Retrieval of 2D Images by Spatial Arrangement of Color Clusters

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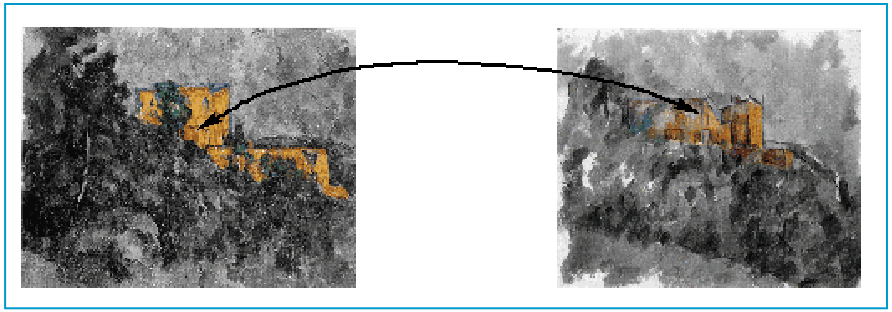
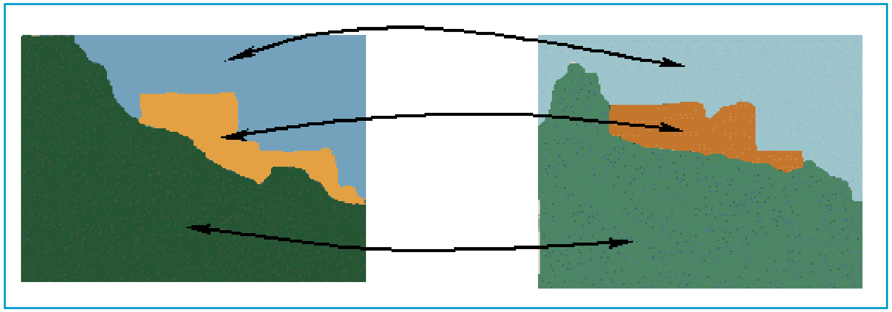
Spatial similarity in retrieval by content

- Retrieval by visual content relies on appearing features of spatial entities
  - shape, color, texture, semantics



- When multiple entities are considered, the model may also capture relational information
  - spatial relationships

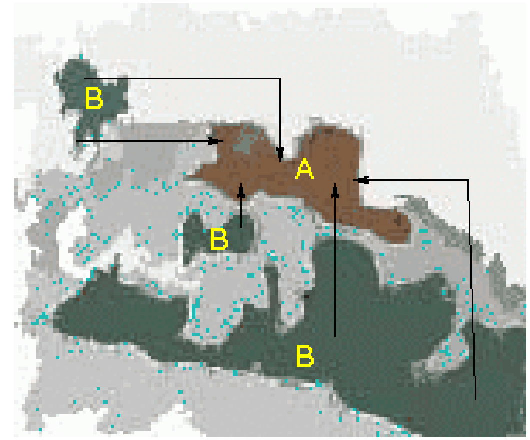


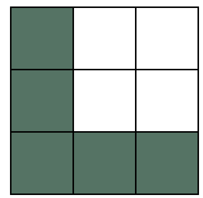
- This improves perceptual effectiveness

- But, basically changes the complexity of match and the applicability of indexing schemes

Weighted walkthroughs between extended sets

- Cartesian reference system
- 9 walkthroughs w_{ij} along primitive directions, connecting pixels in A and B
- Each walkthrough is weighted with an integral measure of the number of pixel pairs to which it applies





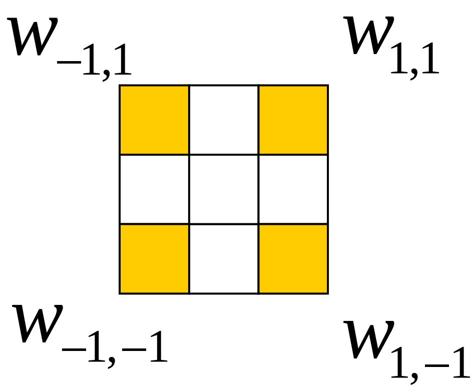
0.3	0	0
0.1	0	0
0.7	0.8	1

ww (A,B)

$$w_{ij}(A,B) = K_{ij} \int_A \int_B C_i(x_b - x_a) C_j(y_b - y_a) dx_b dy_b dx_a dy_b$$

