# Colour Indexing

Swain and Ballard

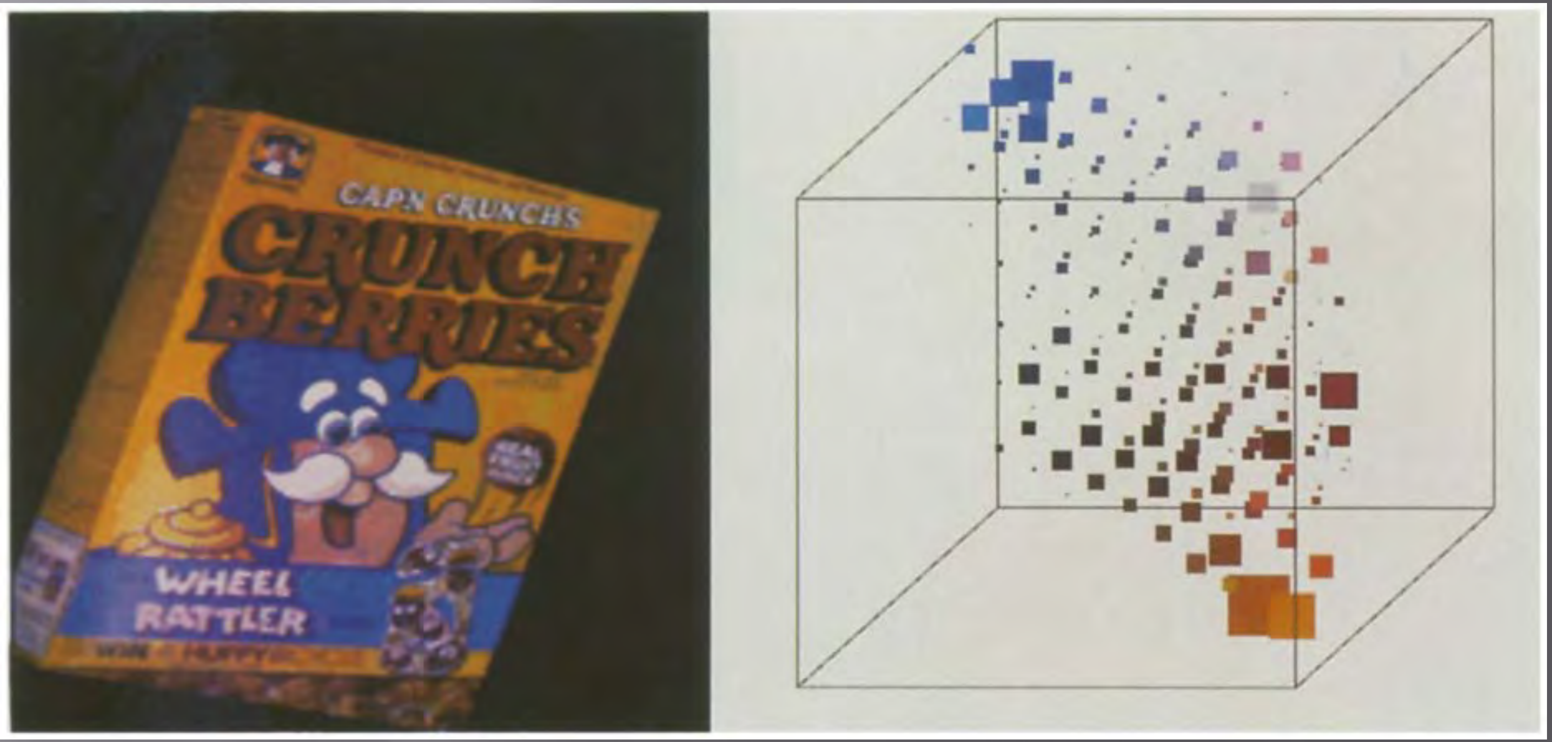
Michael J. Swain and Dana H. Ballard. 1991. Color indexing. *International Journal of Computer Vision* 7, 1 (November 1991), 11-32.

