MedFuse: a multi-source data fusion framework for diabetic retinopathy lesion segmentation

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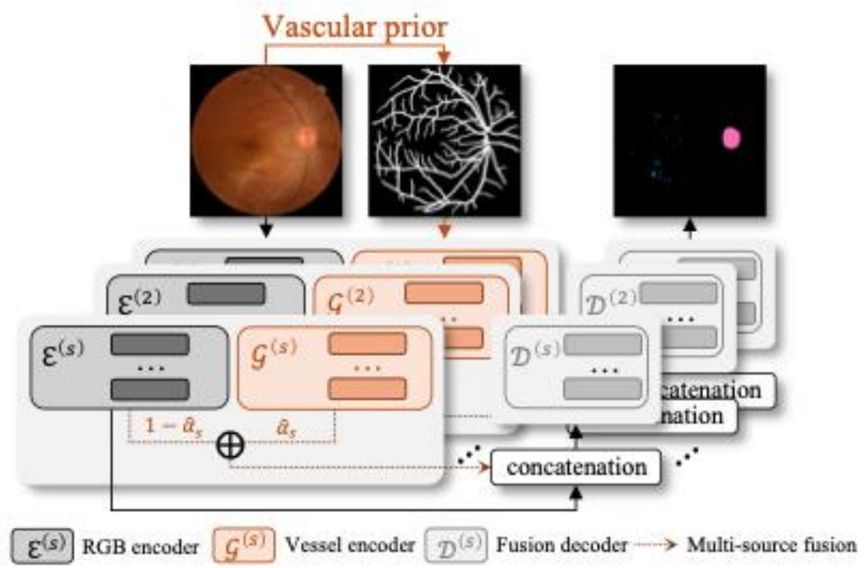
Problems & Ideas

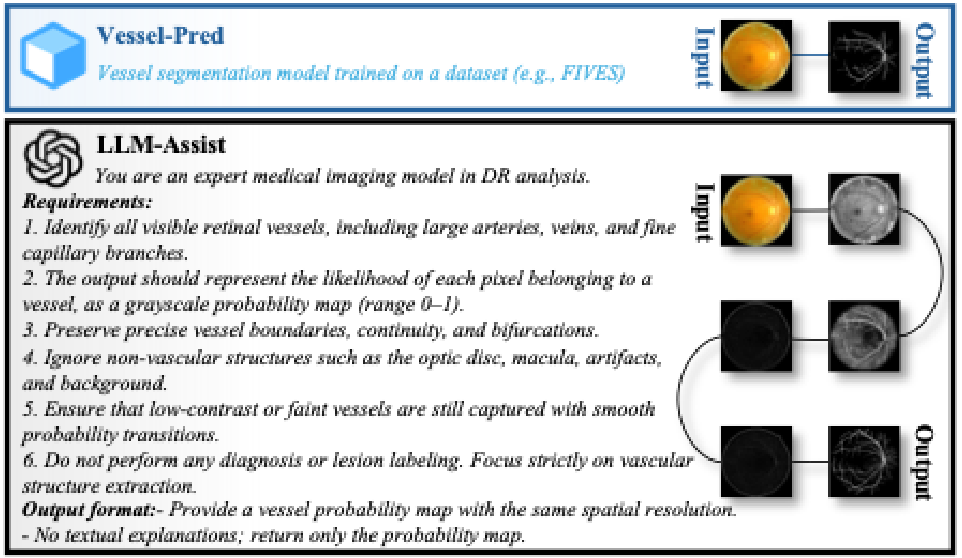
Problems of conventional approaches:

- ☐ Existing models rely heavily on texture features (texture-centric).
- ☐ They lack intrinsic anatomical understanding of the retina.
- ☐ High annotation cost of retina imaging.

Ideas (Our Solution):

- ✓ **Multi-Source Fusion:** A dual-encoder framework to fuse RGB features with structural priors hierarchically.
- ✓ **Mechanism-Guided:** Explicitly integrate the "Vascular Structural Prior" as an anatomical anchor.
- ✓ **LLM-Empowered:** Use Large Language Models for zero-shot generation of vascular maps (annotation-free).





Main Contributions & Results

- ✓ Proposed MedFuse, a flexible framework integrating anatomical priors for robust DR segmentation.
- ✓ Introduced a zero-shot, LLM-driven strategy for vascular structure extraction.
- ✓ Achieved consistent performance gains across various backbones.

Table 1 Quantitative comparison of lesion segmentation performance on the DDR dataset (mean±std). Unit: %.

