

Computer Vision Assignment Seven @ ETH
Zurich
Structure from Motion

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1 Feature extraction and initialization with epipolar geometry

Using SIFT, the features are extracted from the first and last images and then matched. The 8 point RANSAC algorithm was used to determine the inliers and outliers (see the epipolar lines of the inliers detected as shown below). The essential matrix is then computed using K and F which are then used along with the decomposeE function to compute the projection matrix. The 3D points are then obtained after triangulation of the 2d points (and also after calibration of the points using K matrix provided.)

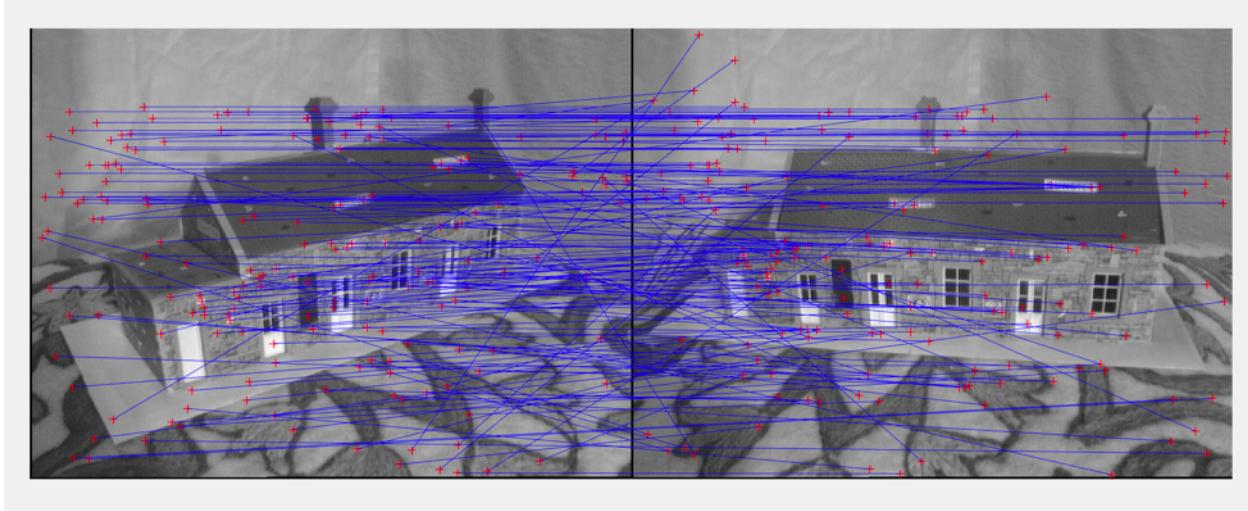


Figure 1: Task 1: Matches after features extractions and matching using SIFT(images 0 and 4).