You can download a pdf of the paper from the SFU library. Go to

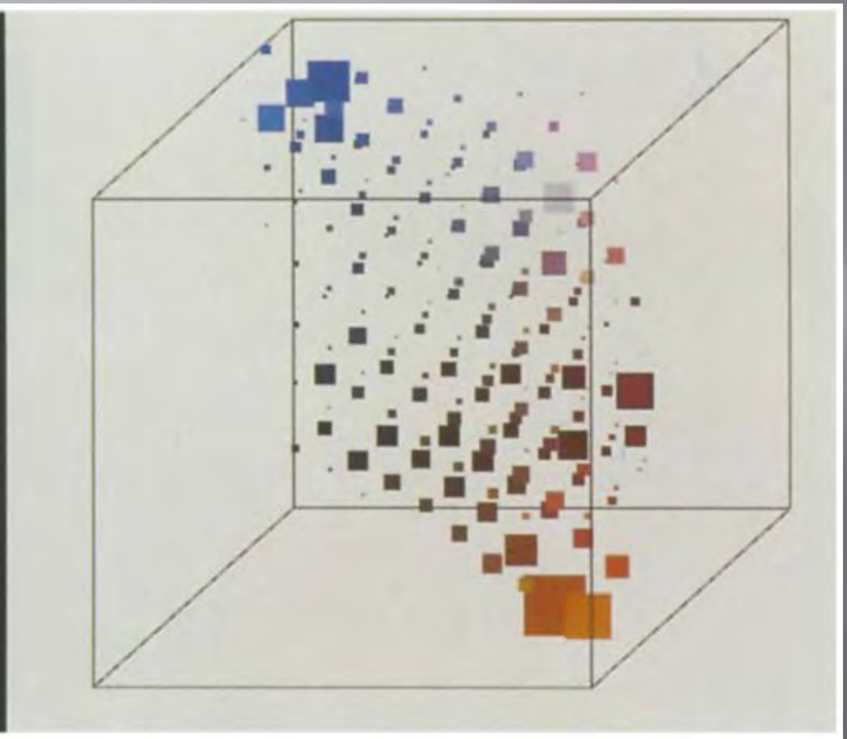
http://cufts2.lib.sfu.ca/CJDB4/BVAS/browse

# Colour-Only Object Recognition

# Colour Histogram



# Number of Histogram Bins?



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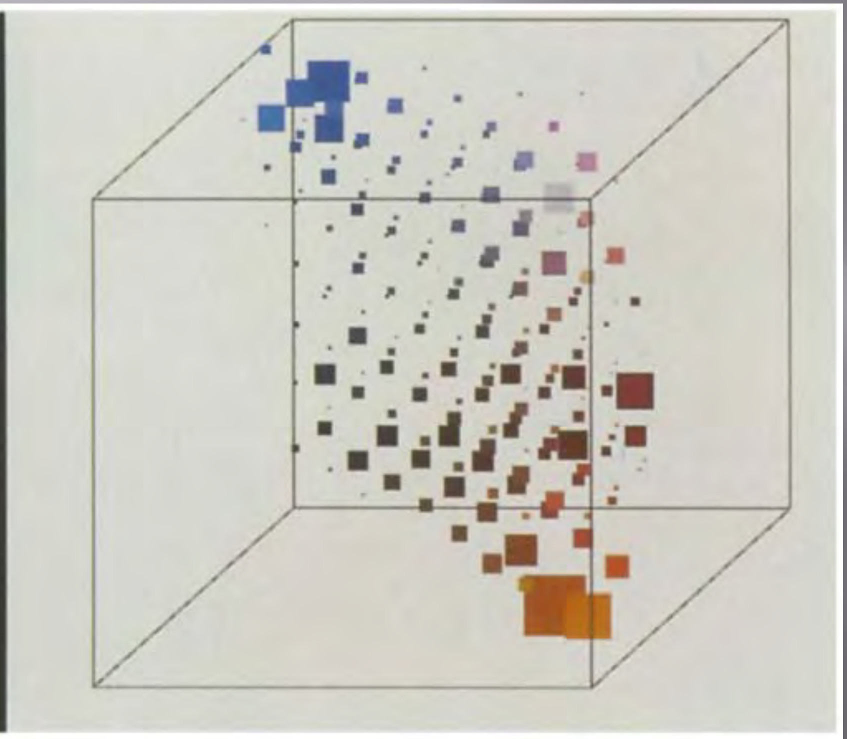

