Fully Automated Traffic Sign Substitution in Real-World Images for Large-Scale Data Augmentation

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Natural traffic sign images (left of arrows) taken from the GTSRB dataset serve as basis for the automatic generation of various other realistic traffic sign classes.

Motivation
• Automatic generation of images for training purposes
• Data augmentation
  – Enhance small datasets
  – Increase number of training samples for rare classes
• Traffic sign generation similar to GTSRB samples
• Transferable to other image generation techniques with simple geometry

Method
• Use samples from GTSRB
• Substitute traffic sign by generated one but keep background
• Use previously presented CycleGAN\textsuperscript{2} to transfer between life-like and cartoon domains
• Extract pose from original sample and apply to substitute

Extraction

Composition

Experimental Setup
• Multi-class SVM classifier on HOG features
• Training on dataset according to composition table
• Test on same set of real-world samples from GTSRB

Results

Generated images in all classes
• Category-wise classification results
• All new training sets better than previous method
• SVM\textsubscript{Gen} outperforms baseline classifier

One unseen generated image class
• Three different traffic sign replacements
• Accuracy of replaced class always better than previous method
• Overall accuracy comparable to baseline

Table: SVM\textsubscript{Gen} experiments compared to baseline

<table>
<thead>
<tr>
<th>SVM\textsuperscript{Prev}</th>
<th>SVM\textsuperscript{Base}</th>
<th>SVM\textsuperscript{Gen}</th>
<th>SVM\textsuperscript{Gen}</th>
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</thead>
<tbody>
<tr>
<td>SVM\textsuperscript{Base}</td>
<td>70.45 73.00</td>
<td>73.06 75.60</td>
<td>75.20 77.80</td>
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</tbody>
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Results for training on partially generated data. SVMs were trained on real-world data, with the exception of one generated class as stated in each table. Number of generated samples for replaced class follows dataset composition rules stated above. Highlighted numbers show deviating results from baseline.

Generation of realistic looking images from arbitrary (including fictitious) traffic sign icons.