

LanePainter: Lane Marks Enhancement via Generative Adversarial Network

PROJECT TITLE

LanePainter: Lane Marks Enhancement via Generative Adversarial Network

STUDY TIMELINE

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VTRANS CONTACTS

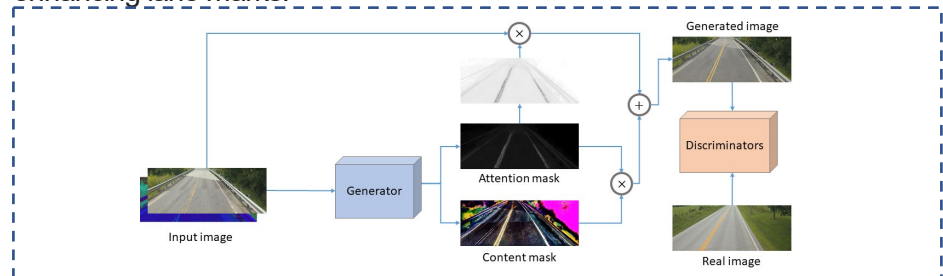
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KEYWORDS

Computer Vision, Deep Learning, Lane detection, Lane Quality Estimation

Problem Statement

Lane detection is one of the popular research fields in computer vision and autonomous driving. In practice, current lane detection algorithms struggle with the erosion of the lane marks which is unclear and even partially disappear. In this research, we study this problem and propose LanePainter, a Generative Adversarial Network (GAN) based model for simultaneously classifying and enhancing lane marks.



Proposed model overview

Methodology

Following the typical GAN structure, our model has a generator and a discriminator. Our generator takes a front dash camera image as input and generates an attention mask and content map as shown above. The enhanced image is a weighted combination of the original image and the content map from the attention mask. The discriminator learns to distinguish between the generated images and the real high-quality lane mark images.

Experiments and Conclusions

We perform a classification analysis on our test set. We achieve values of **98.16%**, **98.59%**, **97.48%** and, **97.99%** in accuracy, precision, recall, F1 score respectively. The table on the right shows that the performance of an existing lane detection algorithm on a low-quality lane marks test set and the enhanced lane marks generated by our model. The difference in F1 score between before enhancement and after enhancement demonstrates that our model can improve the performance of lane detection algorithms under low-quality lane mark conditions.

ResNet50			
	Before	After	Difference
TP ↑	174	247	73
FP ↓	81	65	-16
FN ↓	170	97	-73
Precision ↑	0.6824	0.7917	0.1093
Recall ↑	0.5058	0.7180	0.2122
F1 ↑	0.5810	0.7530	0.1720

Potential Impacts and VTrans Benefits

Our research provides a solution which automatically annotates the quality of lane marks. This will help in accelerating the road maintenance and thus increase the safety of Vermont's roads. In addition, our method will help in understanding the lane types for road planning purposes.

More information about the VTrans Research Program, including additional Fact Sheets, can be found at: <http://vtrans.vermont.gov/planning/research>