0811.tif



0.776344
0477.tif

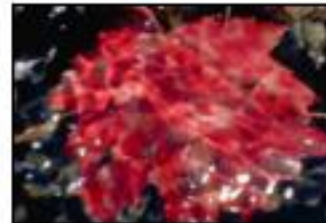


0.641734
0806.tif



0.631958
0450.tif

Sample Query Results



QUERY
1684.tif

0.440884
0651.tif



QUERY
1639.tif



0.578109
1020.tif



0.548853
0638.tif



0.548767
1367.tif



0.490217
0599.tif

Sample Query Results



QUERY
1765.tif



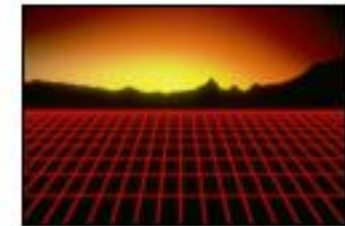
0.558792
0691.tif



0.534160
0695.tif



0.517377
0686.tif



0.517008
0584.tif



QUERY
1711.tif



0.639230
0700.tif



0.568857
0845.tif



0.524034
1068.tif



0.472768
0134.tif

Sample Query Results



QUERY
1911.tif



0.677941
1100.tif



0.677790
1101.tif



0.655517
1098.tif



0.653394
1104.tif



QUERY
1822.tif



0.636983
0458.tif



0.636445
0427.tif



0.633637
0844.tif



0.615850
0362.tif

Sample Query Results



QUERY
1916.tif



0.656276
1098.tif



0.631933
1099.tif



0.613052
1104.tif



0.588279
1094.tif



QUERY
1911.tif



0.677941
1100.tif



0.677790
1101.tif



0.655517
1098.tif



0.653394
1104.tif

Sample Query Results



QUERY
1940.tif



0.753174
1135.tif



0.745709
1152.tif



0.699157
0689.tif



0.645395
0907.tif



QUERY
1930.tif



0.735603
1146.tif



0.687955
0123.tif



0.677124
1145.tif



0.643013
1135.tif

Sample Query Results



QUERY
2083.tif



0.598717
1363.tif



0.579545
0268.tif



0.578178
0088.tif



0.566785
0332.tif

System Performance



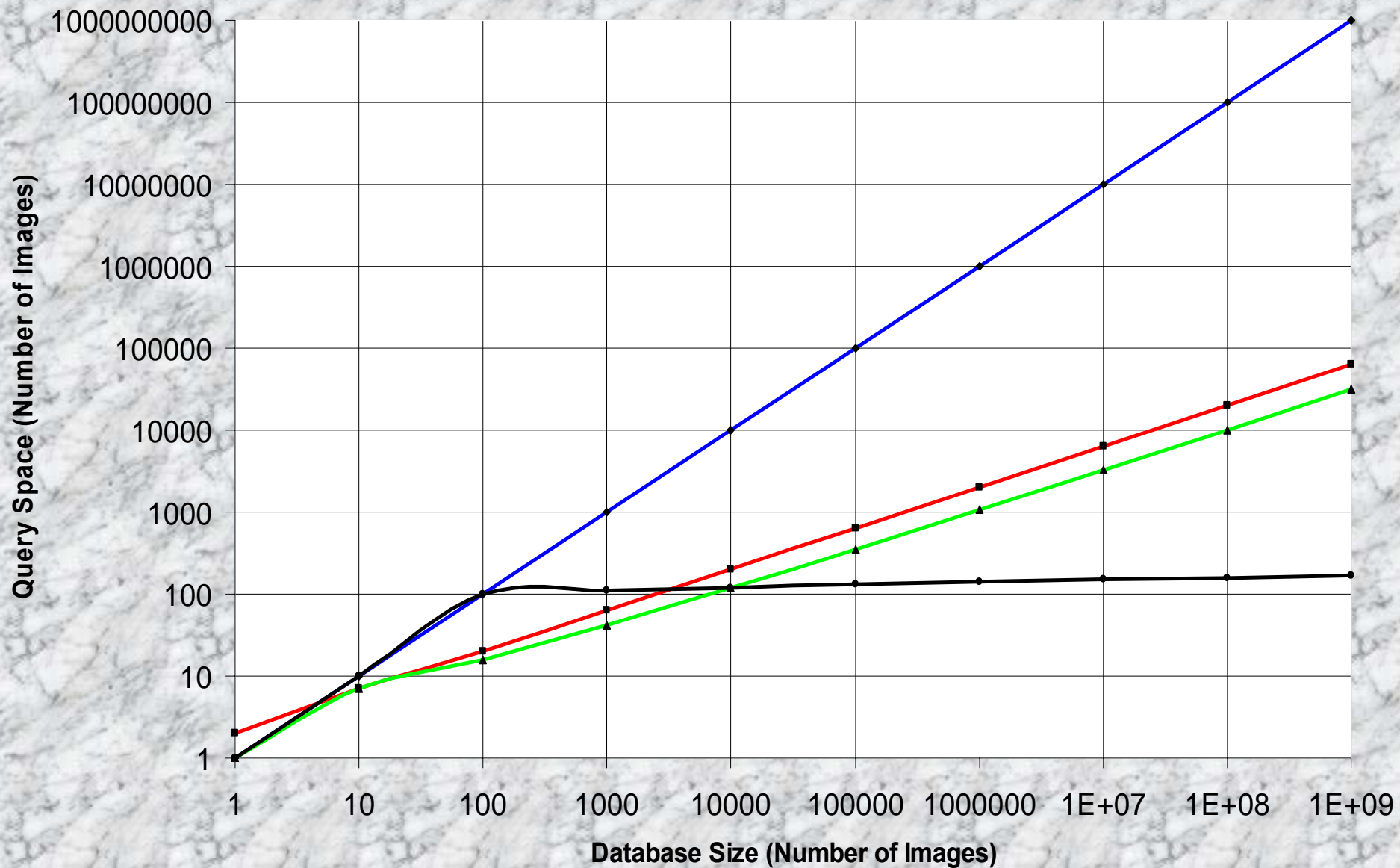
Clusters	No clusters	37
Query Space	1382	74
Feature Space	265344	14208
Time to Cluster (seconds)	0.296838	1.19904
Time to search (seconds)	0.080869	0.003182
Time to extract features in 1 image (seconds)	1.09525	1.09525
Compare images per second	17089.37	23255.81

