



life.augmented

ST Imaging Enhances Smart Living

Market leading smart optical sensing solutions portfolio

ALS & Proximity



ALS & proximity sensor
High sensitivity
Under OLED operation

>500 Mu

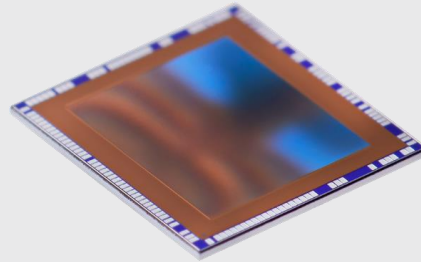
ToF module



Single point to multizone
All-in-one ToF system
In-house sensor & optics

>2 Bu

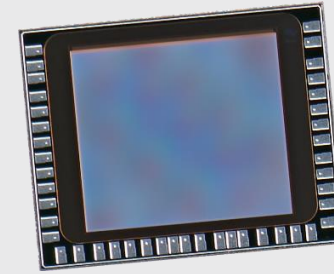
3D ToF sensor



High resolution
Indirect & direct ToF
3D stacked BSI 40nm

n°1

Global shutter

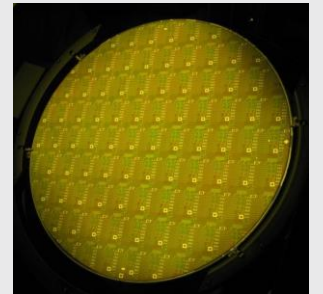


High sensitivity
Smallest size
Ultra low power

>1 Bu

n°1

Optics



Meta-surface Technology
Wafer Level Processing
Multi-functionality

>250 Mu

n°1



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Ambient Light Sensor (ALS)

VD6283TX





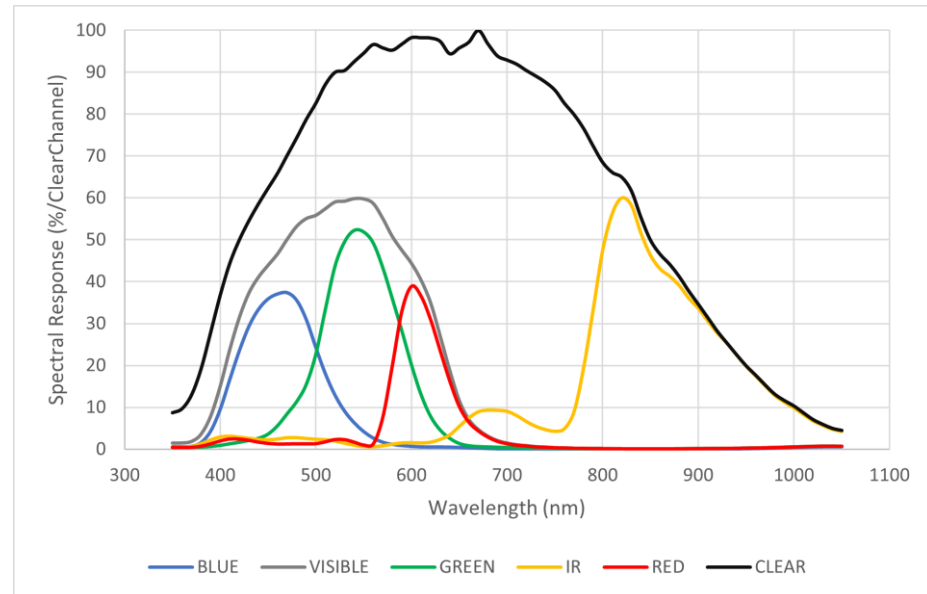
Ambient light Sensor

VD6283
6 channels
(**R**, **G**, **B**, **IR**,
Clear, **Visible**)
ALS + Flicker



- ✓ **Smallest color sensor** on the market
- ✓ **Lux and CCT information** for screen color and brightness control
- ✓ **Light flicker frequency extraction** to remove banding effect on webcam
- ✓ **Ultra sensitive** in low light environment

intel C1 certified
Qualcomm certified



Light Flicker extractor

true flicker extraction engine For all frequencies from 100Hz up to 2kHz

ST ALS VD6283 | Applications

World's smallest multispectral Ambient Light sensors for multiple applications and use cases

Smartphone Applications



Camera Auto-white balance



Flicker correction



Lux extraction for IP Security cameras



Light level monitoring for Lighting



Display brightness control

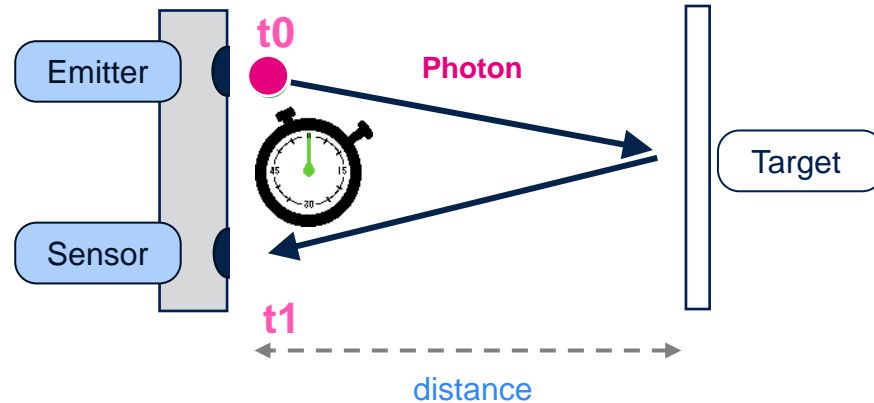


Color management

ST IMG TOF

Fundamentals of Time-Of Flight

FlightSense™ Principle



$$\text{Measured distance} = \text{Photon travel time} / 2 \times \text{Speed of light}$$

1cm round-trip at 67ps!

