Taking up the RoCKIn@Work Object Recognition Challenge With The Bag Of Keypoints Approach

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RoCKIn@Work 2014

- Recognize object-types
- App. 10 object types
- Benchmark
Research Question

• Investigate the performance of the Bag Of Key-points method combined with generic object features

Csurka et al. 2004 [1]
- Distinct classes (faces, trees, cars)
- Much cluttering/noise/occlusion

smARTLab@Work 2014 [2]
- Image intensity, object size
- Changing camera position

RoCKIn@Work 2014
- Similar classes
- Little noise
Bag Of Key-points

- $N_{\text{descr}} \times 64$ descriptor matrix
- $N \times k$ histogram matrix

Descriptors clustered in $k$ clusters
Bag Of Key-points

SURF [3] key-points:
• Scale- and rotation-invariant
• Fast implementation in OpenCV

Histograms of descriptors
Research Methods

- Investigate:
  - Influence of parameter $k$ on the classification result
  - Key-point histograms VS generic object features
  - Classification algorithms
Parameter $k$

- Classification result determined by clustering result (compactness)?

- Optimal value of $k$
Key-points VS Generic Features

• SURF key-point histograms

• Extra Features
  Distribution of key-points
  Nr. of key-points
  Occupied area
  Nr. of Hough-lines [4]
Key-points VS Generic Features Results

10-folds cross validation
1029 images

<table>
<thead>
<tr>
<th></th>
<th>histograms</th>
<th>only extra features</th>
<th>histograms and extra features</th>
</tr>
</thead>
<tbody>
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<td>error-rate</td>
<td>0.247446</td>
<td>0.502294</td>
<td>0.216262</td>
</tr>
</tbody>
</table>
Classification

  - Support Vector Machines (Csurka et al. [1])
  - K-nearest neighbor
  - Naïve Bayes

- Dataset
  - Controlled, no noise

- Method:
  - 10-folds cross validation
Classification Results
Conclusion

• Ideal number of clusters is not just dependant on clustering result

• Histograms of key-points are better than generic features, but both contribute to result

• K-nearest neighbor works best with big datasets
Future work

- Different clustering algorithm
- Different types of key-points
- Other datasets