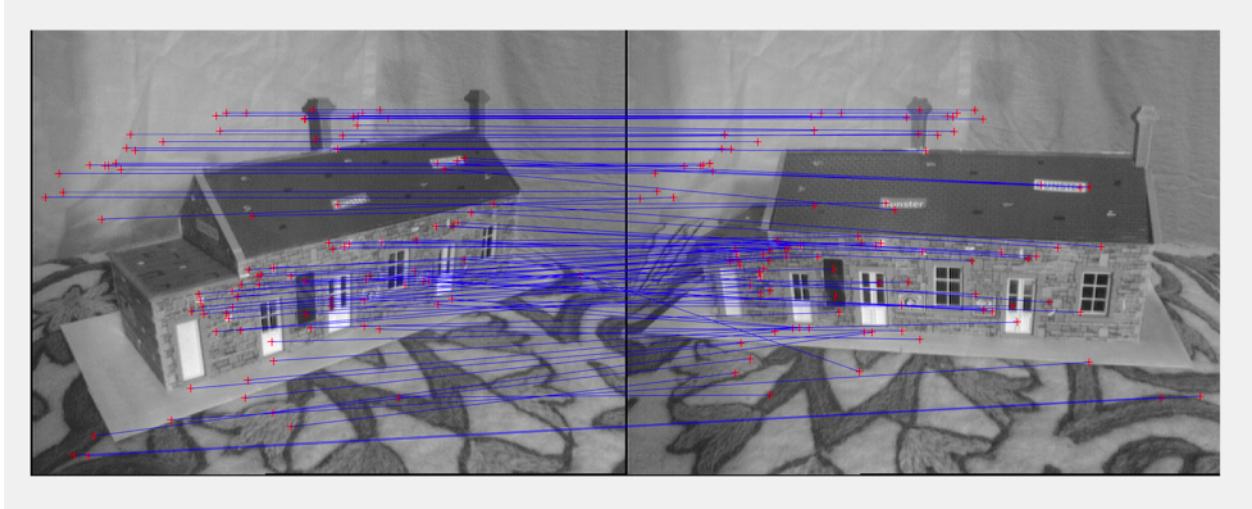


Figure 2: Task 1: Inlier matches after 8-point RANSAC (images 0 and 4).

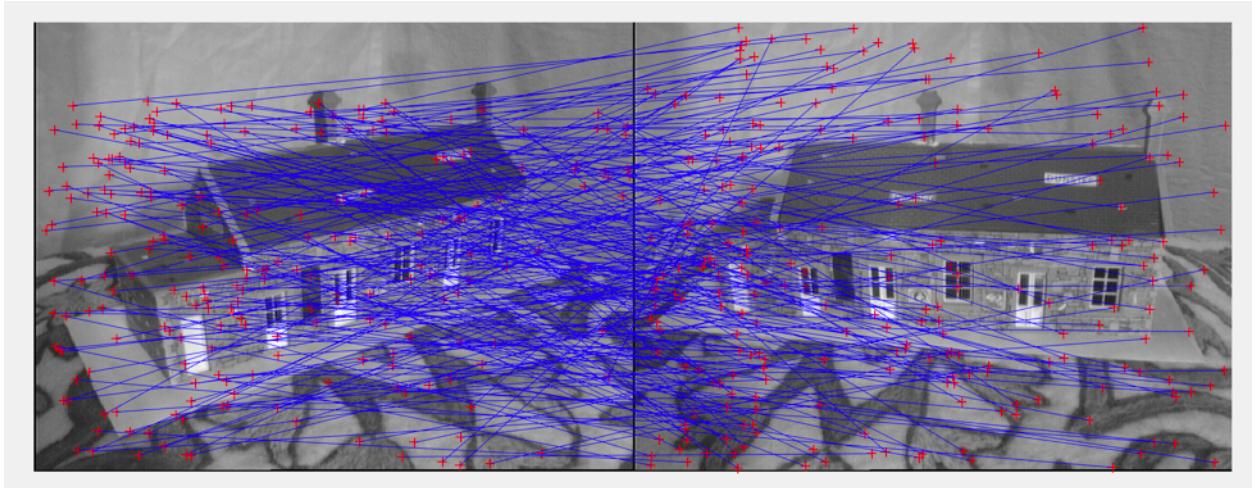


Figure 3: Task 1: Outlier matches after 8-point RANSAC (images 0 and 4).

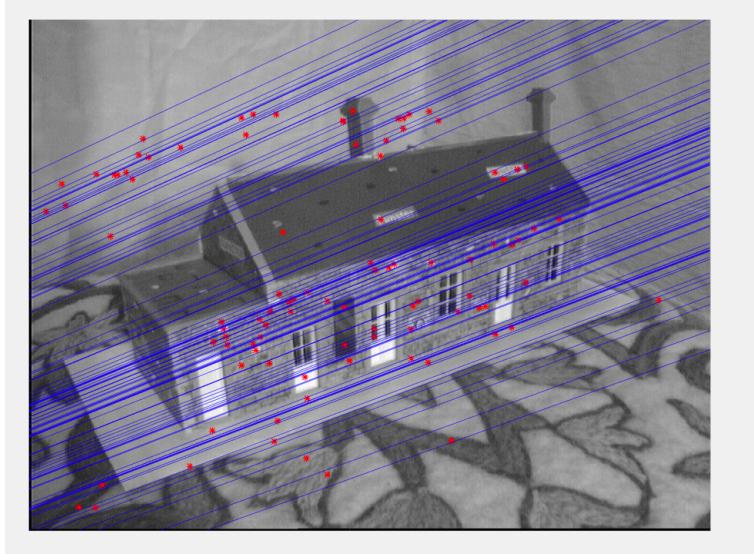


Figure 4: Task 1: Epipolar lines on image 0.