- At t_0 , the VCSEL emits Multiple train pulses to generate a time-of-arrival histogram towards a target
- Photons are partially reflected by the target to the receiver SPAD array (t_1)
- The SPAD generates a small pulse for each received photon
- Time between initial pulse and reconstructed received pulse is measured and added to time counters to create a photon event histogram.
- Time is converted in distance using dedicated algo
- Distance value ready to be read in sensor registers

FlightSense™

Typical module overview

All-in-One (illumination & sensor) Time of Flight System → Optimized Size, Performance, Cost mix

Advanced optics with
integrated IR filters

State-of-art assembly & testing
ST manufacturing line in Shenzhen



Monolithic ToF SoC, SPAD Array,
RAM/ROM & high safety Class1
VCSEL driver

Full Class 1 safety
high efficiency VCSEL

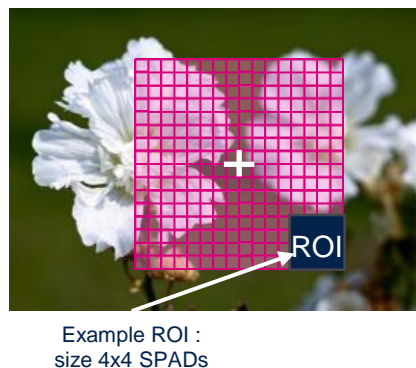
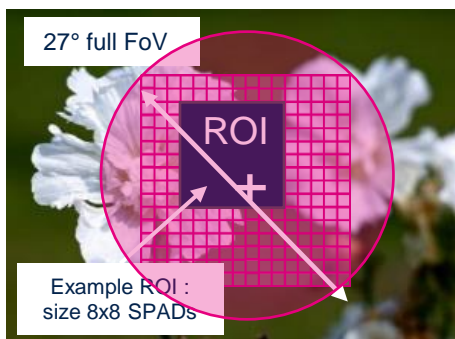
FlightSense

FOV, Multizone, Sigma Delta & Histogram



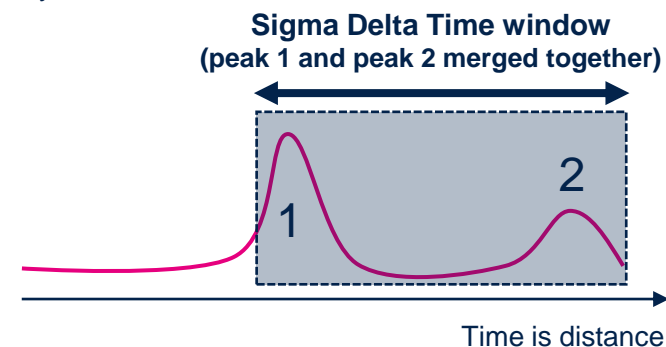
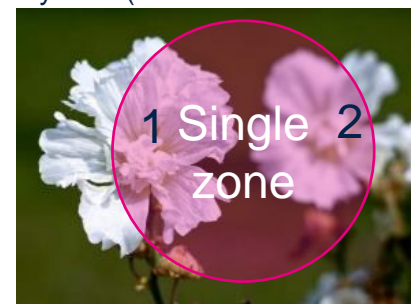
Programmable Field of View

- The ROI can be programmed and ONLY the signal coming back into this ROI will be taken into account and averaged.



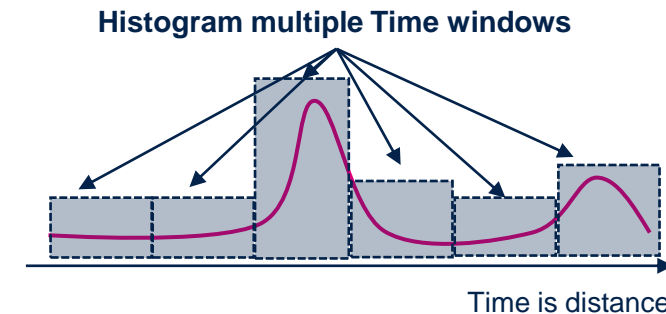
Sigma Delta(VL53L0CX/ VL53L1CX)

- The sensor is averaging the signal within the whole array. No ability to separate object by time (inside the time window) or by ROI inside FoV.

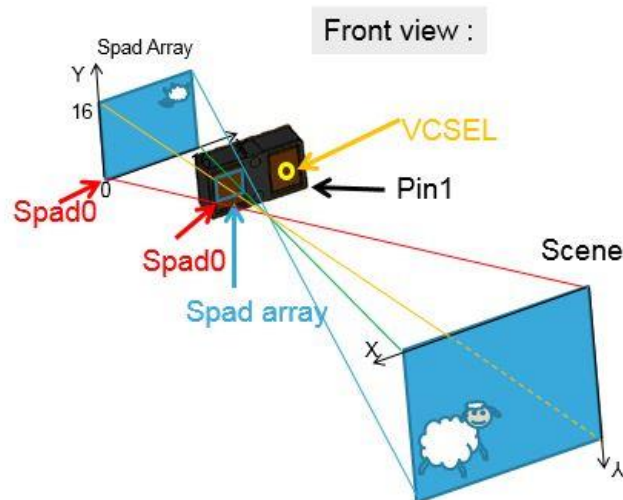


Histogram for Multi-Object detection (VL53L3CX/ VL53L1CB)

