Wheelchair Detection and Pose Estimation in Monocular Images
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Introduction

- Wheelchairs are the most important auxiliary instrument for people with mobility impairments. Accurate detection and tracking of these devices could bring a number of improvements in automated services.
- Our goal is to present a deep learning-based wheelchair detection and tracking system along with an algorithm that can estimate its pose.

Challenges

- Extract features from different types of wheelchairs.
- Detection from different viewing angles and in cluttered environments.
- Avoid pre-calibration.

Our Approach

- We used object recognition framework Faster R-CNN to perform detection and tracking.
- We evaluated the performance of the framework using the approximate joint training scheme.
- We used ResNet50 as our baseline architecture.

- We used data augmentation and bin-specific separation techniques to increase robustness and accuracy.

Results

- Generated bounding boxes are used for wheelchair pose estimation.
- Wheelchair pose is estimated using contours and wheel search using least mean squares fitting ellipse algorithm.

<table>
<thead>
<tr>
<th>Wheelchair Detection</th>
<th>No Data Augmentation</th>
<th>Data Augmentation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mAP@0.50 (%)</td>
<td>mAP@0.70 (%)</td>
</tr>
<tr>
<td>Non-Motorized wheelchair bin</td>
<td>61.71</td>
<td>78.73</td>
</tr>
<tr>
<td>Complete dataset</td>
<td>91.21</td>
<td>75.47</td>
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</table>

Table 1: mAP results of the Approximate Joint Training.

Discussion

- Our implementation robustly and accurately addressed the challenges previously presented.
- The approach for the wheelchair pose estimation is simple to apply, and does not require previous training data sets.

Future Work

- Implement Mask R-CNN to increase the robustness of detection and to facilitate pose estimation by segmenting the regions of interest.

Acknowledgments

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References