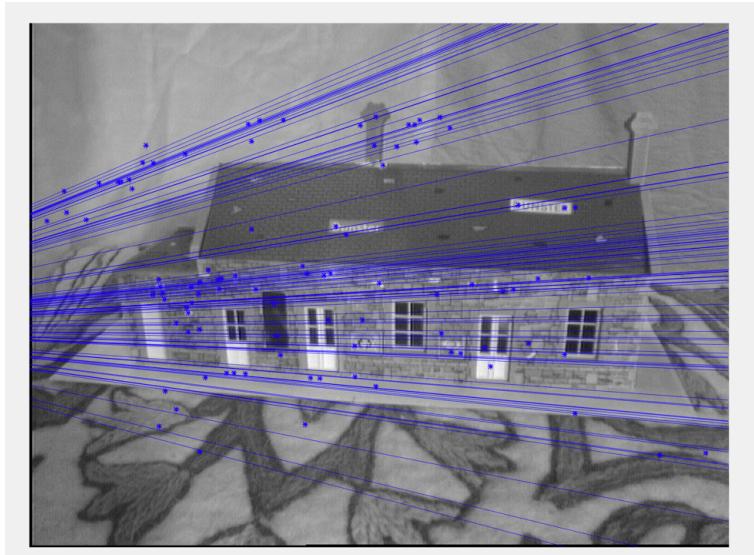


Figure 5: Task 1: Epipolar lines on image 4.

2 Triangulation and adding new views

Features of each image of the sequence are then matched with the first image's features. The 6 point RANSAC algorithm is then used to compute the projection matrix and to find the inliers of each view (the traingulated 3D points from the first part are used here). After finding the projection matrix of each view, the 3D points of the features are retrieved.

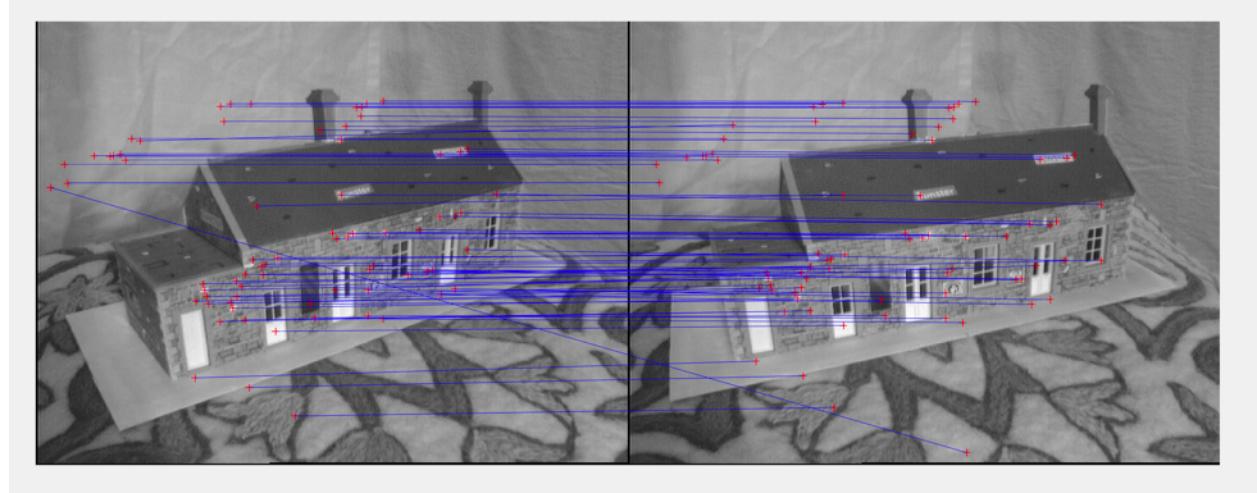


Figure 6: Task 12 Inlier matches after 6-point RANSAC (images 0 and 1).

