Construction of Cascaded Traffic Sign Detector Using Generative Learning

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Abstract

We propose a method for construction of a cascaded traffic sign detector. Viola et al. have proposed a robust and extremely rapid object detection method based on a boosted cascade of simple feature classifiers. To obtain a high detection accuracy in real environment, it is necessary to train the classifier with a set of learning images which contain various appearances of detection targets. However, collecting the traffic sign images manually for training takes much cost. Therefore, we use a generative learning method for constructing the traffic sign detector. In this paper, shape, texture and color changes are considered in the generative learning. By this method, the performance of the traffic sign detection improves and the cost of collecting the training images is reduced at the same time. Experimental results using car-mounted camera images showed the effectiveness of the proposed method.

1. Introduction

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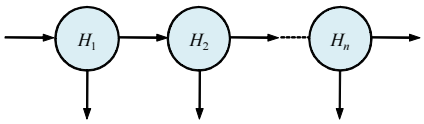

Figure 1. Architecture of a classi er-cascade.

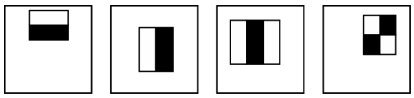

Figure 2. Examples of Haar-like features.

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Figure 3. Examples of Japanese traf c signs captured in various conditions. These captured images contain various changes on shape, texture and color, such as 3D-rotation, stretching, optical blurring, background pattern, discoloration and re ection.

2. Construction of cascaded traffic sign detector using generative learning

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2.1. Modeling shape, texture and color changes

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- **Shape and texture change models**

  Rotation :

  $x \quad y \quad z$

  Shifting :

  Δ Δ

  Stretching :

  w h

  Optical blurring :

$$(\quad) = \frac{1}{2} \exp \mu - \frac{^2 + ^2}{2 \ ^2} \P$$

Background pattern :

- **Color change models**

  Discoloration :

  $(\ i \quad i \quad i)$

  Reflection and shadow :

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2.2. Generation of traffic sign images

fi $\boldsymbol{P} =$ $(\ x \quad y \quad z \ \Delta \quad \Delta \quad b \quad i \quad i \quad i \ )$ fi

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2.3. Construction of a cascaded traffic sign detector

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- $= \quad = \quad = \quad + \quad +$
- $= 0 \ 2989 \quad + 0 \ 5866 \quad + 0 \ 1145$

Figure 4. Examples of the generated traf c sign images. In the experiments, detection targets are these twenty kinds of round regulartory signs.

3. Experiments

3.1. Conditions

640×480

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μ σ

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3.2. Methods

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3.3. Results

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4. Conclusion

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Table 1. Mean and standard deviation of generation parameters.

	Shape and texture models								Color models							
	Rotation °			Shifting		Stretching		Optical blurring	Discoloration						Reflection & shadow	
									Red region			Blue region				
	θ_x	θ_y	θ_z	Δx	Δy	w	h	σ	h_r	s_r	v_r	h_b	s_b	v_b	v	
$\boldsymbol{\mu}$															-0.25	
$\boldsymbol{\sigma}$																

Table 2. Comparison of detection ability.

		0.97
		0.93
		0.95

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Acknowledgments :

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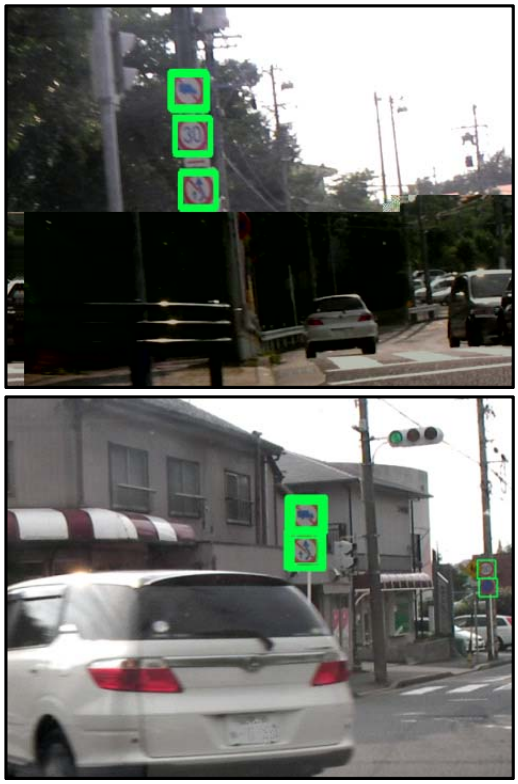

Figure 5. Examples of the detection results. Each rectangle represents detected traf c sign.

References

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