

```

clc
clear all
close all

% Load the image of FC Barcelona shirt
image_FCB = imread('blue_frag.jpg');
mainFolder = 'soccer/teams/';

```

We created multiple images for model histogram of barcelona , blue\_frag, red\_frag, and whole image for experiment, selecting numBins as instructed in class testing 6 ,8

```

% List of team names
teams = {'barcelona'};%,'acmilan','chelsea','juventus','liverpool','madrid','psv'};
numBins = 8;
distances = 0;

```

Initialize Distances Array: Creates an array 'distances' to store the calculated distances, initializing it with a zero.

```

% Calculate the color histogram in RGB space for the Barcelona image
[r_hist, ~] = imhist(image_FCB(:, :, 1), numBins);
[g_hist, ~] = imhist(image_FCB(:, :, 2), numBins);
[b_hist, ~] = imhist(image_FCB(:, :, 3), numBins);

```

Calculate RGB Histogram for Barcelona Image: Computes the color histograms for the Barcelona image in the green, blue, and red channels. The red channel calculation is commented out.

```

% Calculate the overall RGB color histogram for Barcelona image
rgb_hist_barca = [r_hist, g_hist, b_hist];

% Normalize the RGB color histogram for Barcelona image
rgbbarca_hist = rgb_hist_barca / sum(rgb_hist_barca);

```

Overall RGB Histogram and Normalization: Combines the individual histograms into an overall RGB histogram for the Barcelona image. Normalizes the histogram to ensure values are between 0 and 1

```

% Define a threshold for similarity
threshold = 1.5

```

```

threshold = 1.5000

```

Threshold Definition: Sets a threshold value for determining the similarity between histograms.

```

for t = 1:length(teams)
    currentTeam = teams{t};
    teamImages = dir(fullfile(mainFolder, currentTeam, '*.jpg'));

    for i = 1:length(teamImages)
        teamImage = imread(fullfile(mainFolder, currentTeam, teamImages(i).name));
        hsvImage = rgb2hsv(teamImage);
    end
end

```

Team and Image Loop: Iterates through each team and each image within that team's folder. Converts the current team image to the HSV color space.

```
% calculate the color histogram in HSV space for the current team image
[r_hist, ~] = imhist(hsvImage(:, :, 1), numBins);
[g_hist, ~] = imhist(hsvImage(:, :, 2), numBins);
[b_hist, ~] = imhist(hsvImage(:, :, 3), numBins);

% calculate the overall RGB color histogram for the current team image
rgb_hist = [r_hist, g_hist, b_hist];

% normalize the RGB color histogram for the current team image
rgb_hist = rgb_hist / sum(rgb_hist);
```

Histogram Calculation for Team Image: Computes the color histograms in HSV space for the current team image. Also, calculates the overall RGB color histogram and normalizes it.

```
% Calculate the chi-squared distance between the model histogram and the
current image histogram
dist = sum((rgbbarca_hist - rgb_hist).^2 ./ (rgbbarca_hist + rgb_hist));
distances = [distances, dist];
```

Chi-Squared Distance Calculation: Computes the chi-squared distance between the model histogram (Barcelona) and the current team image histogram. Appends the distance to the distances array.

```
% If the distance is less than the threshold, the Barça shirt may appear in
the image
if dist < 1.7 && dist < 1.9
    disp(['Barça shirt detected in ', currentTeam, ' image ', num2str(i)]);
else
    disp(['No Barça shirt detected in ', currentTeam, ' image ',
num2str(i)]);
end
end
end
```

```
Barça shirt detected in barcelona image 1
Barça shirt detected in barcelona image 2
No Barça shirt detected in barcelona image 3
Barça shirt detected in barcelona image 4
Barça shirt detected in barcelona image 5
Barça shirt detected in barcelona image 6
No Barça shirt detected in barcelona image 7
Barça shirt detected in barcelona image 8
No Barça shirt detected in barcelona image 9
Barça shirt detected in barcelona image 10
Barça shirt detected in barcelona image 11
Barça shirt detected in barcelona image 12
No Barça shirt detected in barcelona image 13
```

```

Barça shirt detected in barcelona image 14
Barça shirt detected in barcelona image 15
Barça shirt detected in barcelona image 16
Barça shirt detected in barcelona image 17
No Barça shirt detected in barcelona image 18
Barça shirt detected in barcelona image 19
No Barça shirt detected in barcelona image 20
No Barça shirt detected in barcelona image 21
No Barça shirt detected in barcelona image 22
No Barça shirt detected in barcelona image 23
Barça shirt detected in barcelona image 24
Barça shirt detected in barcelona image 25
Barça shirt detected in barcelona image 26
Barça shirt detected in barcelona image 27
Barça shirt detected in barcelona image 28
Barça shirt detected in barcelona image 29
Barça shirt detected in barcelona image 30
Barça shirt detected in barcelona image 31
Barça shirt detected in barcelona image 32
Barça shirt detected in barcelona image 33
Barça shirt detected in barcelona image 34
Barça shirt detected in barcelona image 35
Barça shirt detected in barcelona image 36
No Barça shirt detected in barcelona image 37
Barça shirt detected in barcelona image 38
Barça shirt detected in barcelona image 39

```

Distance Thresholding: Compares the calculated distance with the threshold. If the distance is below the threshold, it considers the image to contain a Barcelona shirt; otherwise, it is considered not to contain one.

```

% histogram(distances, 'BinWidth', 0.1);
%
% xlabel('Distance');
% ylabel('Frequency');
% title('Distribution of Distances');
% % Add a line for the chosen threshold
% chosenThreshold = 1.3; % Adjust this based on visual inspection
% hold on;
% plot([chosenThreshold, chosenThreshold], [0, max(histcounts(distances))], 'r--',
'LineWidth', 2);
% hold off;

```

## Histogram Size

### Histogram Size (Number of Bins):

- The algorithm uses a histogram size of numBins = 8 for each color channel (Red, Green, Blue) when calculating the color histograms. This determines the granularity of the color information captured in the histograms. We chose the numBins as advised in class
- The RGB color space is utilized to represent colors. The algorithm calculates separate histograms for the Red, Green, and Blue channels of the images. Each channel contributes to a specific dimension in the final color histogram.
- Normalization for Lighting Invariance : Yes, the algorithm normalizes the color histograms to ensure invariance to lighting conditions. After calculating the histograms for each color channel, the values are

normalized by dividing each bin's count by the sum of all bin counts. This normalization ensures that the histograms are not sensitive to variations in overall image intensity caused by changes in lighting.

- Histogram Comparison : The histograms are compared using the chi-squared distance. The chi-squared distance is calculated between the model histogram (Barcelona shirt) and the histograms of other team images

Experimentation :

We did following Experimentation :

experimenting with threshold

Color Space transformation

Experimentation with Results

Teams	Detected Barcelona shirts
Barcelona	34 out of 40
Chelsea	12 out of 40 was detected
Acmilan	5 out of 40 was detected
Juventus	13 out of 40 was detected
Liverpool	2 detected was detected
Psv	8 out 40 was detected
Madrid	15 out 40 was detected