System Performance



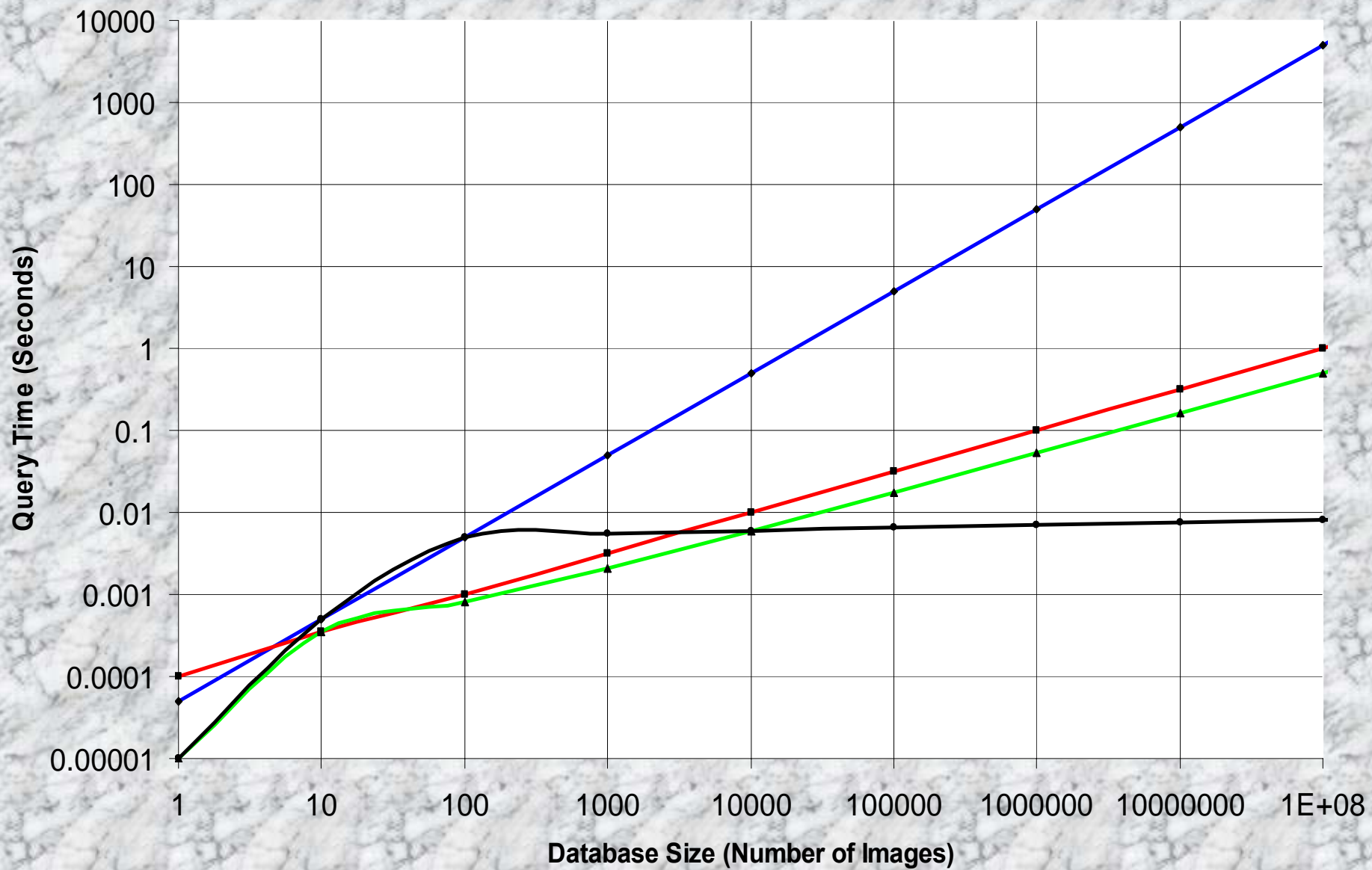
	Time
Reading Features Vectors (seconds)	0.822919
Computing Features Vectors (seconds)	1513.636
Reading Distance Matrix (seconds)	9.87374
Computing Distance Matrix (seconds)	64.12314

Query Space



—◆— QS - NO C —■— QS - 1 C —▲— QS - H sq C —●— QS - H log C

Query Time



Legend: QT - NO C (blue line with diamonds), QT - 1 C (red line with squares), QT - H sq C (green line with triangles), QT - H log C (black line with circles)

Questions?