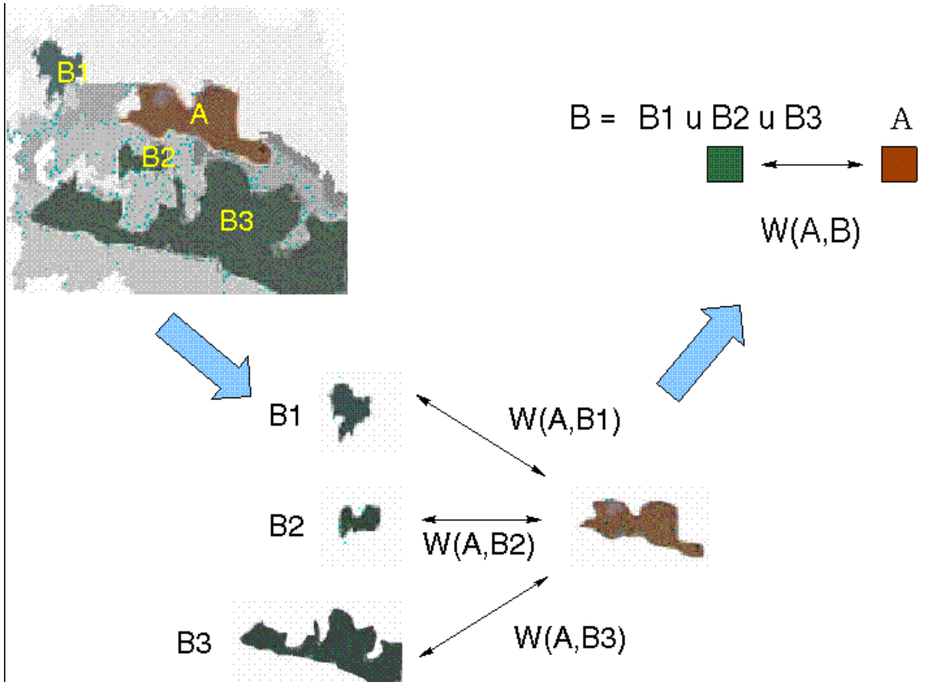
Reduced set of weighted walkthroughs

- Weighted walkthroughs are simplified by considering only corner weights
  - evaluation of corner weights is as complex as a conventional representation based on centroids
  - avoids management of bounded rectangles requested by middle weights
  - neglects the central weight which is significant only when overlapping is considered



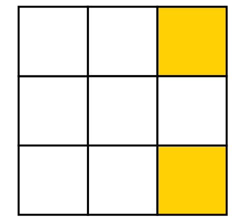
Properties

- Reflexive and invariant with respect to shifting and zooming
- Continuous with respect to changes in the image
- Compositional
  - the weight $W(A, B_1 U B_2)$ is derived by linear combination of $W(A, B_1)$ and $W(A, B_2)$
  - circumvents the complexity of numerical integration

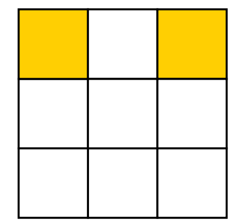


Independent directional indexes

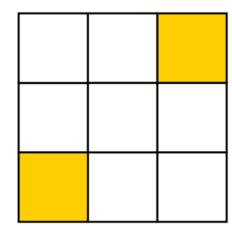
- The 4 corner have sum equal to 1and can be replaced with 3 independent indexes
  - $$w_H(A,B) = w_{1,1}(A,B) + w_{1,-1}(A,B)$$
    accounts for the degree by which *A* is on the left of *B*



  - $$w_V(A,B) = w_{-1,1}(A,B) + w_{1,1}(A,B)$$
    accounts for the degree by which *A* is below of *B*

