

[Supplemental Material] V-RoAst: Visual Road Assessment Can VLM be a Road Safety Assessor Using the iRAP Standard?

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Attribute-level Performance Comparison

This supplementary section expands on the attribute-level analysis introduced in Section 5.2.3 of the main paper. Table 1 provides detailed performance results for all 52 iRAP-defined attributes, comparing four models, two CNN-based baselines (VGG and ResNet) and two vision-language models (GPT-4o-mini and Gemini-1.5-flash).

Metrics reported include Accuracy, Precision, Recall, and F1-score. The best-performing model for each metric is **bolded**. This breakdown complements the summary metrics in the main paper and highlights performance variation across diverse attribute types.

As discussed, vision-language models are capable of zero-shot prediction across all attributes, including those with limited or no training samples in the CNN setting.

Table 1. Performance comparison across all iRAP-defined attributes using four models: VGG, Res(Net), GPT(-4o-mini), and Gem(ini-1.5-flash). Attribute group abbreviations: OF = Observed Flow, F = Facilities, DS = Driver-Side, PS = Passenger-Side, PC = Pedestrian Crossing, POF = Pedestrian Observed Flow, RS = Roadside Severity, SZ = School Zone. Metrics include Accuracy, Precision, Recall, and F1-score. For each attribute group, the last row (“All”) reports the macro-average across all attributes. **Bold** indicates the best-performing model.

