Enabling Visual AI at the Edge

From Surveillance Cameras to People Counters

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Synaptics

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Synaptics at a Glance

2021 embedded VISION summit

Engineering Exceptional Experiences

TECHNOLOGY AREAS OF EXPERTISE

Wireless Connectivity

Display Driver & Integrated Sensing

Capacitive Sensing

AI & Neural Networks

Far-field Voice & Speech Capture

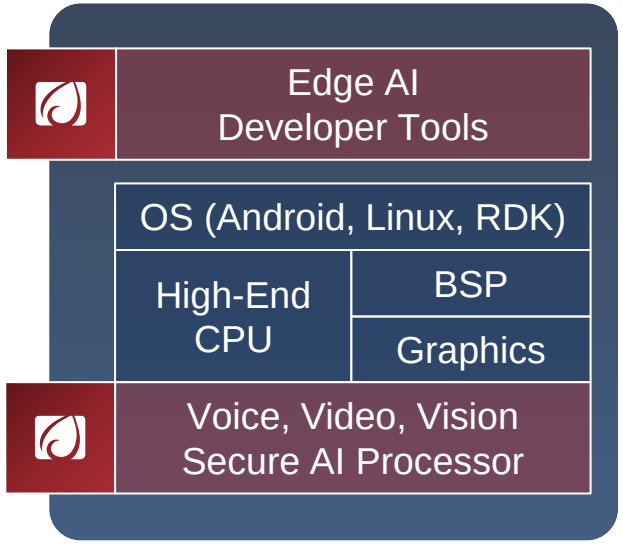
Optical Imaging

Video & Image Processing

Acoustics & Audio Processing

End Markets and Products

Synaptics AI at the Edge



Family of SoCs	SyNAP™ AI Developer Tools	Secure AI Processing
• Voice • Video • Vision	• Open, full stack solution • Built on industry standard AI frameworks • Seamless integration into secure, real-time video processing pipeline	• Analytics • Recognition • Enhancement

SyNAP™ AI Developer Tools

Synaptics Neural network Acceleration and Processing

- **Easy AI model optimization and deployment**
  - Import from TFLite, TensorFlow, PyTorch, Caffe and ONNX
  - Model optimization

    Layer fusion, pruning, 8-bit quantization
  - Network graph and metadata generation for target NPU
- **Performance profiling with simulator or on silicon**
  - Per layer analysis of network execution