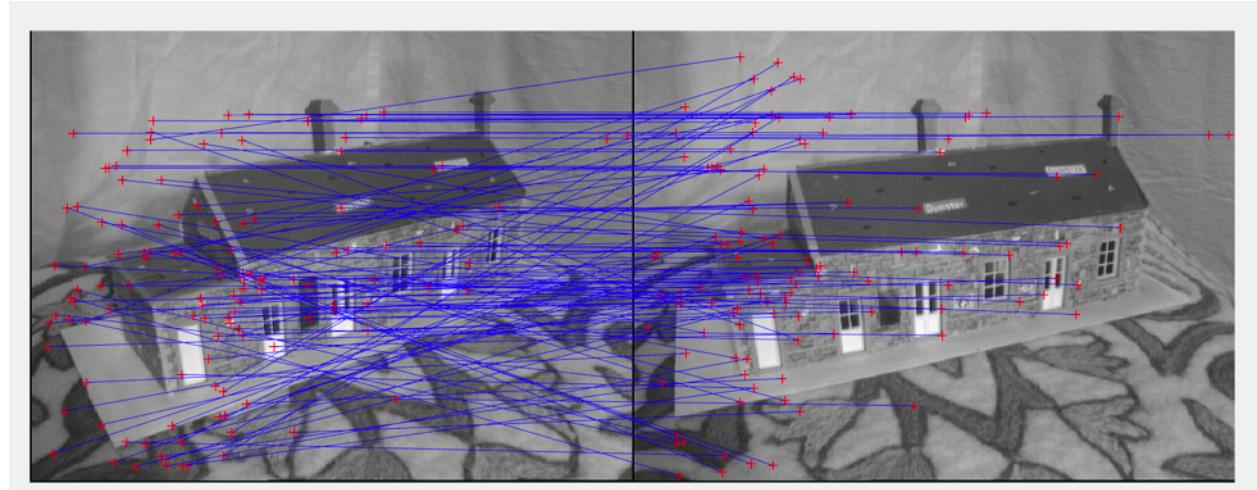


Figure 7: Task 2: Outlier matches after 6-point RANSAC (images 0 and 1).

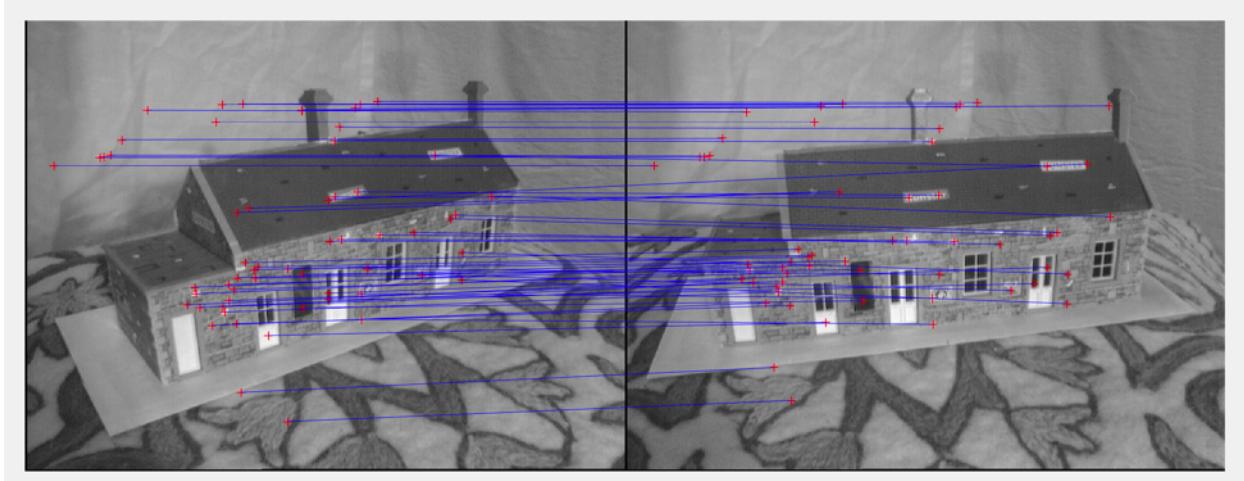


Figure 8: Task 2: Inlier matches after 6-point RANSAC (images 0 and 2).

