











## **DesignWare EV5x Processor** 5X the Power Efficiency of Existing Vision Solutions Multicore architecture optimized MetaWare for vision processing OpenCV, OpenVX Development libraries and API - Dual-core (EV52) and quad-core (EV54) Tools CPU based on latest ARCv2 ISA Ţ ĮĻ Object detection engine implementing convolutional neural network (CNN) EV5x Processor · Flexibility of software-based Object Detection solutions with the performance ARC CPU Shared Engine Memory and power efficiency of dedicated 32-Bi PE PE hardware DMA 32-Bi RISC PE >1000 GOPS/W - 5X better power efficiency than existing vision AXI Interconnect solutions PE – F OpenCV and OpenVX software na Ele • programming environments speed General Availability: July 2015 application SW development SYNOPSYS' © 2015 Synopsys, Inc. 7







## CNN for a Wide Range of Vision Applications

- Image classification, search similar images
- Object detection, classification & localization -Any type of object(s), depending on training phase
- Face recognition
- Scene recognition and labelling, semantic segmentation
  - -Sky, mountain, road, tree, building, ...
- Visual attention
- Facial expression recognition
- · Gesture recognition / hand tracking
- Recent advocates
  - -Nvidia, Microsoft, Google, Baidu, Adobe, Yahoo ...

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Impleme	entation C	ompariso	ns	
• Starting pc –~10 millior 200 Hollyv –Trained C	oint: n faces/non-face wood and Bollyw NN to detect face	s generated fror ood full length n es in those movi	n over novies es	
Metric	GPU-based CNN graph	Embedded version		
Weight Space	400 MB	0.5 MB	*Cyr: Convolution layors	
Layers	10 (7 Cv+3 FC)*	5 (3 Cv+2 FC)*	(partially connected) FC: Fully connected layers	
Compute	200x	1x	1	
Bandwidth	400x	1x		
F1-Score	.96	.91		
Accuracy	.99	.98	1	
	1		4	

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Detection Accuracy for Face Detection								
<ul> <li>FDDB: Face Detection Data Set and Benchmark</li> <li>Results shown for embedded small &amp; fixed point graph</li> <li>Localization can be improved with pre/post processing <ul> <li>Impacts F-1 accuracy scores</li> <li>Not done here</li> </ul> </li> </ul>								
	Туре	Accuracy	F-1					
	Best (CascadeCNN)	0.993	0.91	32bit				
	Top 20 average		0.84	point				
	Embedded - 40% overlap		0.84	8bit				
	Embedded - 50% overlap	0.986	0.82	point				
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