- Separate objects in time (looking at first object detected, then second, third) by looking at time windows. Different from Multi-zone looking at object which signal comes back into different SPADs of the matrix, Using histogram and looking for edges



Multizone



Direct ToF Multi-zone Technology



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

- 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

VL53L5
for Gesture






FlightSense industrial & mass market portfolio

Legacy product

Recent product

New product

Multizone	Up to 64 zones (8x8) Artificial intelligence enabler CNH data	New product		Compact normalized histogram	VL53L7CH 90° FoV 64 zones (8x8) 350 cm dark	VL53L8CH 65° FoV 64 zones (8x8) 400 cm dark/285cm amb Low power consumption		
	Up to 64 zones (8x8) Histogram mode Autonomous mode	 STGesture™ recognition	VL53L5CX 65° FoV 64 zones (8x8) 400 cm dark/170cm amb		VL53L7CX 90° FoV 64 zones (8x8) 350 cm dark	VL53L8CX 65° FoV 64 zones (8x8) 400 cm dark/285cm amb Low power consumption		
Single zone	Histogram mode Long distance up to 8 m High ambient immunity					VL53L3CX 25° FoV 500 cm dark/140cm amb ULP mode	VL53L4CX 18° FoV 600 cm dark/180cm amb 10 mm linearity	VL53L1CB 27° FoV configurable 800 cm dark/160cm amb Sequential 2x2 zones
	Ranging up to 4 m Autonomous mode	VL53L0CX 25° FoV 200 cm dark				VL53L1CX 27° FoV configurable 400 cm dark/130cm amb ULP mode		
	Proximity up to 1.3 m Short distance linearity Low power consumption	VL6180V1 25° FoV 60 cm dark 10 mm linearity	VL6180X Integrated ambient light sensor	Ultralow power		VL53L4CD 18° FoV 130 cm dark 1 mm linearity ULP mode	VL53L4ED 18° FoV / 130 cm dark 1 mm linearity / ULP mode 40°C to 105°C - Extended temperature range	

11

PTN - No long-term design - Large inventories

ST L4CD EVK & GUI Setup

- <https://www.st.com/en/imaging-and-photonics-solutions/vl53l4cd.html#overview>

VL53L4CD ACTIVE Save to MyST

Time-of-Flight (ToF) high accuracy proximity sensor

[Download datasheet](#) [Order Direct](#)

[Overview](#) [Sample & Buy](#) [Documentation](#) [CAD Resources](#) [Tools & Software](#) [Quality & Reliability](#)

Product overview

Description All features You might also... Recommended for you

Description

Specifically designed for proximity and short-range measurements, the VL53L4CD provides very accurate distance measurements from only 1 mm up to 1300 mm. A new generation laser emitter with 18° FoV improves performances under ambient light, with ranging speed up to 100 Hz.



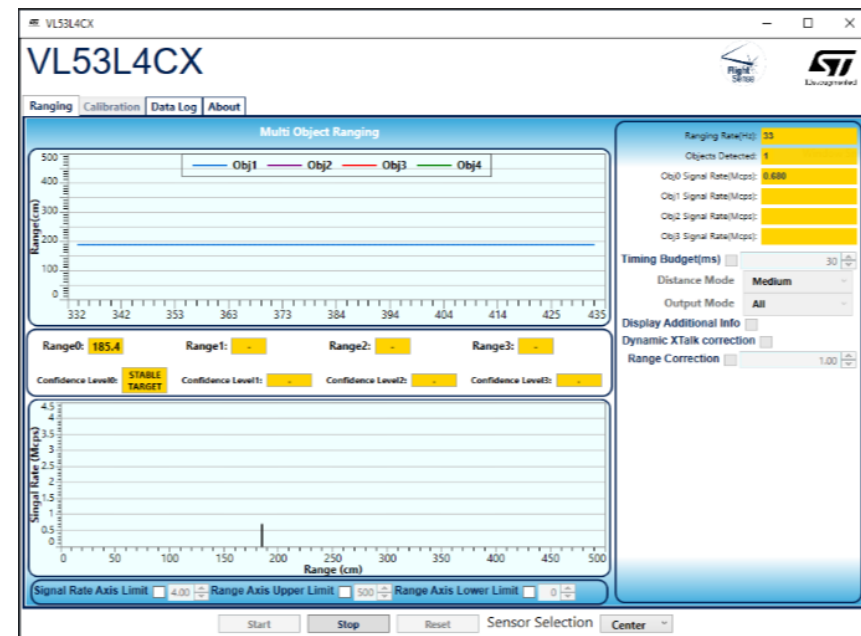
With very low power consumption thanks to an autonomous mode with programmable distance threshold, the VL53L4CD is ideal for use in battery-powered devices. Its fully embedded on-chip processing helps to reduce design complexity as well as BOM cost since less powerful and less expensive microcontrollers can be used.

Like all Time-of-Flight (ToF) sensors based on ST's FlightSense technology, the VL53L4CD records an absolute distance measurement regardless of the target color and reflectance.

Housed in a miniature reflowable package, which integrates a SPAD (single photon avalanche diode) array, the VL53L4CD achieves the best ranging performance in various ambient lighting conditions and for a wide range of cover glass materials.

All of ST's ToF sensors integrate a VCSEL (vertical cavity surface emitting laser). It emits a fully invisible 940 nm IR light that is totally safe for eyes (Class 1 certification).