The Obvious Answer

8 bits per R,G,B channel

2^8*2^8*2*8 = 256*256*256 ~= 16 million bins

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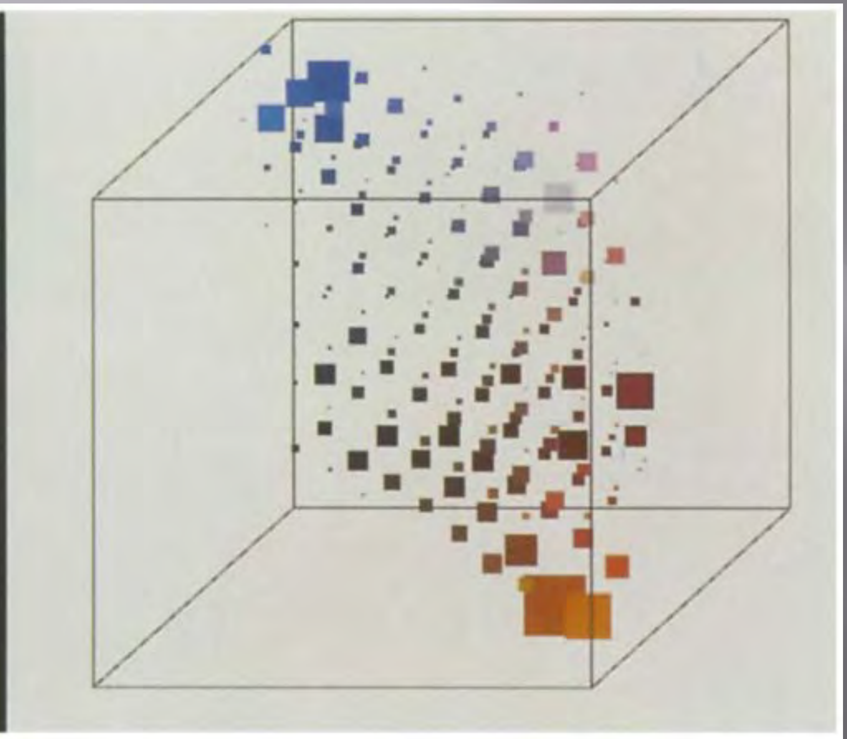

The Obvious Answer

8 bits per R,G,B channel

2^8*2^8*2*8 = 256*256*256 ~= 16 million bins

Swain & Ballard's Answer

3 bits per channel

(2^3)^3 = 2^9 = 512 bins

# Histogram Intersection

$$\sum_{j=1}^{n} \min(I_j, M_j)$$

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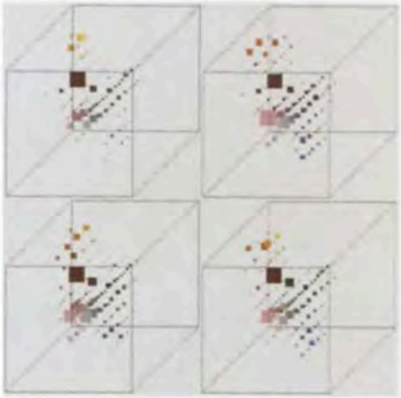
$$\sum_{j=1}^{n} \min(I_j, M_j)$$

## Normalization

$$H(I,M) = \frac{\sum_{j=1}^{n} \min(I_j, M_j)}{\sum_{j=1}^{n} M_j}$$

*Fig. 2.* Four views of Snoopy.



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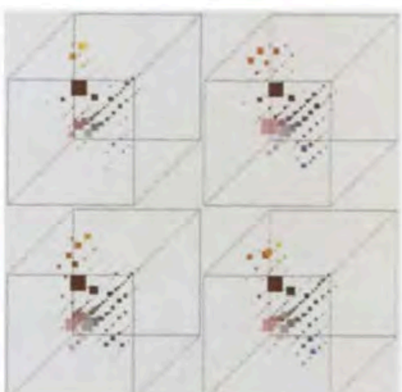


*Fig. 4.* Modeling indexing experiment based on color cues (continued in figures 6 and 8). Each of the sixty-six models shown here is represented by its color histogram.