    Instructions, clock cycles, memory bandwidth

VS680 Multimedia SoC

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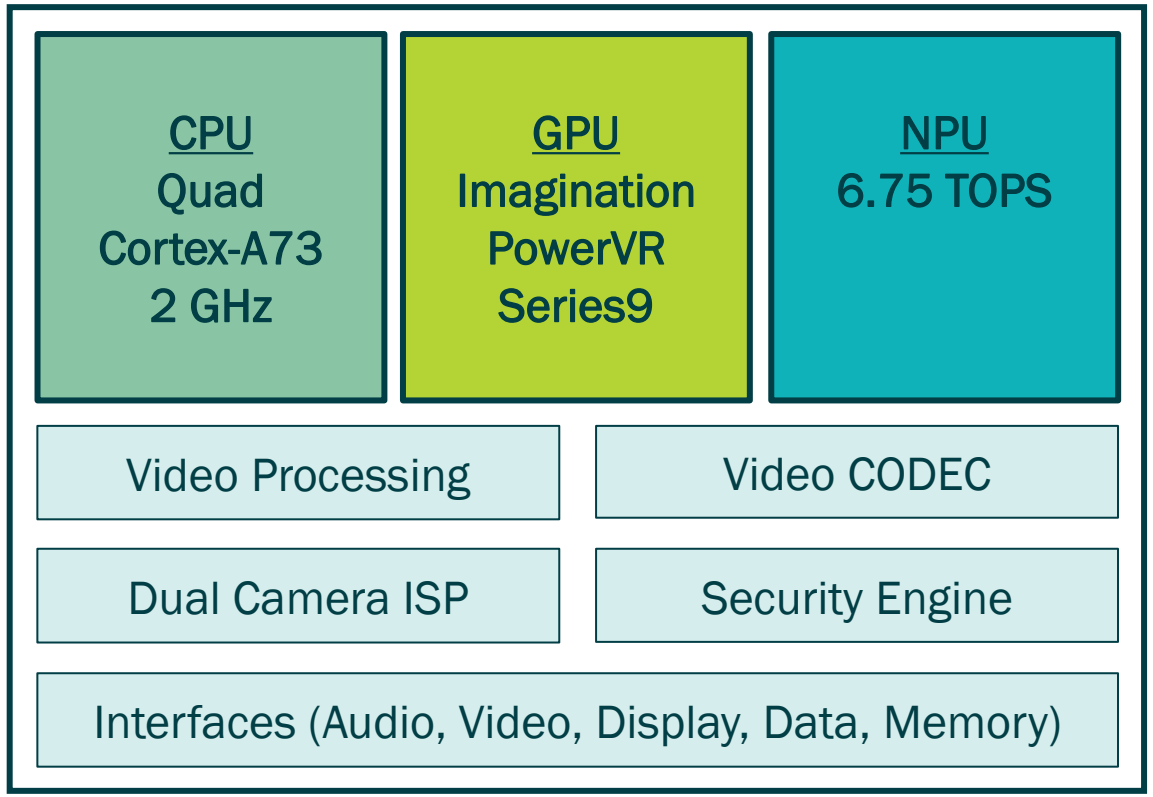
VS680 Multimedia SoC

- **Multimedia SoC**
  - CPU, GPU and NPU
- **Example applications**
  - Smart displays & smart monitors
  - Set-top boxes, soundbars, & media streamers
  - Video conferencing
  - Smart cameras
  - Smart signage
  - Emerging computer vision IoT products



Example Application: Super-resolution

- **Upscaling video to higher resolutions for displays, cameras, media streamers, set-top boxes, and video conferencing**

Scale Factor	In	Out	FPS	HW Scaler VMAF	DNN Scaler VMAF
2X	FHD	4K UHD	>30	86	93
3X	HD	4K UHD	>60	66	77
4X	qHD	4K UHD	>60	49	63

FHD → 4K UHD: 10B MACs/frame

Output from Traditional HW Scaler

Output from DNN Scaler

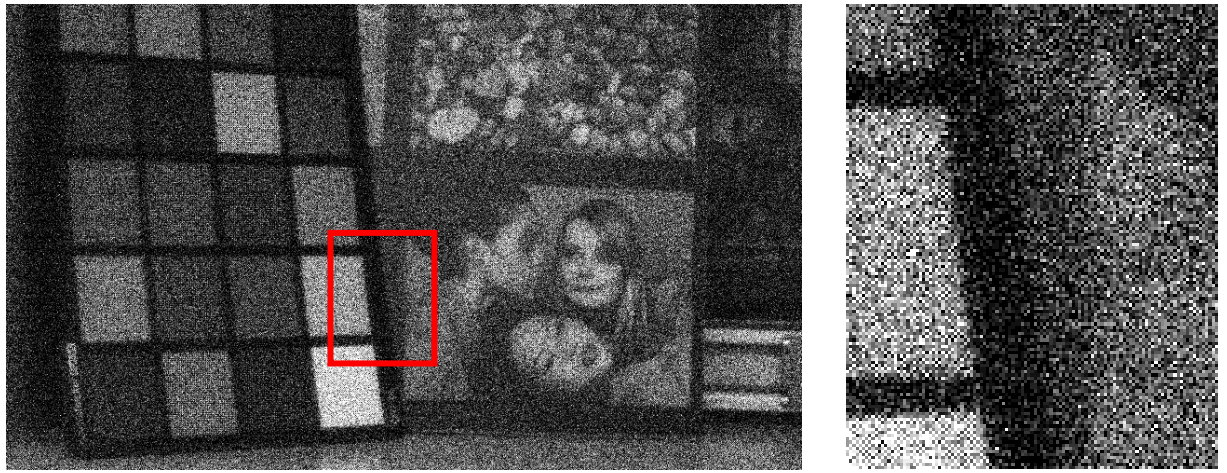
See Synaptics' demo: *Real-time Video Post-processing Using Machine Learning*