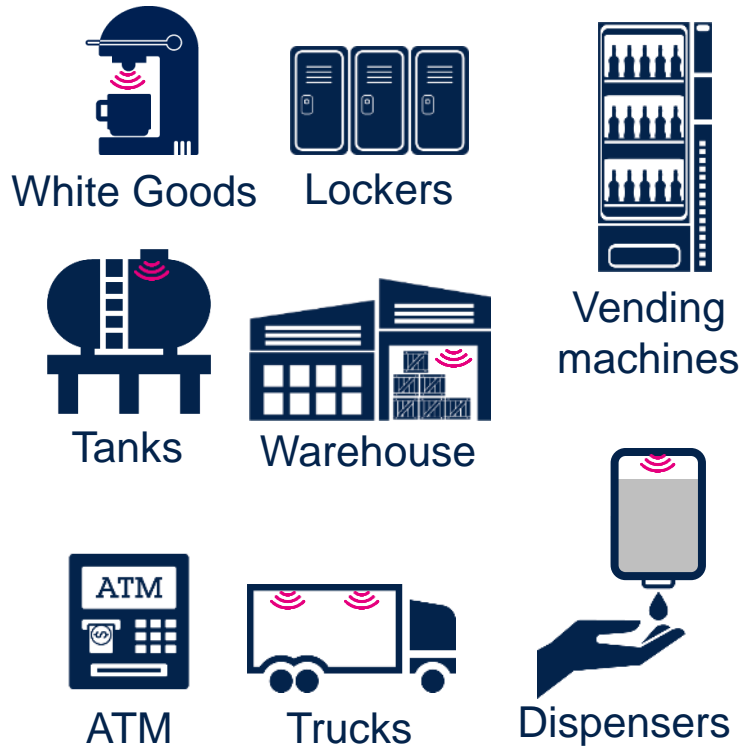
Imaging Software				
Part number	Status	Description	Type	Supplier
STSW-IMG026	ACTIVE	Ultra lite driver (ULD) application programming interface (API) for the VL53L4CD Time-of-Flight high accuracy proximity sensor	Imaging Software	ST
STSW-IMG027	ACTIVE	P-NUCLEO-53L4A1 pack graphical user interface (GUI)	Imaging Software	ST
STSW-IMG028	ACTIVE	Linux driver for the VL53L4CD Time-of-Flight high accuracy proximity sensor	Imaging Software	ST
STSW-IMG034	ACTIVE	Ultralow power (ULP) application programming interface (API) for the VL53L4CD Time-of-Flight sensor	Imaging Software	ST
STSW-IMG039	ACTIVE	Liquid Level Monitoring Code Example using Time-of-Flight sensors	Imaging Software	--



Content management

Inventory management, waste management and liquid level control

Markets and applications



Core Benefits



Smart Shelves demo

- Using **VL53L1CX** and programmable Region of Interest
- www.youtube.com/watch?v=iayV3r5ALbk





STGesture™ recognition

Turnkey solution working with VL53L5CX, VL53L7CX and VL53L8CX

Applications

User-friendly



Laptops



Thermostats



Switch

Hygiene



Digital Signage



Sanitary



Elevators

Safety



Kitchen appliances



Industrial robots

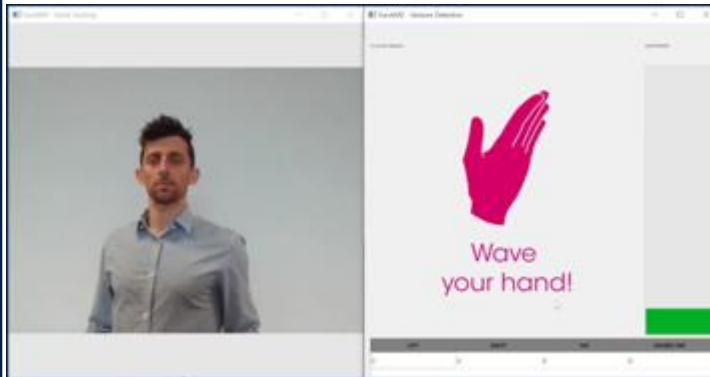


Production lines

Motion gesture recognition

Turnkey STGesture™ libraries:

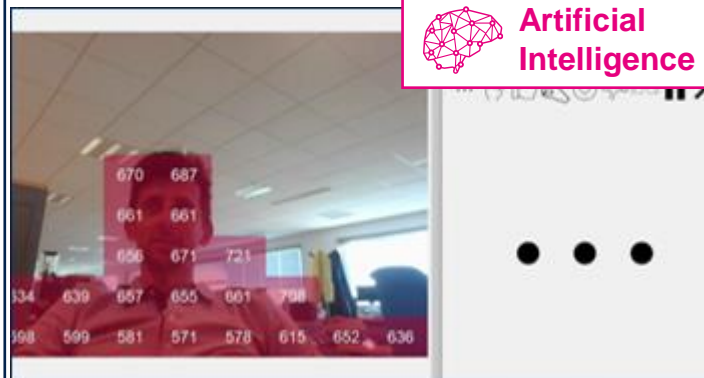
- Hand tracking
- Tap: single and double
- Swipe: left, right, up, and down
- Level control



Download [STSW-IMG035](#) package

Hand posture recognition

Up to 7 hand postures recognized



Discover now our solution on [stm32ai.st.com](#)

AI framework available on [GitHub.com/STMicroelectronics](#)

Want to learn more?