Group	Attribute	Accuracy				Precision				Recall				F1			
		CNN		VLM		CNN		VLM		CNN		VLM		CNN		VLM	
		VGG	Res	GPT	Gem	VGG	Res	GPT	Gem	VGG	Res	GPT	Gem	VGG	Res	GPT	Gem
Observed Flow	Motorcycle (OF)	0.96	0.96	0.80	0.93	0.48	0.67	0.20	0.58	0.48	0.97	0.27	0.42	0.48	0.73	0.20	0.46
	Bicycle (OF)			1.00	1.00			1.00	1.00			1.00	1.00			1.00	1.00
	(POF) across the road			1.00	1.00			0.50	1.00			0.50	1.00			0.50	1.00
	(POF) along the road (DS)	1.00	1.00	0.99	0.99	1.00	1.00	0.33	0.33	1.00	1.00	0.33	0.33	1.00	1.00	0.33	0.33
	(POF) along the road (PS)	1.00	1.00	0.99	0.99	1.00	1.00	0.33	0.50	1.00	1.00	0.33	0.50	1.00	1.00	0.33	0.50
	All Observed Flow	0.99	0.99	0.95	0.98	0.83	0.89	0.47	0.68	0.83	0.99	0.49	0.65	0.83	0.91	0.47	0.66
Speed Limits	Speed limit	0.99	0.98	0.44	0.74	0.65	0.98	0.34	0.50	0.67	0.97	0.33	0.48	0.66	0.98	0.30	0.48
	Motorcycle speed limit	1.00	1.00	0.54	0.96	0.48	1.00	0.55	0.86	0.50	1.00	0.76	0.73	0.49	1.00	0.44	0.78
	Truck speed limit	1.00	1.00	0.62	0.94	0.48	1.00	0.38	0.57	0.50	1.00	0.52	0.48	0.49	1.00	0.34	0.52
	Differential speed limits	0.99	0.98	0.21	0.74	1.00	0.97	0.60	0.39	1.00	0.96	0.51	0.46	1.00	0.97	0.19	0.43
	Speed management	0.98	0.96	0.80	0.80	1.00	0.97	0.40	0.40	1.00	0.96	0.50	0.50	1.00	0.97	0.45	0.45
	All Speed Limits	0.99	0.98	0.52	0.84	0.72	0.98	0.46	0.55	0.73	0.98	0.52	0.53	0.73	0.98	0.34	0.53
Mid-block	Number of lanes	0.95	0.95	0.14	0.55	0.66	0.82	0.29	0.30	0.44	0.82	0.32	0.54	0.49	0.82	0.09	0.26
	Lane width			1.00	1.00			1.00	1.00			1.00	1.00			1.00	1.00
	Curvature	0.99	0.99	0.98	0.98	0.50	1.00	0.49	0.62	0.48	1.00	0.50	0.62	0.49	1.00	0.49	0.62
	Quality of curve	0.99	0.99	0.98	0.98	0.50	1.00	0.49	0.62	0.48	1.00	0.50	0.62	0.49	1.00	0.49	0.62
	Upgrade cost	0.93	0.96	0.49	0.61	0.92	0.98	0.57	0.39	0.83	0.97	0.34	0.45	0.86	0.97	0.25	0.40
	Median type	0.93	0.95	0.19	0.72	0.67	0.97	0.17	0.21	0.70	0.84	0.22	0.25	0.68	0.89	0.08	0.23
	Skid resistance / grip	0.98	0.99	0.80	0.80	0.98	0.98	0.40	0.73	0.95	0.95	0.50	0.51	0.96	0.96	0.44	0.47
	Road condition	0.00	0.00	0.99	0.98			0.50	0.50			0.50	0.49			0.50	0.49
	Vehicle parking	0.99	1.00	0.79	0.97	0.48	0.48	0.33	0.50	0.50	0.50	0.27	0.49	0.49	0.49	0.30	0.49
	Grade			1.00	1.00			1.00	1.00			1.00	1.00			1.00	1.00
	Roadworks			1.00	0.99			0.50	0.50			0.50	0.50			0.50	0.50
	Sight distance			1.00	1.00			1.00	1.00			1.00	1.00			1.00	1.00
	Delineation	1.00	1.00	1.00	1.00	0.50	1.00	0.50	0.50	0.48	1.00	0.50	0.50	0.49	1.00	0.50	0.50
	Street lighting	0.96	0.97	0.89	0.94	1.00	1.00	0.62	0.75	1.00	1.00	0.68	0.72	1.00	1.00	0.64	0.73
	Service road	0.97	0.98	0.12	0.10	0.47	0.98	0.55	0.05	0.50	0.75	0.51	0.50	0.48	0.83	0.11	0.09
	Centreline rumble strips			1.00	1.00			1.00	1.00			1.00	1.00			1.00	1.00
	All Mid-block	0.97	0.98	0.77	0.85	0.67	0.92	0.59	0.60	0.64	0.88	0.58	0.64	0.64	0.90	0.52	0.59
Roadside	(RS) - (DS) distance	0.97	0.96	0.13	0.00	0.91	0.94	0.25	0.00	0.91	0.98	0.17	0.00	0.91	0.96	0.10	0.00
	(RS) - (DS) object	0.93	0.94	0.25	0.82	0.46	0.46	0.18	0.27	0.48	0.48	0.10	0.29	0.47	0.47	0.10	0.28
	(RS) - (PS) distance	0.86	0.88	0.36	0.04	0.60	0.66	0.39	0.03	0.58	0.52	0.38	0.26	0.57	0.55	0.22	0.04
	(RS) - (PS) object	0.71	0.76	0.24	0.26	0.82	0.89	0.29	0.06	0.80	0.87	0.26	0.16	0.80	0.88	0.16	0.09
	Shoulder rumble strips	0.99	0.98	0.99	0.96	0.48	0.48	0.50	0.50	0.50	0.50	0.50	0.48	0.49	0.49	0.50	0.49
	Paved shoulder - (DS)	0.98	0.96	0.11	0.02	0.91	0.88	0.22	0.25	0.91	0.84	0.03	0.01	0.91	0.86	0.06	0.01
	Paved shoulder - (PS)	0.87	0.89	0.19	0.41	0.86	0.98	0.09	0.31	0.87	0.94	0.11	0.27	0.86	0.96	0.10	0.25
	All Roadside	0.90	0.91	0.33	0.36	0.72	0.76	0.27	0.20	0.72	0.73	0.22	0.21	0.72	0.74	0.18	0.17
Intersections	Land use - (DS)	1.00	1.00	0.38	0.99	1.00	1.00	0.33	0.33	1.00	1.00	0.46	0.33	1.00	1.00	0.19	0.33
	Land use - (PS)	0.86	0.88	0.70	0.26	0.55	0.55	0.26	0.21	0.53	0.54	0.31	0.17	0.54	0.54	0.27	0.11
	Area type	0.96	0.98	0.90	0.82	1.00	1.00	0.68	0.66	1.00	1.00	0.58	0.86	1.00	1.00	0.61	0.68
	(PC) (F) - inspected road	0.94	0.96	0.94	0.95	0.48	0.48	0.31	0.57	0.48	0.47	0.33	0.39	0.48	0.48	0.32	0.42
	(PC) (F) - intersecting road	0.99	0.99	0.99	0.99	1.00	1.00	0.33	0.33	1.00	1.00	0.33	0.33	1.00	1.00	0.33	0.33
	(PC) quality	0.95	0.95	0.93	0.93	0.48	0.48	0.47	0.47	0.48	0.47	0.50	0.50	0.48	0.48	0.48	0.48
	Pedestrian fencing	1.00	1.00	1.00	1.00	1.00	1.00	0.50	0.50	1.00	1.00	0.50	0.50	1.00	1.00	0.50	0.50
	Sidewalk - (DS)			0.89	0.98			0.50	0.33			0.45	0.33			0.47	0.33
	Sidewalk - (PS)	0.92	0.93	0.77	0.83	0.34	0.72	0.18	0.31	0.32	0.74	0.21	0.20	0.33	0.73	0.20	0.20
	(F) for bicycles			1.00	1.00			1.00	1.00			1.00	1.00			1.00	1.00
	(F) for motorised two wheelers			1.00	1.00			0.50	1.00			0.50	1.00			0.50	1.00
	(SZ) crossing supervisor	0.96	0.98	0.96	0.96	0.73	0.98	0.48	0.32	0.73	0.75	0.50	0.33	0.73	0.83	0.49	0.33
	(SZ) warning	0.96	0.98	0.96	0.96	0.98	0.98	0.48	0.32	0.75	0.75	0.50	0.33	0.83	0.83	0.49	0.33
	All Intersections	0.95	0.97	0.88	0.90	0.76	0.82	0.46	0.49	0.73	0.77	0.48	0.48	0.74	0.79	0.45	0.46