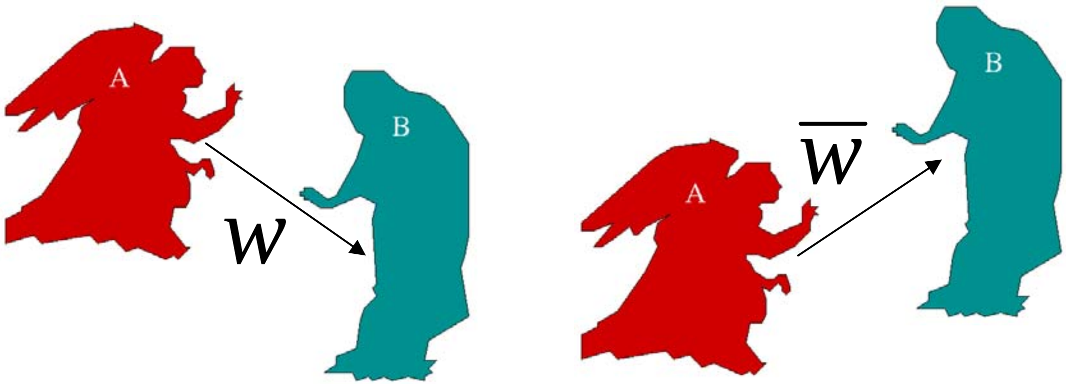


  - $$w_D(A,B) = w_{-1,-1}(A,B) + w_{1,1}(A,B)$$
    accounts for the degree by which *A* and *B* are diagonal



Distance measure

- Dissimilarity between spatial relationships is evaluated by convex composition of distances between homologous directional indexes



$$D(w,\overline{w}) = \alpha\left|w_H - \overline{w}_H\right| + \beta\left|w_V - \overline{w}_V\right| + \gamma\left|w_D - \overline{w}_D\right|$$

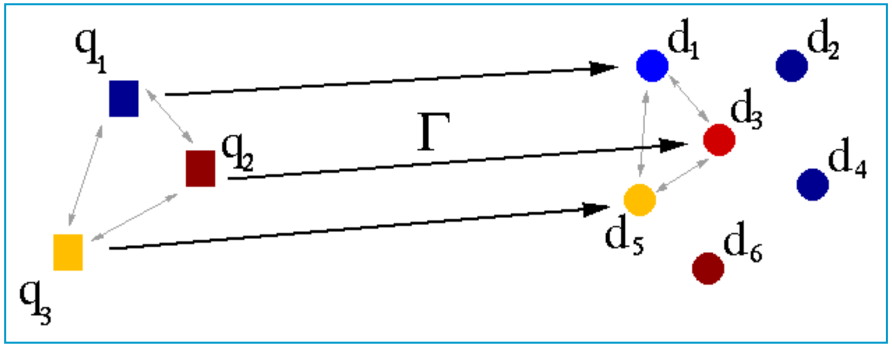
$$\alpha + \beta + \gamma = 1 \qquad \alpha, \beta, \gamma \geq 0$$

- D is a metric and changes with continuity

Computing distances between graphs

- Comparison involves interpretation of the entities of a query on the entities of a description $\Gamma : Q \rightarrow D$
  - query specification $<Q, a^q, s^q>$
  - image description $<D, a^d, s^d>$
  - Interpretation Γ of Q on D

    $$q_1 \neq q_2 \rightarrow \Gamma(q_1) \neq \Gamma(q_2)$$



- Distance under interpretation Γ:Q$\rightarrow$D
  - convex combination of distance between associated entities and between their homologous relationships