Go to the landing page:

www.st.com/gesture-recognition



You will find:

- Real-life examples
- Technical resources
- On-demand webinar



Cost effective

Inexpensive system architecture, and development

Privacy

No image unlike camera. Only ranging distance

BENEFITS

Ready to use

No image unlike camera. Only ranging distance

Low power

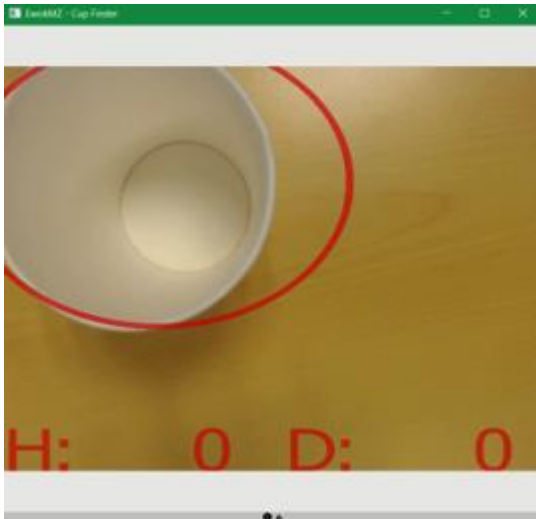
Low power ToF compared to other technology

Infinite numbers of applications

ST Time-of-Flight are used everywhere in daily life

Cup detection

- Diameter estimation
- Height measurement
- Liquid level monitoring
- ...



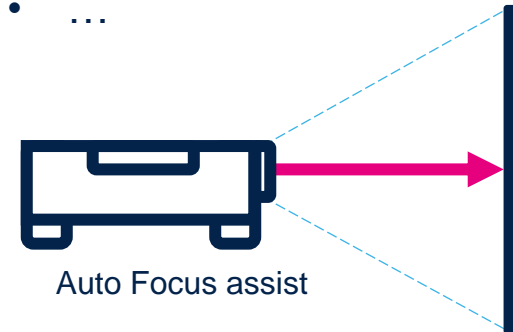
Presence detection

- Wake-on-Approach
- Passing-by filtering
- Walk-away lock
- ...

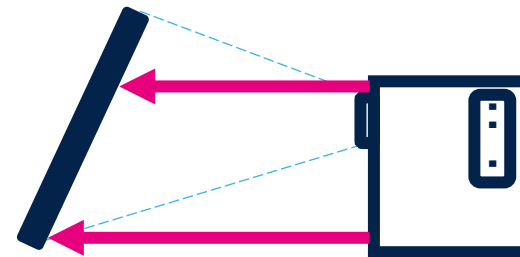


Projectors

- Autofocus
- Eye protection
- Keystone correction
- ...



Auto Focus assist



Adaptive Geometry adjustment assist

Others

- Drones



- Cameras



- Laptops/Tablets



- Industrial



NEXT applications using FlightSense

ST continuously improves its solution portfolio with new applications and features

Robotics

- Full solution addressing up to 10 use-cases with ToF sensors
- 3 use-cases already supported:
 - Floor sensing (with AI)
 - Small object detection
 - Cliff prediction

Release planned: Q4'24

Smart presence detection

- Complete turnkey solution with advanced algorithms for easy integration and significant energy savings
- Solutions capitalizing on:
 - Wake-on approach
 - Walk-away lock
 - Passing-by filtering
 - Stop and go
 - Multi-human detection

Release planned: Q1'24

Cup detection

- Develop AI model using new sensors to improve coffee cup positioning whatever the material:
 - Diameter estimation
 - Height measurement
- Other applications supported:
 - Liquid level monitoring
 - Gesture recognition


