

# ATTENTION BASED COUPLED FRAMEWORK FOR ROAD AND POTHOLE SEGMENTATION

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## **Abstract**

In this paper, we propose a novel attention based coupled framework for road and pothole segmentation. In many developing countries as well as in rural areas, the drivable areas are neither well-defined, nor well-maintained. Under such circumstances, an Advance Driver Assistant System (ADAS) is needed to assess the drivable area and alert about the potholes ahead to ensure vehicle safety. Moreover, this information can also be used in structured environments for assessment and maintenance of road health. We demonstrate few-shot learning approach for pothole detection to leverage accuracy even with fewer training samples. We report the exhaustive experimental results for road segmentation on KITTI and IDD datasets. We also present pothole segmentation on IDD.

## **Methodology**





#### Fig. 1. Framework of proposed road and pothole detection architecture.



(a) Attention Based Refinement Module, Right:corresponding Attention Map.





Proposed Model (With 73.83 Attention Module)

Module)

#### Fig. 5. Knee Graph mIoU V/s No of training samples

Table 1 : Quantitative results on road segmentation (IDD dataset)



Fig. 5. Pothole Detection Results on IDD showing variability in size, depth and shadow

### **Conclusion**

- The experiments show that the overall mIoU of the proposed attention framework is 98.42% for road segmentation and 73.83% for pothole segmentation on IDD dataset. The road segmentation on KITTI dataset is evaluated in terms of F1-score which is 95.21% with reduction in run-time by 81% in comparison.
- The future extension of this work is directed towards finetuning the model for tackling road-scene images under different weather (such as rain, fog, snow) and light (like road condition assessment during night) conditions.



(b) Feature Fusion Module.

## Fig. 2. Attention Based Refinement With Feature Fusion Dataset Created

For experiments on pothole detection, we have annotated 237 images from IDD dataset with varying pothole sizes using LabelMe toolbox.

## **Experimental Results**

Method	mIoU	MaxF1	Precision	Recall	Accuracy	FPR	FNR	Runtime
Results on complete dataset								
SOTA results	-	97.05%	97.18%	96.92%	-	1.28	3.08	0.16s
SOTA results	-	95.78%	94.92%	96.66%	-	2.36	3.34	0.16s
Proposed Model (w/o Attention Module)	93.2%	94.63%	94%	95.17%	98.0%	1.29	4.05	0.017s
Proposed Model (With Attention Module)	93.6%	95.21%	94.02%	95.95%	98.1%	1.29	4.84	0.030s
Results on UM, UMM UU from KITTI dataset								
UM: Proposed Model (w/o Attention Module)	89.84%	96.52%	97.22%	95.53%	-	0.47	4.48	-
UM: Proposed Model (with Attention Module)	89.95%	95.75%	92.91%	98.45%	-	1.40	1.55	-
UMM: Proposed Model (w/o Attention Module)	90.63%	97.32%	97.73%	96.64%	-	0.61	3.37	-
UMM: Proposed Model (with Attention Module)	91.04%	96.59%	94.38%	98.62%	-	1.735	1.38	-
UU: Proposed Model (w/o Attention Module)	93.0%	95.46%	96.87%	93.80%	-	0.423	6.22	-
UU: Proposed Model (with Attention Module)	92.80%	95.77%	93.92%	97.37%	-	0.93	2.63	-

Fig. 3. Quantitative results on road segmentation (KITTI dataset)

• Another interesting area to explore would be semi-supervised learning technique to improve classification performance when there is a significant difference between the distributions of the unlabeled and the labeled data.

## **References**

- 1. G. Varma, A. Subramanian, A. Namboodiri, M. Chandraker, and C. Jawahar, "Idd: A dataset for exploring problems of autonomous navigation in unconstrained environments," in 2019 IEEE Winter Conference on Applications of Computer Vision (WACV). IEEE, 2019, pp. 1743–1751.
- 2. L.-C. Chen, Y. Zhu, G. Papandreou, F. Schroff, and H. Adam, "Encoderdecoder with atrous separable convolution for semantic image segmentation," in ECCV, 2018.

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