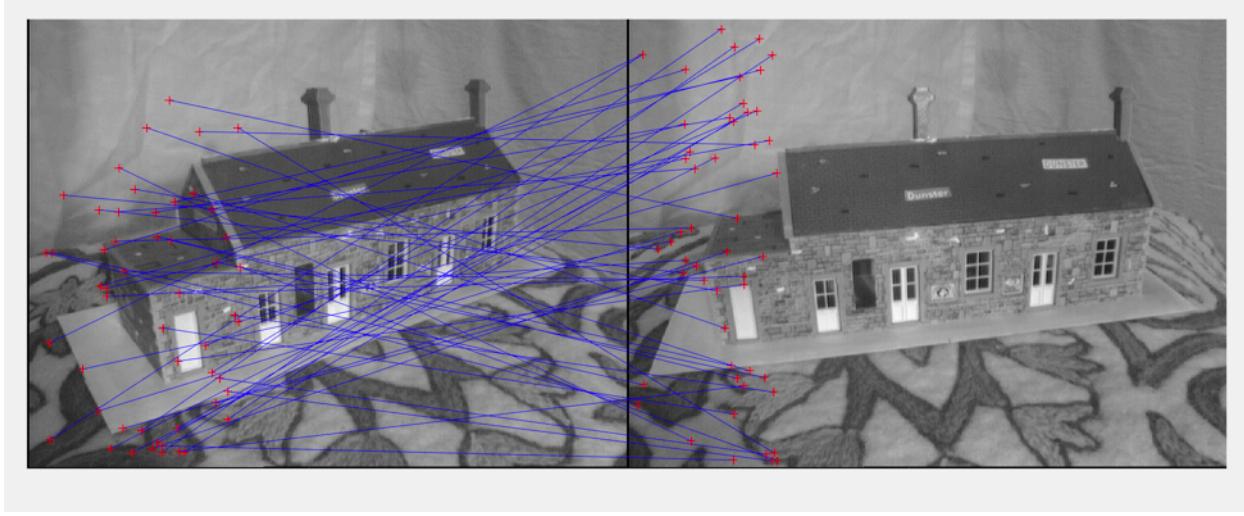


Figure 9: Task 2: Outlier matches after 6-point RANSAC (images 0 and 2).

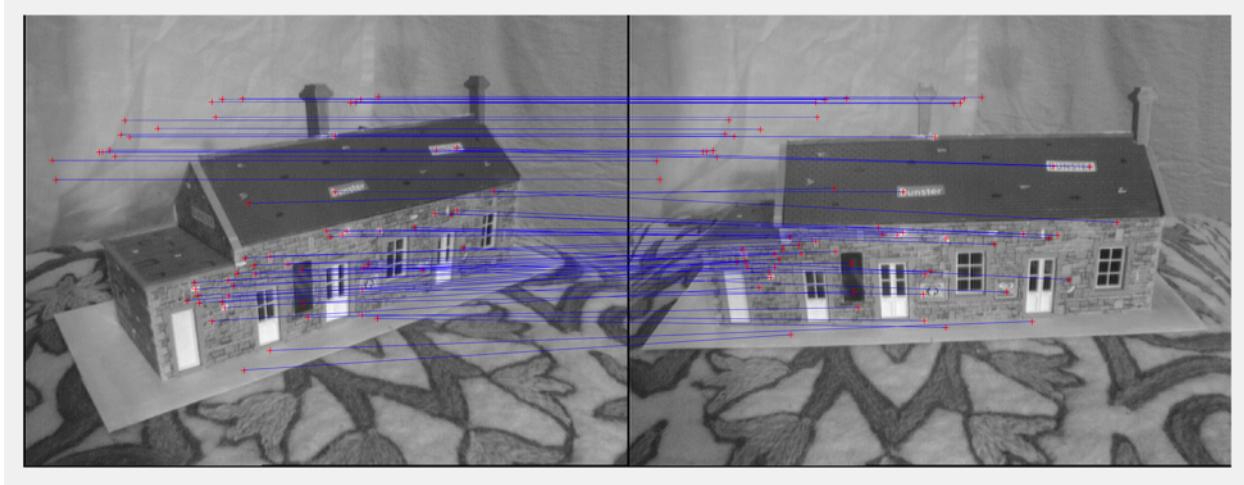


Figure 10: Task 2: Inlier matches after 6-point RANSAC (images 0 and 3).