Release planned: Q2'24

Hand posture with AI

- Extend STGesture recognition now supporting hand posture

Releases Q2'23

Air quality control

- Air quality / Particle & smoke detection
- Partnership with  mobile physics

Release planned: TBD

Press Release - February 12, 2024

FlightSense, Global shutter sensors & 3D sensing

Unlimited markets & applications

PC, Tablets & Peripherals



Educational Tablets



Headsets



AR/VR



Smart Home



Home assistants



Air purifiers



Smart storage



Biometric ID Readers



Factory management



Sanitary



Monitors



Laptops



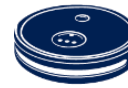
Wearable & IoT



Projectors



Home Automation



Cleaning Robots



ATM



Locks



Conveyor belts



Lighting



Faucets



Tablets



Printers



Instant Cameras



Toys



Home Appliances



Pet Robots



Trucks



Lockers



Tanks



Dispensers



Packing



Keyboards



TVs



Conf. systems



Smartphones



Smart Speakers



White Goods



Service Robots



Parking



Vending machines



Industrial robots



Logistics



Smart Bins



Smart Mirrors

Home Appliance & Home Automation

Smart Services & Retail Automation

Industrial & Factory Automation

Personal Electronics & Smartphones

Cleaning Robots & Robots

Access Control & Security

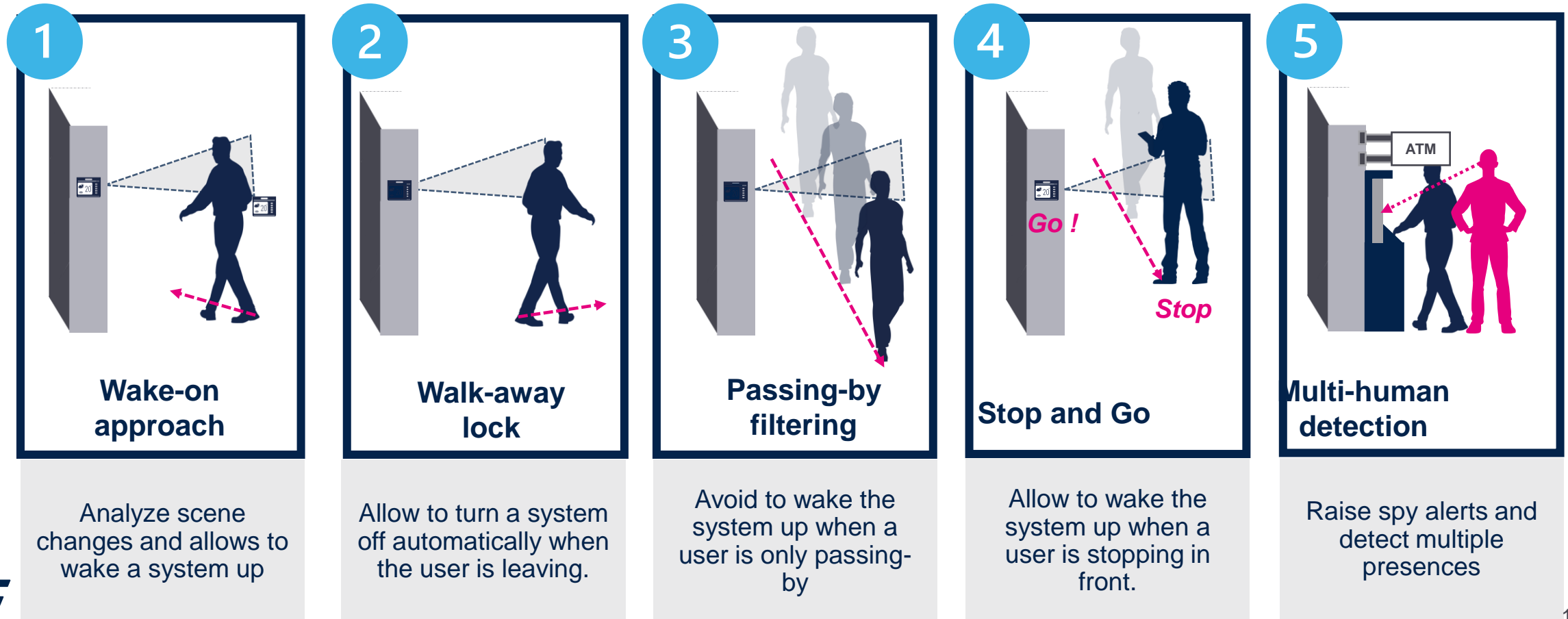
Sanitary Devices & Equipment



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ST TOF VL53L8 - Smart Presence Detection

Smart presence detection, a complete turn-key solution
5 features making it smart!



ST TOF VL53L8: Robotics multi use-cases

VL53L8CH (CNH= Compact Normalized Histogram) use in robots to replace several sensors

Available features

- 4 main use-cases in priority:
 - **Floor sensing with AI (WIP)**
 - Cliff prediction
 - Obstacle detection
 - Small object detection

NEW demo deliverables

- Floor Sensing GUI on PC
 - F401 + L8CH EVK + MZAI GUI
- 4-in-1 Robot
 - Compact robot with handheld GUI
 - Floor sensing, Cliff detect, Small object detect, Obstacle detect

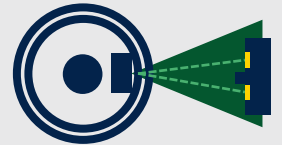
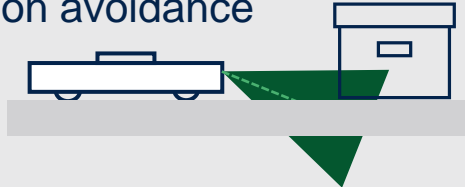
4-in-1 demo

- Autonomous robot: 4-in-1 application running on free navigation
- Broadcasting 4 algorithm output for any nb of display (PC, RPI, TV w/RPI)



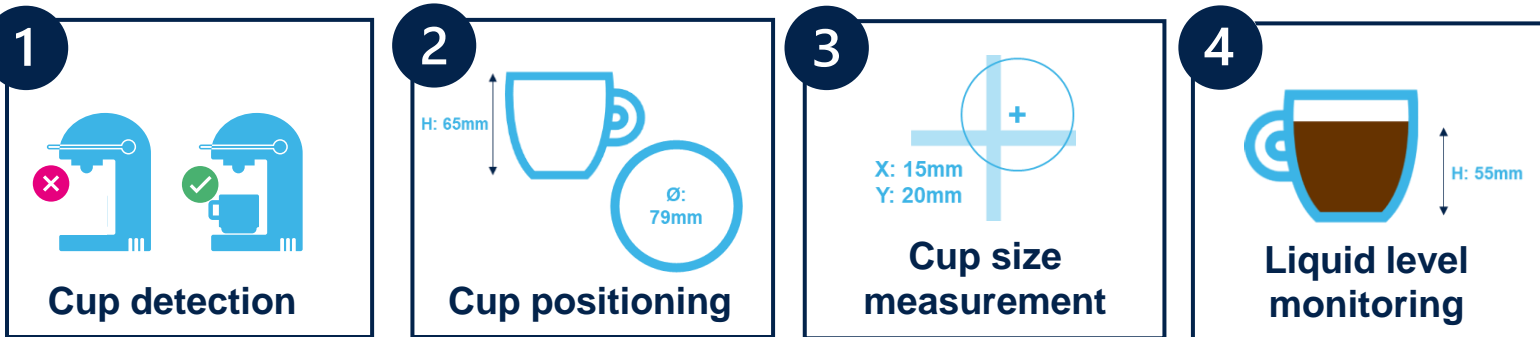
Other use-cases

- Wall tracking
- Collision avoidance
- Ceiling / Gap detection
- Safe docking assist