*Fig. 5.* The unknown objects. Each is identified with the model color histogram that best matches its own color histogram. Compared to the models the unknown objects are translated (Ajax), rotated about various axes (Frankenberry, Ajax) scaled (USA Flyer), occluded (Charmin), partly outside of the field of view (red, white striped shirt), and deformed (Mickey Mouse underwear).

*Fig. 6 Life cereal box image and reduced resolution copies. Left:* 128x90 (1); Middle: 16×11 (2); Right 8x5 (30). The numbers in parenthesis indicate the rank of the match value for the Life cereal model. The middle image matches effectively, but the one on the right does not.

*Fig. 10.* Images from figure 5, each with the bottom third removed. These images and the images below are used in the occlusion experiment (see table 4).

*Fig. 11.* Images from figure 10, each with the right-hand third removed. The upper left-hand corner (four ninths of the original image)

# Spot that Object

**Ratio Histogram**

$$R_i = \min\left(\frac{M_i}{I_i}, 1\right)$$

**Expresses how much the presence of colour *i* at a pixel indicates the likelihood of the presence of the model object at that pixel.**

**Use min because probability can't exceed one.**

*Fig. 16.* Results of the ratio histogram backprojection step (2) of Histogram Backprojection, using figure 6 as the image and the striped blue and white shirt as the target. The blue hue is found in only a small area outside of the target, so it gives a strong response. White is found in many objects so it gives a weak response.

*Fig. 18.* Results of the ratio histogram backprojection step (2) of Histogram Backprojection when the objects are occluded. Figure 6 is the image and the striped blue and white shirt is the target.

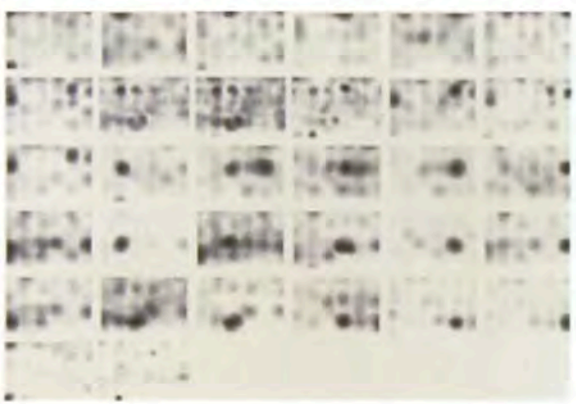

*Fig. 17. Results of the convolution step (3) of Histogram Backprojection,*
for the same image as above. The results for all the models are shown in the image, each in the rectangle corresponding to the location of that model in the composite photo. When the algorithm successfully finds the object, the darkest black dot in the small image is in the same location within that image as the image in the component.

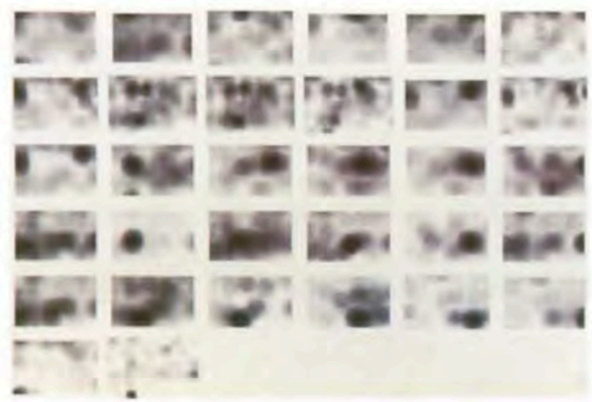

*Fig. 19. Results of the convolution step (3) of Histogram Backprojection,*
for the same image as above. The results of all the models are shown in the image, each in the rectangle corresponding to the location of that model in the composite photo. When the algorithm successfully finds the object, the darkest black dot in the small images is in the same location within that image as the image is in the composite. Compare with figure 17.

# Limitations of this Method?

Change in size due to distance

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Change in size due to distance

Change in intensities due to change in light's radiance

# Limitations of this Method?

Change in size due to distance

Change in intensities due to change in light's radiance

Change in colours due to change in light's colour

# End