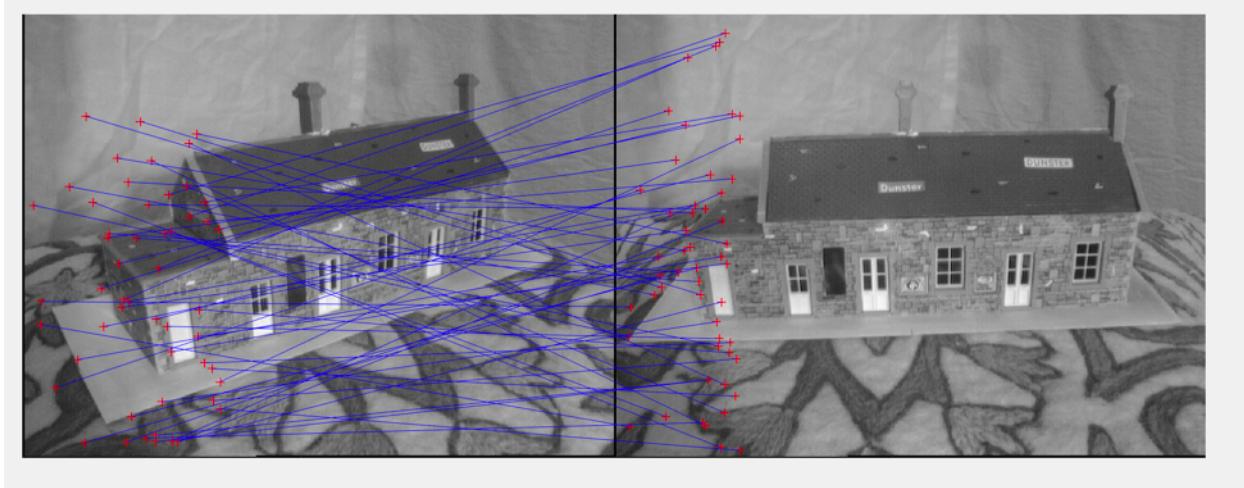


Figure 11: Task 2: Outlier matches after 6-point RANSAC (images 0 and 3).

3 Plotting

In this part the 3D points calculated for each view are plotted on the graph along with the camera poses as well. As we can see that the results are not perfect, bundle adjustment probably is needed to get better results. Also, this was the best run out of couple of trials. What can be deduced is that the random factor of the RANSAC algorithm can really affect the results here.

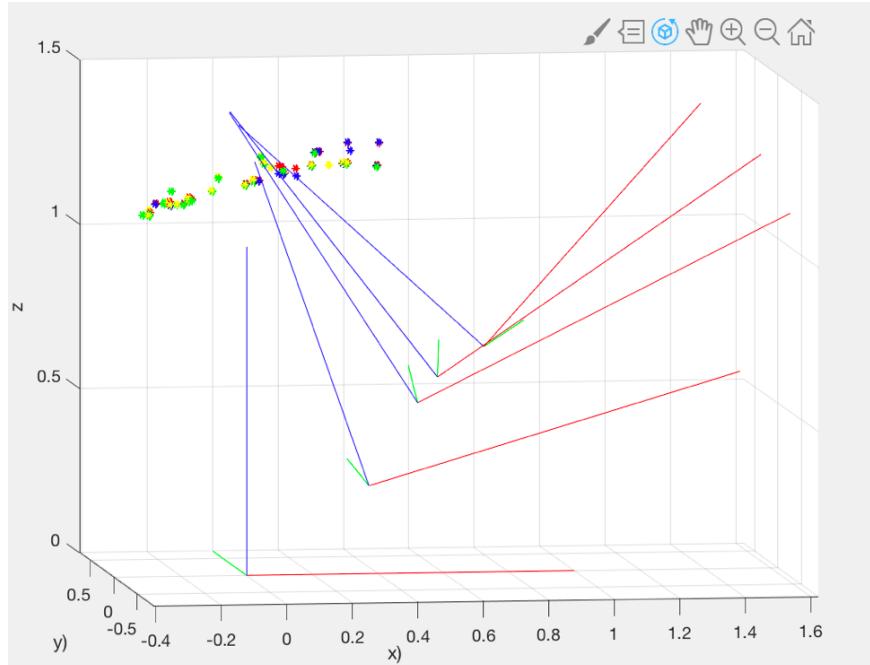


Figure 12: Task 3: Triangulated points and camera poses plotted in 3D. Red dots are the triangulated points from the initialization, blue dots are the triangulated points from the first additional image, green dots are from the second additional image and yellow dots are from the third additional image