NEW: Cup detection turn-key solution

Four functions



Two ST solutions

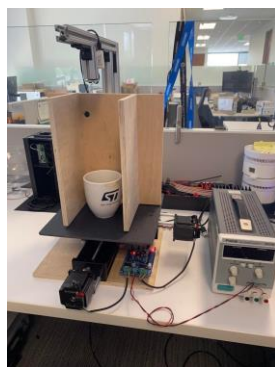
VL53L7CH

- 8x8 multizone
- 90° wide FoV
- **Compact Normalized Histogram feature**
- Up to 350 cm ranging

VL53L8CH

- 8x8 multizone
- 65° wide FoV
- **Compact Normalized Histogram feature**
- Up to 400 cm ranging
- I²C (1 MHz) and SPI (3 MHz)

Data-capture setup



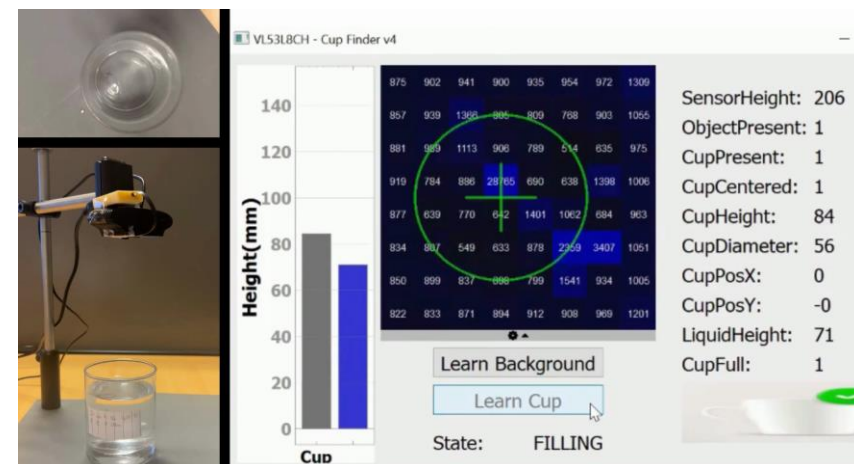
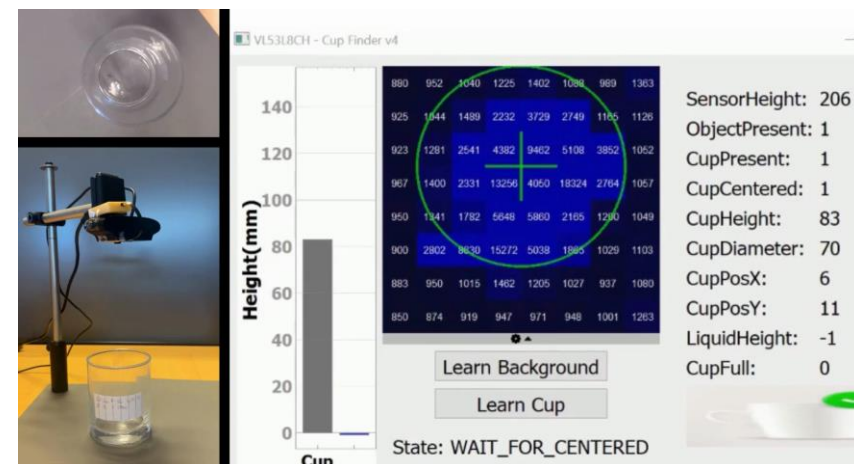
“Dry” demo
(ready in AME)



“Wet” demo
(Q1'24)



All-in-one solution



Get the exact position of the cup to avoid spilling

Coming Next: ST TOF VL53L9 (3DMax)

- <https://www.st.com/en/imaging-and-photonics-solutions/vl53l9ca.html>

Featured Videos

[See All ▶](#)



VL53L9 dToF LiDAR - VR room mapping @ 2.3k resolution

The VL53L9CA is a state of the art, dToF 3D lidar (light detection and ranging) module with market leading resolution of up to 2.3k zones and accurate ranging from 5cm to 10m.

[▶ Watch the video \(0:20\)](#)

VL53L9CA

PREVIEW

[Save to My ST](#)

3D dToF all-in-one LiDAR module with on-chip processing

[Download databrief](#)

[Overview](#)

[Sample & Buy](#)

[Documentation](#)

[CAD Resources](#)

[Tools & Software](#)

[Quality & Reliability](#)

Product overview

[Description](#)

[All features](#)

[Featured Videos](#)

[Recommended for you](#)

Description

The VL53L9CA is a state of the art, dToF 3D lidar (light detection and ranging) module with market leading resolution of up to 2.3k zones enhancing the ST FlightSense product family. Housed in a miniature reflowable package, it integrates all necessary components to make it a true all-in-one and easy to integrate module. The VL53L9CA includes a SPAD array, postprocessing SoC, two VCSELs powered by a dedicated BCD VCSEL driver, physical infrared filters, metasurface optical elements (MOE), and an embedded PMIC. The module is class 1 laser safe, offering skin protection in addition.