Example Application: Deep Night Vision

- **Denoising images captured in low light conditions, preserving color and structure**

- **Denoising DNN**
  - FHD image
  - 15 FPS (66 ms exposure)
  - 150K weights
  - 20B MACs per frame

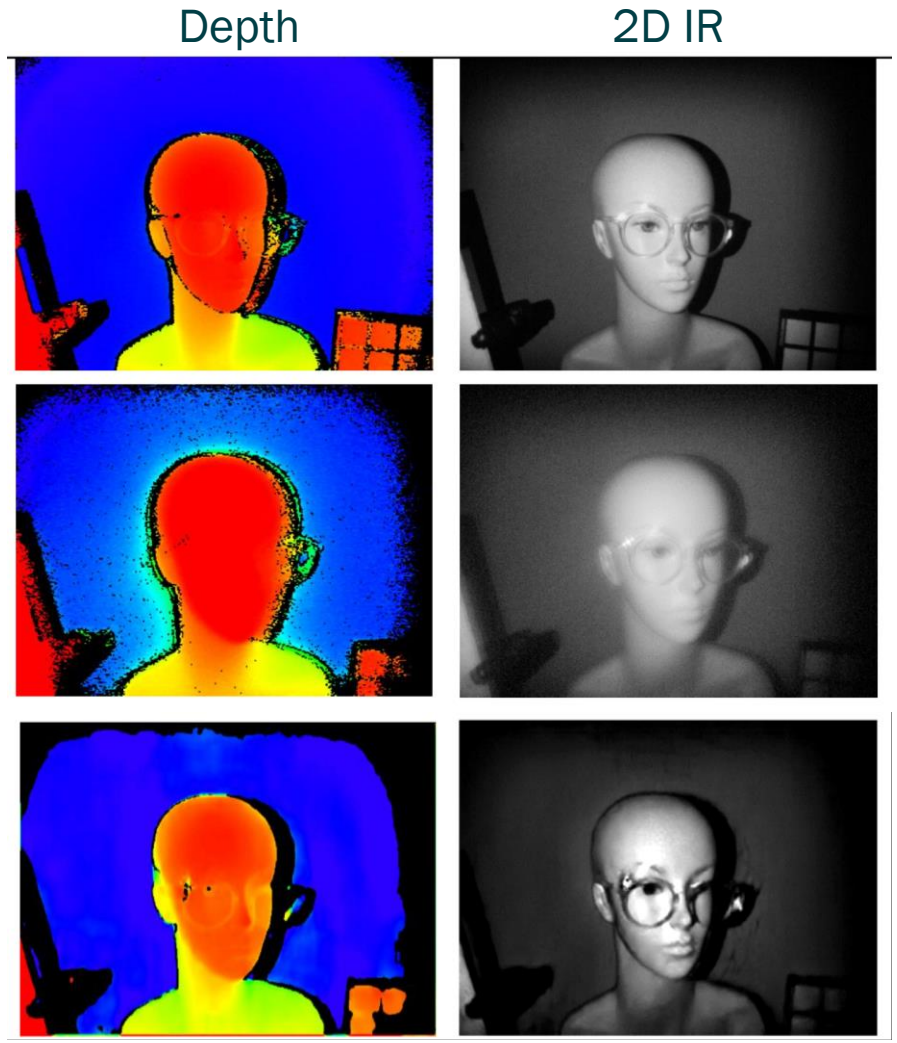
Noisy Low-Light Raw Bayer Image



DNN Denoised Raw Bayer Image

Example Application: Imaging Through a Display

- **To minimize notch/bezel area, there is great interest to place a camera behind a display**
- **A DNN can be used to fix the distortion from the display**
- **Through display ToF depth and 2D IR image restoration DNN**
  - VGA ToF depth image + IR image
  - 22 FPS (198 raw phase images/s)
  - 150K weights
  - 12B MACs per frame



