Programmable Sensors for Task-Specific Imaging

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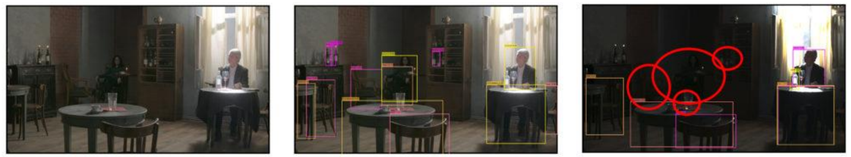
Motivation

- Camera's low dynamic range vs the real world
- Object detection inherently challenged
- New focal-plane sensor-processor technology

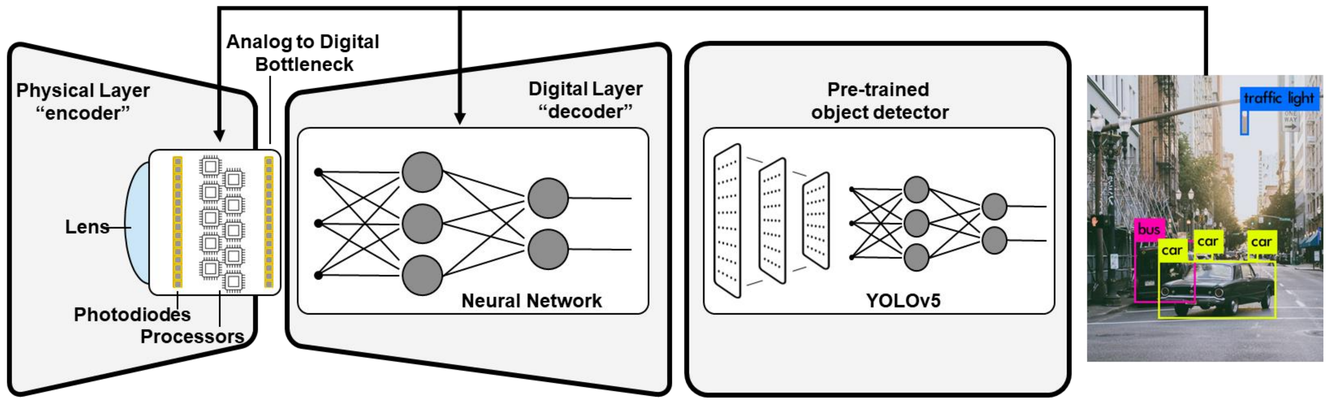


Related Work

- Focal-plane sensor-processors [1]
- Neural Auto Exposure [2]
- Neural Sensors [3]

Purposed method

- Focal-plane sensor-processors for easily configurable sensors
- End-to-end optimization for task-specific objectives



Experimental Results

- Log vs CNN encoder
- Wide vs deep CNNs for decoding
- End-to-end optimization for OD – visual and quantitative results

Name	L1 loss		OD loss	
Log camera	0.0987		26.4/11.7	
After training	TMO	OD	TMO	OD
Log-DCNN	0.11	0.16	9.2/4.1	19.2/8.5
Log-WCNN	0.084	0.13	13.2/6.5	20.8/9.5
Camera that CNNs	0.087	0.13	12.1/5.4	18.8/6.7

References

[1] Carey, Lopich, Barr, Wang, Dudek, "A 100,000 fps vision sensor with embedded 535gops/w 256× 256 simd processor array," in Symposium on VLSI Circuits. 2013.
[2] Onzon, Mannan and Heide, "Neural Auto-Exposure for High-Dynamic Range Object Detection," in CVPR, 2021.
[3] Martel, M¨uller, Carey, Dudek and Wetzstein, "Neural Sensors: Learning Pixel Exposures for HDR Imaging and Video Compressive Sensing With Programmable Sensors," in ICCP & T-PAMI, 2020