Sub-track I – Smart Mobility Presentation
Automotive image sensors for in-cabin monitoring

ST Taiwan Tech Day
02 NOV 2023
Automotive in-cabin monitoring evolution

Innovative, mature technologies derived from consumer & industrial applications, adapted to the latest automotive needs and legislation

- NIR imaging
  - Face analysis to detect potential driver distraction & drowsiness

- RGB-NIR imaging
  - + color imaging for extended user experience as well as larger FoV

- 2D & 3D imaging
  - + 3D imaging for people and object localization and Vital signs
NIR imaging - driver monitoring systems

DMS
Imaging systems including processing to focus on driver’s face to detect drowsiness & distraction (eyelid closure, head position, gaze direction, hand position and ADAS interaction management …)

Hardware
- NIR strobe light
- Global Shutter Image sensor

Software
- Host SOC
VB56G4A global shutter image sensor for driver monitoring systems

Cost-efficient & the most sensitive sensor on the market
Ready for cyber security and ASIL evolutions

Single LED operation with the highest performance (incl. glint coverage) => Press Release:
Smart Eye and STMicroelectronics demonstrate high-sensitivity, lower-cost, 1-LED Driver Monitoring System

6.2 x 6.9 mm package – 145mW power consumption
VB56G6A with ASIL B support and cybersecurity

Exact same package, pinout & pixel matrix + ASIL & cybersecurity

- Package: 6.2 x 6.9mm, Pin-to-Pin compatible
- Same electro-optical performances between 2 products
- Resolution: 1.5Mpx
- Pixel size: 2.6µm
- Functional Safety: ISO 26262 compliant – ASIL B
- CyberSecurity: ECU/Camera pairing/authentication Video Stream authentication
- Schedule: Automotive Qualification 2025
Extending to RGB-NIR imaging base monitoring

Using one camera for multiple applications in all light conditions

120° to 160°

Applications

- Occupancy Monitoring (OMS)
- Driver Monitoring (DMS)
- Safety belt check
- Video chat/Recording
- Identification
- Face ID
- Enhanced HMI (Gesture…)
- Emotion detection
- Object Recognition
- More…
Vx1940 unique pixel: hybrid & flexible

Rolling Shutter Operation
To reach HDR capability & Low Light Performance
*On color images*

Global Shutter Operation
To sync sensor exposures with NIR flashes
*On NIR images*

One single Silicon to manage both modes
To take benefit of both technologies
All pixels can be switched on a frame to frame basis
Managing both NIR and color flows

Dealing with complex image sequences

Image A: Color HDR, full resolution
Image B: NIR image, driver’s face crop
Image C: NIR image, passenger’s face crop
Image D: NIR image, large in cabin scene

The RGB NIR image sensor must be able to deal with complex sequences such as:
BBABBCDBBABBCCDBBABBBCD....
Specific focus on functional safety and cybersecurity

Pulled by ISO standards (ISO 26262, ISO/SAE 21434)

Functional safety in order to:
- prevent unreported loss of configuration capability
- prevent loss of or incorrect camera status
- avoid incorrect frame timing / rate, including dropped frames
- ensure correct spatial information
- avoid image artifacts
- ensure proper contrast on output images

Cyber security features:
- Secure channel (host/sensor) based on secure boot
- Sensor authentication process (brand protection)
- Shared secret (ECDH) for partial frame live HMAC signing
- Control Interface (I2C) protection feature
- Secured industrialization flow with externalization steps
Next step for In-cabin applications: 2D & 3D imaging

- 3D - Occupancy Monitoring System
- 3D - Face-ID
- Button-less
- 3D – Gesture recognition
Direct time-of-flight single zone technology

**Proximity Ranging**

- Buttonless
- Foot detection

**VL53LA**

- ST proprietary FlightSense™ technology
- Fast and low power
- Truly invisible 940 nm illumination
- Compact module < 6.4 x 3.0 x 1.5mm
- Widetemperature range products

- Contactless: no mechanical wear
- Not limit distance for detection and ranging
- Reliable whatever the weather conditions, the clothing and footwear
Direct ToF multi-zone technology

- 4th generation FlightSense™ technology
- 4x4 zones @ 60 fps / 8x8 zones @ 15 fps
- ToF histogram processing embedded (32bit MCU)
- I²C or SPI interface (1.8/2.8V I/O)
- Consumer grade products

- Typical power consumption: 95mW
- Multitarget detection and distance measurement in each zone
- Automatic fingerprint smudge compensation

Package size: 6.4 x 3.0 x 1.5 mm
Square FoV: 43.5° x 43.5° (61° diag)
Multi zone

Proximity Ranging
3D Low resolution
Gesture recognition

VL53L5: Consumer grade (MP)
VL53L8: Automotive grade
Conclusions

Visit ST booth and see live demo on ST images product

The photo-site array
based on dedicated technology, sharply optimized for photo sensing

Image quality is Key

65nm BSI
► High sensitivity and low crosstalk

40nm Digital & Analog
► Digital with high density & low power

But equally important is the added value processing

The low power processor
Integrating both low noise analog and high speed, low power, digital imaging
Our technology starts with You