$$\mu(\Gamma) = \lambda\mu_s(\Gamma) + (1-\lambda)\mu_a(\Gamma)$$

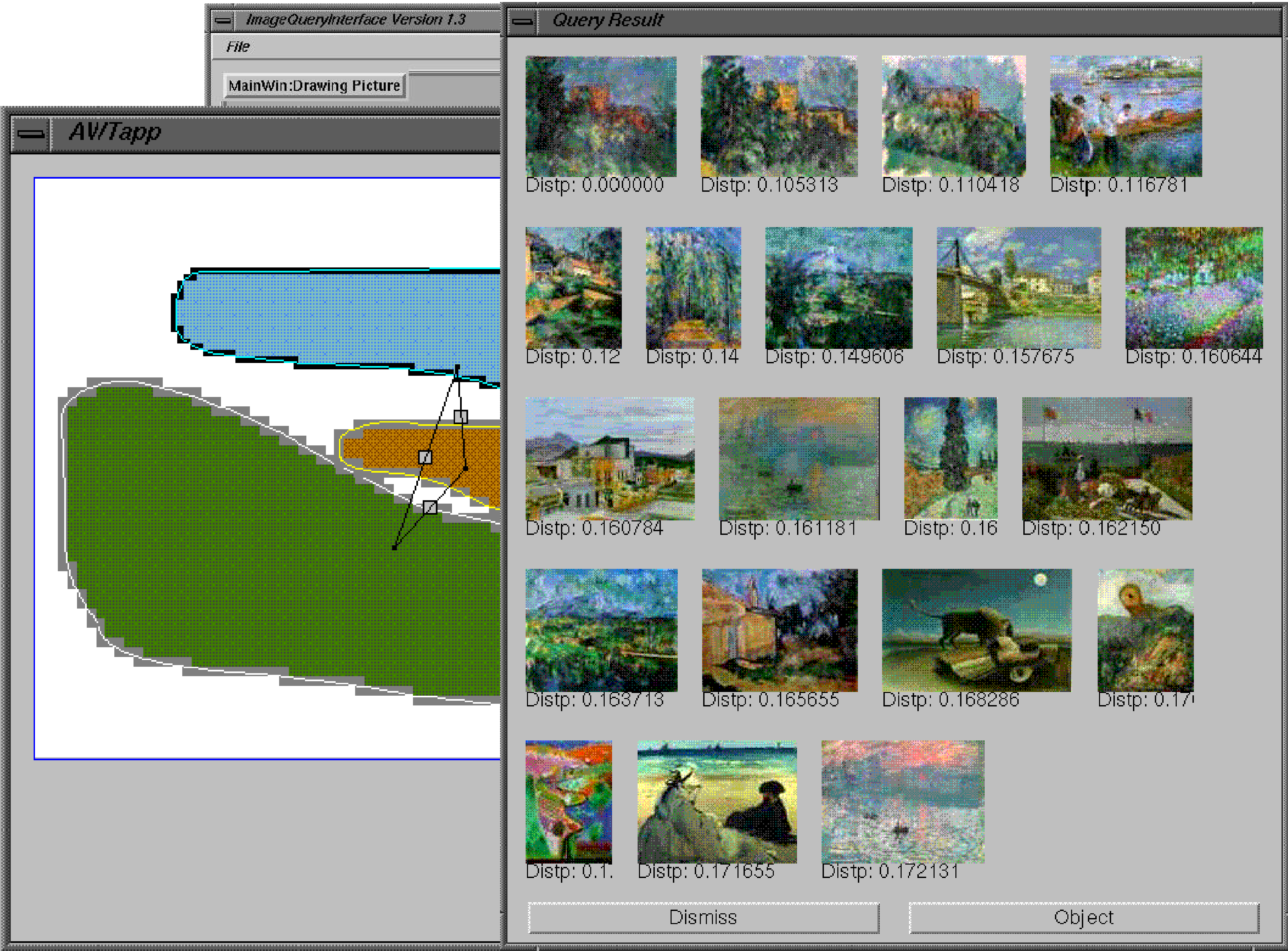
$$\mu_a(\Gamma) = \sum_{k=1}^{N_Q} D_a(q_k, \Gamma(q_k))$$

$$\mu_s(\Gamma) = \sum_{k=1}^{N_Q} \sum_{h=1}^{k-1} D_s(<q_k, q_h>, <\Gamma(q_k), \Gamma(q_h)>)$$

- The absolute distance is evaluated with the optimal interpretation

$$\mu = \underset{\Gamma:Q\rightarrow D}{\mathrm{Min}}\{\mu(\Gamma)\}$$

- The evaluation of a distance between two image models is an optimal error correcting (sub-)graph isomorphism problem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File
MainWin:Drawing Picture
AV/Tapp
Query Result
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Distp: 0.105313
Distp: 0.110418
Distp: 0.116781
Distp: 0.12
Distp: 0.14
Distp: 0.149606
Distp: 0.157675
Distp: 0.160644
Distp: 0.160784
Distp: 0.161181
Distp: 0.16
Distp: 0.162150
Distp: 0.163713
Distp: 0.165655
Distp: 0.168286
Distp: 0.17
Distp: 0.1.
Distp: 0.171655
Distp: 0.172131
Dismiss
Object