

The World Leader in High Performance Signal Processing Solutions



# ***Automotive Safety Applications and Algorithms***

Gabby Yi  
Analog Devices, Inc.  
Embedded Vision Alliance Summit

Wednesday  
September 19<sup>th</sup>, 2012



# Evolution of Automotive Safety

2010



ADAS



**Warn / Intervene**

2000

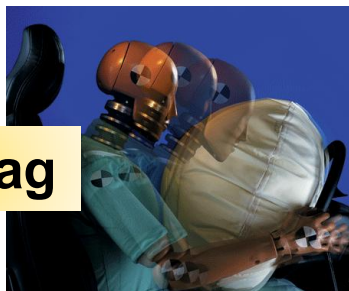


ESC

**Prevent**

1990

Airbag



**Protect**

**Avoid a Collision rather than merely survive one. Where possible, remove human error**

1. **Evaluate the environment around the vehicle to identify potential hazards**

- ◆ **ADAS** using Camera Systems

2. **Monitor Vehicle Behavior to maintain control**

- ◆ Gyro and low-g-XL for Roll, Pitch, Yaw Stability ( rollover and ESC )
- ◆ Steering Wheel angle sensing to determine desired heading
- ◆ Radar and Camera to verify safe path

3. **Provide Improved Protection to both Occupants and Pedestrians**

- ◆ Higher Accuracy Sensors



# ***Automotive Safety Standards***

- ◆ **Euro NCAP tightened safety requirements**
- ◆ **Increasing car safety demands**
- ◆ **Car accidents cost more than \$164B / year in U.S. (AAA)**
- ◆ **Over 30K / year in motor vehicle related deaths in U.S. (NHTSA)**

# ***Example Advanced Driver Assistance Systems (ADAS) functions***

**Forward Collision  
Warning/Mitigation**

**Pedestrian Detection**

**Intelligent High  
Beam control**

**Traffic Sign Recognition**

**Lane Departure Warning/  
Lane Keep Assist**





# ***Vision-Based ADAS Challenges (1 of 2)***

- **Lighting and weather conditions**
- **Obstructions in roadway, graffiti, damaged signs, faint or unpainted lane markings**
- **Low cost for proliferation to lower cost vehicles**
  - ◆ Deployment to date has primarily been in luxury vehicles
  - ◆ Opportunity for growth with deployment across all models
- **Safety critical function**
  - ◆ Functional safety standards need to be met
    - Examples ISO26262