		IoU					AUPR				
Model	**MedFuse**	**mIoU**	EX	HE	SE	MA	**mAUPR**	EX	HE	SE	MA
PSPNet	–	24.80±0.15	37.31±0.13	26.64±0.17	24.51±0.15	8.75±0.11	38.03±0.19	57.04±0.18	42.32±0.20	42.71±0.15	14.85±0.12
	✓	**25.72±0.16**	**38.63±0.15**	**27.92±0.17**	**26.07±0.16**	**10.24±0.11**	**40.28±0.18**	**58.36±0.17**	41.95±0.18	**44.06±0.14**	**16.12±0.13**
Deeplabv3+	–	26.15±0.17	40.12±0.14	24.86±0.16	24.48±0.18	15.11±0.11	43.96±0.20	61.46±0.18	52.13±0.16	38.89±0.13	28.33±0.12
	✓	**27.18±0.16**	**41.71±0.15**	**26.34±0.18**	**25.94±0.16**	**16.73±0.13**	**44.79±0.19**	**62.63±0.19**	**53.62±0.15**	**40.34±0.13**	**29.64±0.13**
Twins-SVT	–	29.27±0.17	39.70±0.14	36.24±0.15	29.08±0.15	12.07±0.10	46.08±0.17	59.71±0.15	52.72±0.17	49.96±0.14	21.54±0.12
	✓	**30.23±0.16**	**40.63±0.16**	**37.13±0.14**	**30.12±0.14**	**13.02±0.10**	**47.01±0.16**	**60.64±0.14**	**53.64±0.16**	**50.93±0.13**	**22.33±0.11**
UNet	–	25.69±0.15	36.68±0.13	23.79±0.16	**28.47±0.16**	13.83±0.11	39.13±0.16	60.31±0.17	**37.25±0.18**	40.92±0.14	17.36±0.11
	✓	**26.26±0.15**	**37.72±0.15**	**24.79±0.16**	28.23±0.15	**14.30±0.11**	**39.95±0.17**	**61.48±0.16**	36.53±0.15	**41.33±0.14**	**18.20±0.10**
Swin-L	–	30.31±0.17	41.17±0.15	30.79±0.14	35.81±0.17	13.48±0.12	47.47±0.16	63.10±0.15	51.35±0.15	52.99±0.13	24.46±0.11
	✓	**31.64±0.16**	**42.53±0.16**	**32.05±0.15**	**37.23±0.16**	**14.86±0.12**	**48.15±0.17**	**64.25±0.16**	**52.56±0.15**	**54.46±0.14**	**25.84±0.12**

Table 2 Quantitative comparison of lesion segmentation performance on the IDRiD dataset (mean±std). Unit: %.

		IoU					AUPR				
Model	**MedFuse**	**mIoU**	EX	HE	SE	MA	**mAUPR**	EX	HE	SE	MA
PSPNet	–	41.83±0.21	57.52±0.19	**45.61±0.27**	43.87±0.30	19.24±0.33	58.64±0.21	75.03±0.23	**63.47±0.25**	63.38±0.29	32.42±0.31
	✓	**43.28±0.19**	**59.87±0.17**	45.58±0.22	**46.15±0.26**	**21.08±0.31**	**59.97±0.17**	**76.38±0.19**	63.29±0.25	**63.91±0.27**	**34.71±0.27**
Deeplabv3+	–	45.02±0.19	66.08±0.20	44.62±0.24	44.72±0.28	25.43±0.33	63.70±0.18	82.04±0.22	63.23±0.26	**64.52±0.28**	43.05±0.28
	✓	**46.91±0.17**	**67.27±0.18**	**45.82±0.24**	**45.18±0.24**	**29.18±0.29**	**64.96±0.18**	**83.08±0.21**	**64.07±0.22**	64.41±0.27	**46.28±0.26**
Twins-SVT	–	47.60±0.18	64.72±0.19	51.79±0.25	44.97±0.25	27.04±0.29	63.90±0.17	80.12±0.21	**68.87±0.25**	63.22±0.26	43.28±0.28
	✓	**48.39±0.16**	**66.19±0.17**	**51.96±0.23**	**46.16±0.25**	**29.25±0.27**	**65.07±0.15**	**81.09±0.18**	68.85±0.23	**64.12±0.23**	**45.47±0.25**
UNet	–	44.60±0.22	60.23±0.21	47.85±0.27	47.76±0.29	**22.36±0.34**	56.82±0.21	64.21±0.22	64.08±0.28	63.99±0.28	35.01±0.31
	✓	**46.86±0.19**	**61.12±0.19**	**48.95±0.24**	**49.01±0.28**	21.03±0.32	**57.77±0.19**	**65.23±0.23**	**65.01±0.26**	**64.77±0.28**	**36.09±0.29**
Swin-L	–	49.87±0.15	65.23±0.18	52.03±0.23	51.42±0.25	30.81±0.29	69.50±0.17	85.29±0.20	**72.23±0.23**	72.62±0.25	46.02±0.27
	✓	**51.18±0.15**	**66.79±0.14**	**53.02±0.21**	**52.28±0.22**	**32.87±0.27**	**70.28±0.15**	**85.98±0.17**	72.15±0.22	**73.48±0.24**	**47.39±0.26**