A scalable vision processor for automotive applications
Industry trend – embedding cameras in phones

- **iPhone 1** 2007
  - Front cam
  - 1 camera

- **iPhone 4** 2010
  - +Selfie cam
  - 2 cameras

- **iPhone 5s** 2013
  - +Touch ID
  - 3 cameras

- **iPhone 7+** 2016
  - +Dual cam
  - 4 cameras

- **iPhone X** 2017
  - +Face ID
  - 4 cameras
Industry trend – embedding cameras in cars

Roadster
2008
Rear
1 camera

Model S
2012
Rear
1 camera

Model S
2014
+Front
2 cameras

Model S
2016
3F, 4S, 1R
8 cameras
Industry trend – intelligent cameras everywhere

Automotive  Mobile  Drones  Gaming

Cloud  Surveillance  AR/VR  IOT

Smart sensing is a key technology to many new applications
Our mission: giving machines the power of sight

captured images by camera

videantis v-MP6000UDX processor

pixels

meaning

what do we see?
where is it?

Use case: computer vision and deep learning in self-driving cars
About videantis – place in the value chain

Software → Chips → Applications

videantis provides key processing technology for all embedded vision markets
Global traction in automotive market

- Millions of cars on the road with videantis inside
- 40M+ automotive cameras scheduled for production
- Next processor generation drives further growth
v-MP6000UDX: Integrated product offering for deep learning and visual computing

Deep learning
- Computer vision
- Image processing
- Video coding

Processor
- v-MP6000UDX architecture

Software
- CNN libraries of optimized kernels
- v-CNNDesigner mapping tool

Tools
- 1-256 cores

Launched at CES 2018
- 16384 MACs per cycle
v-MP6000UDX Architecture Overview

Heterogenous multi-core IP
- Stream processor core v-SP
- Media processor core v-MP

Configuration tailored towards performance requirements
- Array of v-MPs for deep learning, video encoding, decoding, image processing, embedded vision
- v-SPs for bitstream parsing and packing in video encode/decode
- Example v-MP62320UDX
  - 6 - 6000 series processor IP
  - 2x v-SP cores (dual channel bitstream coding)
  - 32x v-MP cores (deep learning, embedded vision, codecs)

Wide variety of configurable system interfaces available
Multi-core scalable architecture

- 256 v-MP cores
  - E.g. ultra performance self-driving vehicle system SOC

- 64 v-MP cores
  - E.g. high-end deep learning camera with several complex detectors

- 32 v-MP cores
  - E.g. deep-learning-enabled forward-looking ADAS system

- 8 v-MP cores
  - E.g. smart rear-view camera for automotive

Seamless performance scaling from 1-256 cores
Fulfilling all visual processing needs

- **Deep learning**
  - Lowest power
  - Supports all CNNs
  - Push-button software flow

- **Computer Vision**
  - SLAM, SfM
  - Optical flow
  - Haar/Adaboost
  - HOG/SVM
  - 3D processing

- **Image processing**
  - Lens correction
  - Image enhancement

- **Codecs for transmission & storage**
  - Video compression: 8K60, low delay, 10/12bit, multi-channel, DRAM-less
  - Optimized for specialized use cases

**Combine CNNs with computer vision, imaging and codecs**
Comprehensive solution supporting autonomous driving and ADAS

**Trends**
- Processing sensor data crucial to autonomous drive and ADAS
- Industry marching toward 10+ cameras/car, 20+ sensors

**videantis automotive targets**
- Deep learning on all sensors
- In-camera, ECU and central processing solutions
- Sensor fusion with radar, Lidar, ultrasound and night vision
- Codecs for automotive Ethernet
- + Infotainment and dashboard

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*Self driving, Front camera, Surround video, Mirror replace, Rear view, Driver monitor*
Example 1: smart rear-view automotive camera

- **Wide angle lens imager**
- **ISP**
- **Image processing**
  - 1 core
  - Wide angle lens correction
  - Original frame
  - Wide angle lens correction and scaling down
- **Computer vision**
  - 1 core
  - Online camera calibration
  - Dirty lens detection
  - SLAM/Structure from Motion for distance detection for parking assistance
  - Deep-learning-based vulnerable road user detection for back over protection
- **Video coding**
  - 2 core
  - Low delay H.264 10-bit encode for transmission over automotive Ethernet toward display on head unit
- **Vehicle control**
- **15/16 cores used**

16-core v-MP6000UDX runs all tasks with headroom
Minimizing data moves, reducing power, reducing dark silicon

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Example 2: automotive driver monitoring

Wide angle lens & imager

ISP

Image processing

1 core

Wide angle lens correction

Computer vision

Dirty lens detection

1 core

Face detection

2 core

Deep-learning-based driver gaze, drowsiness & distraction recognition

10 core

Warning

16-core v-MP6000UDX runs all tasks with headroom
Minimizing data moves, reducing power, reducing dark silicon
Flexible task allocation: smart rear camera

- Rear view camera
  - 1 core: Lens correct + scale
  - 1 core: Online camera calibration
  - 1 core: Dirty lens detection
  - 2 core: SLAM SfM
  - 8 core: Deep learning pedestrian detect
  - 2 core: H.264 Encode

15/16 cores used

Driver monitoring system
- Lens correct + scale
- Dirty lens detection
- Face detect
- Deep learning face/eye analysis
Flexible task allocation: driver monitoring

- Rear view camera
  - Lens correct + scale
  - Online camera calibration
  - Dirty lens detection
  - SLAM SfM
  - Deep learning pedestrian detect
  - H.264 Encode

**v-MP60160UDX**

- 14/16 cores used

**Driver monitoring system**
- Lens correct + scale
- Dirty lens detection
- Face detect
- Deep learning face/eye analysis

- 1 core
- 1 core
- 2 core
- 10 core
Summary

v-MP6000UDX visual processor family

- Highest performance embedded deep learning solution
- New v-CNNDesigner tool for easy porting of neural nets
- Seamless upgrade path from industry proven v-MP4000HDX
- Single unified architecture runs all visual processing tasks, saving power, area, time-to-market, extending product life
- Flexible multi-task allocation dynamically at runtime
- Scalable from ultra low cost to extreme performance

Enables self-driving cars, ADAS, smart sensing devices

Giving electronics the power of sight
passion for video

Thank you!

www.videantis.com