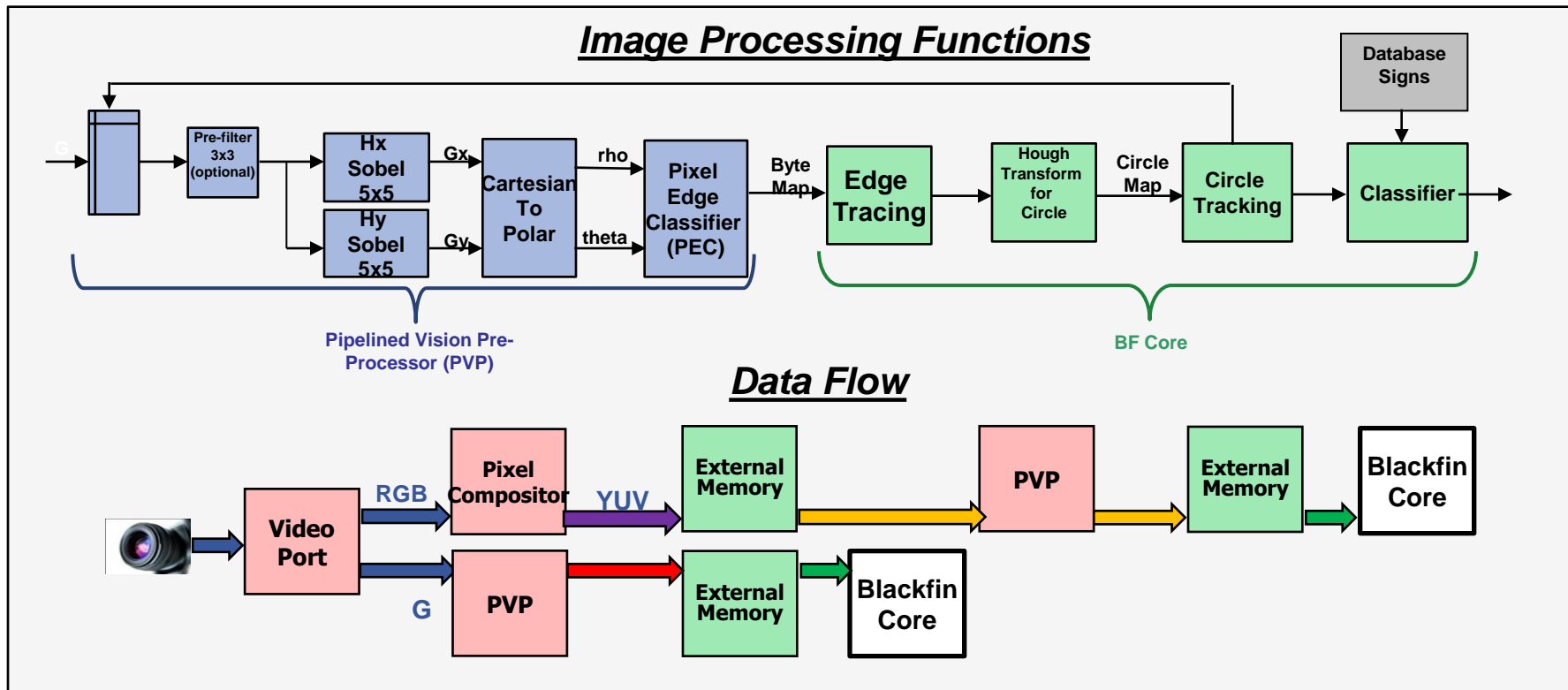




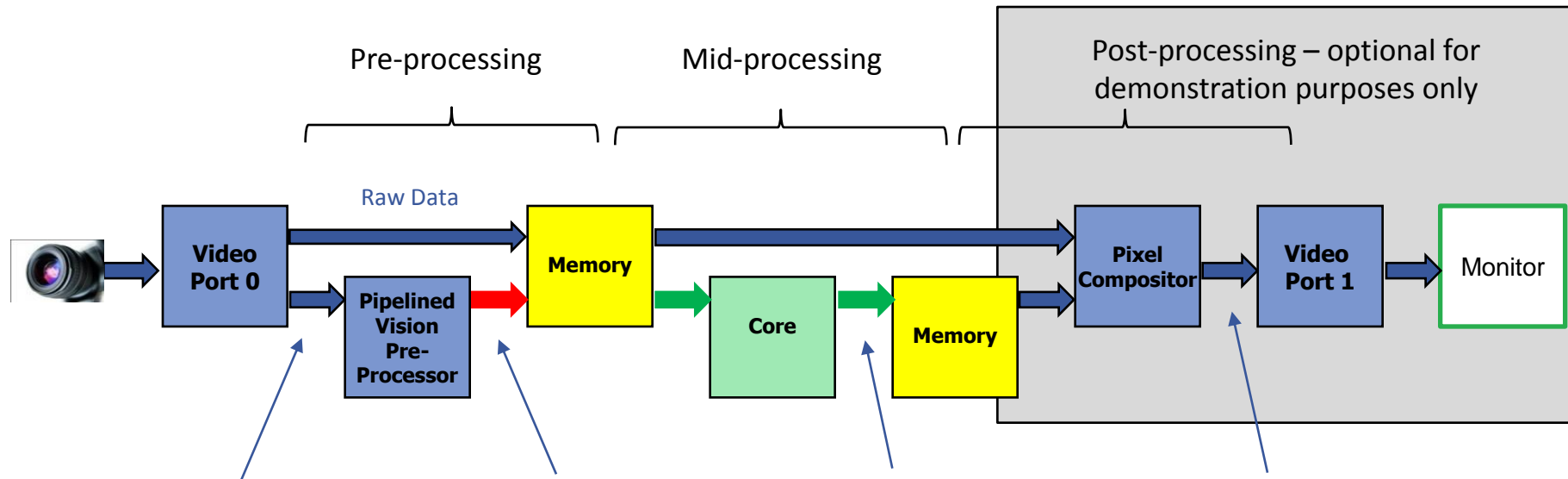
## ***Vision-Based ADAS Challenges (2 of 2)***

- **High temperature operating conditions**
  - ◆ Up to 105C ambient temperature conditions
- **Very large processing requirements**
  - ◆ High definition images
  - ◆ Multiple concurrent analytics functions
  - ◆ Multiple thousands of processor MIPS needed
- **No standard way of performing listed ADAS functions**
  - ◆ Different solutions from different developers

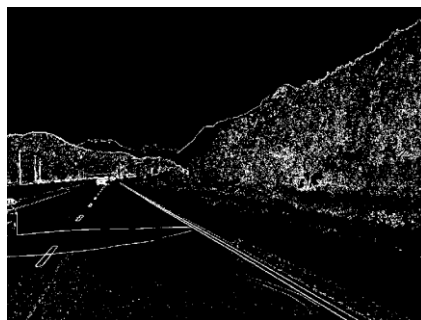
# Traffic Sign Recognition



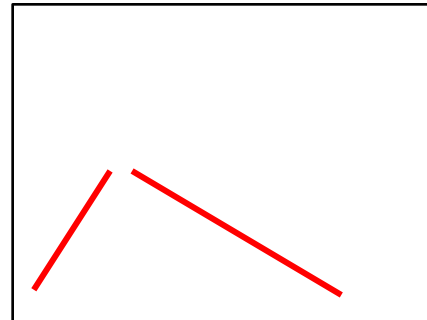
# Lane Departure Warning



Road Scene



Edge Map



Hough Transform  
and  
Kalman Filtering



Overlay





# ***To Address ADAS Challenges***

- ◆ **Embedded processing solutions need to:**
  - **Support HD images and multiple functions**
    - ◆ Analytics image processing requires specific hardware to meet demand for very large computational requirements
    - ◆ Data flow support for high bandwidth data movement
  - **Include programmable cores**
    - ◆ Non-standard analytics algorithms can be run
  - **Support high temperature operation**
    - ◆ Max power consumption carefully analyzed and optimized for
  - **Low cost**
    - ◆ Silicon optimized in terms of features and die area
  - **Functional Safety**
    - ◆ Hardware designed for safety (ECC memories, fault identification, fault recovery)



# ***Conclusion***

- ◆ **Increasing importance and proliferation of ADAS**
- ◆ **Still many challenges**
  - **Common among other vision based systems**
  - **Optimization of power and performance**
  - **Accuracy is critical for safety**

**Thank You**