Katana Low Power SoC

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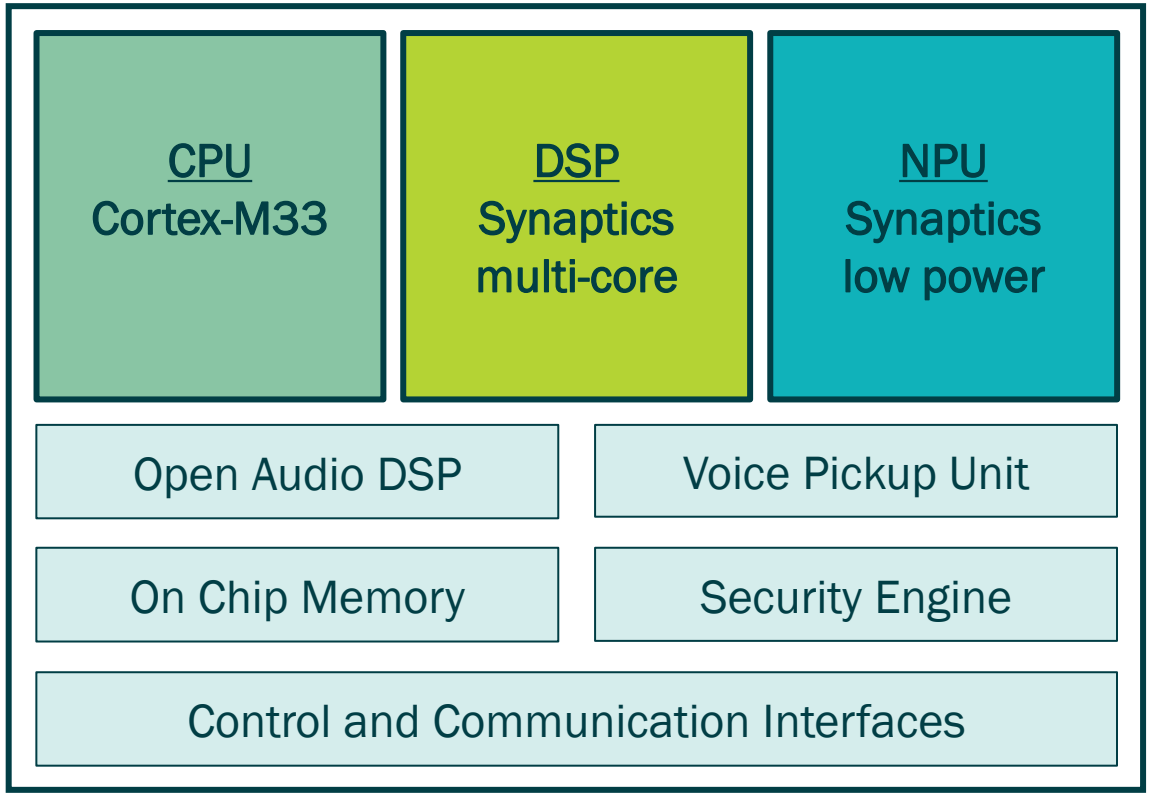
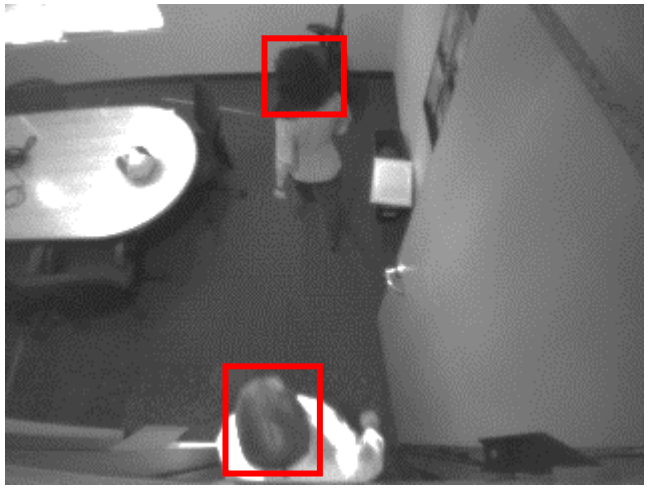
Katana Low-Power SoC

