Extracting Scale and Rotation Invariant Features for Reliable Object Matching

Ajay Ramesh
A20384062

Chandra Kumar Basavaraju
A20377471

Paper Details:
Title- Distinctive Image Features from Scale-Invariant Keypoints
Author - David G. Lowe **Publication Year -** November 2004

Problem Statement :

Extracting features for an object inside an image is an essential aspect of computer vision. Features should be invariant to image scale, rotation, translation and illumination[1]. The Harris corner method only finds the features that are invariant to rotation. For the matching problem, we need the features to be invariant also to scale so that we can identify the similar objects in the image taken from different viewpoints. So extracting invariant features are very important for reliable object matching.

Approach:

As described in the paper, we aim to extract distinctive invariant features, which are invariant to scale and rotation, from the image that can be used for reliable object matching in images. We will use the features that our method extracts for the object matching, using the approach mentioned in the paper. We compare the results we get to the ORD implementation provided by opencv[3].

Stages in generating the features are as below:

1. **Scale space extrema detection:** in this stage we scan over all scales and location of the input image to find interest points that are invariant to scale and orientation, using Difference of Gaussian (DoG) function.
2. **Keypoint localization:** In this stage we fit a detailed model at each candidate position to determine its location and scale.
3. **Orientation assignment:** In this stage, we assign orientations based on image gradients for each keypoint and use it further in our processing.
4. **Keypoint description:** In this stage, for each keypoint we measure the local image gradient around at the selected scale and these we transform into a

representation that allows for significant distortion and illumination change.Keypoint Matching ?

We use Cascading filtering approach to find the features, in which expensive operations are done only at location that pass an initial condition, for the efficiency of the model.

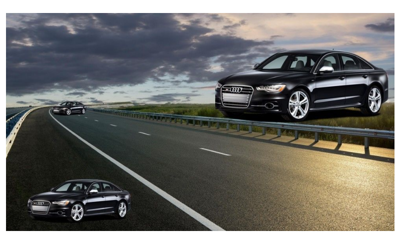
Team Member's responsibility:

Each of us will implement two stages of the algorithm as described in our reference paper[1]. Please find below the stages assigned:
Ajay Ramesh - Keypoint localization & Keypoint description.
Chandra Kumar Basavaraju - Scale space extrema detection: & Orientation .

Finally, both of us together will test and compare our results with the results of ORD in OpenCV.

Data:

We have created similar test images like mentioned in the paper[1], that is we will train an object(fig-a), using that object we see it in actual test image(fig-b). The test image is created in paint using that object, we scaled,rotated and transformed(fib-c). Please find those in image folder for this image. This forms one test case. We will test across the different resolutions also.Once everything implemented we will train multiple objects. We will try to get the same image used in the paper[1] for final demo, if not available, we will get similar images for multiple object matching.

		
Fig-a: Train Object	Fig-b: Test Image	Fig-c: Test image overview

References :

1. Lowe, D.G. International Journal of Computer Vision (2004) 60: 91. https://doi.org/10.1023/B:VISI.0000029664.99615.94
2. Introduction to SIFT (Scale-Invariant Feature Transform)
3. E. Rublee, V. Rabaud, K. Konolige and G. Bradski, "ORB: An efficient alternative to SIFT or SURF," *2011 International Conference on Computer Vision*, Barcelona, 2011, pp. 2564-2571. doi: 10.1109/ICCV.2011.6126544