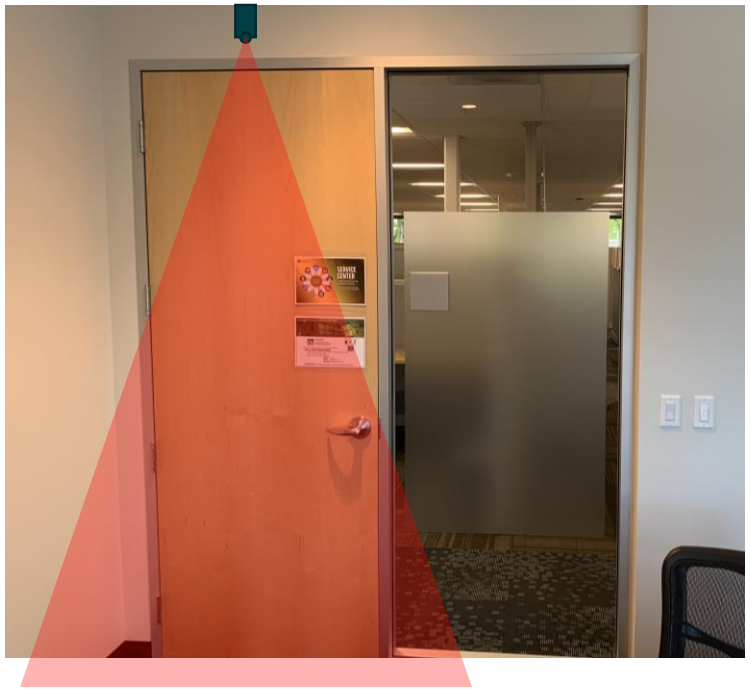
- **Low-power SoC**
  - CPU, Synaptics multi-core DSP, open DSP, Synaptics NPU
- **Example applications**
  - Person and object detection
  - Inventory tracking
  - Keyword spotting/audio event detection
  - Environmental sensing
  - Emerging battery-powered audio and vision IoT products



Example Application: People Counting

- **Counting people passing through a door, within a room, entering a region**
  - Battery powered for ease of install
  - Low resolution B&W camera
- **Person detection DNN**
  - QVGA image
  - 10 FPS
  - 100K weights
  - 20M MACs per frame





See Synaptics' demo on the Katana tool chain

Synaptics Edge AI SoC Roadmap Highlights

	2021		2022	
Multimedia	VS680	Smaller NPU No camera interface	VS7xx	Dedicated image enhancement DNN HW
	VS640			
Battery Powered	Katana		Imaging optimized	
			Audio optimized	

Conclusions

- **Advances in edge compute and machine learning are allowing whole new classes of applications to be deployed in edge devices**

  Pervasive sensors, ubiquitous high-speed connectivity, AI, and immersive media will drive the next transformation of augmented reality, autonomous vehicles, smart buildings, and digital cities.

- **Synaptics has a family of SoCs that enable AI at the edge for a range of voice, video, and vision applications**

Resources

2021 Embedded Vision Summit

Demo: ***Real-time Video Post-processing Using Machine Learning***

Demo: ***Smart Video Conferencing on the Edge***

Demo: ***From NN to Edge with Synaptics' Katana Processor and Eta Compute's TENSAI Flow Tool***

Synaptics Website

Edge Computing SoCs with AI

https://www.synaptics.com/technology/edge-computing

Thank You

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