The use of a MOE above the VCSELs allows to project an optimized rectangular FoV onto the scene. The receiver lens focuses the reflection of this light onto the SPAD array.

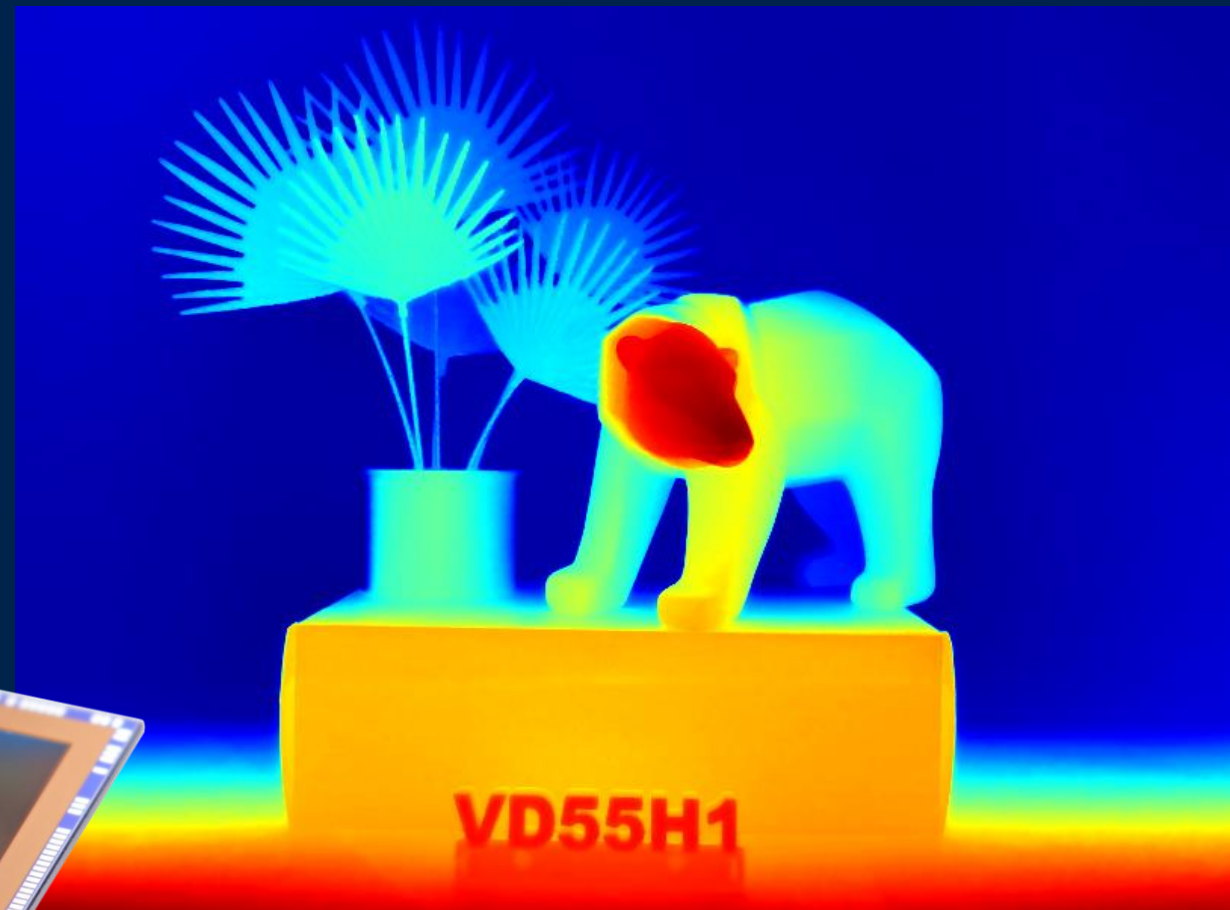
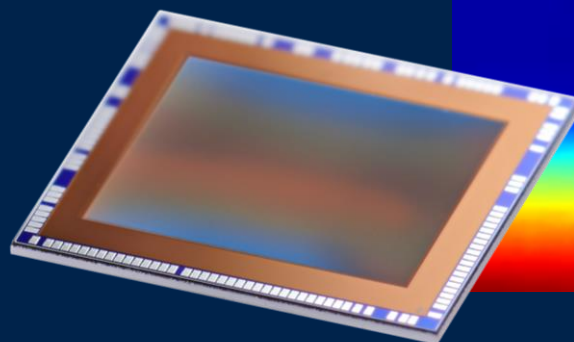
Unlike conventional IR sensors, the VL53L9CA uses ST's latest generation BSI stacked direct ToF technology, which allows absolute distance measurement whatever the target color and reflectance. It provides accurate ranging from below 5 cm up to 10 m and can stream a postprocessed 2D IR image, depth and confidence map at maximum frame rate (60 Hz), which makes it the fastest, truly integrated 3D lidar camera module on the market. Raw histogram output is also available for dedicated use-case development such as AI-based postprocessing.

The VL53L9CA achieves the best ranging performance, including under strong ambient light conditions, with a range of cover glass materials. Multizone distance measurements are possible up to 54 x 42 zones with a wide 54°x42° FoV, which can be reduced by software.



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VD55H1 product brief iToF 0.5Mpix



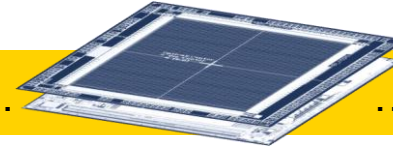
VD55H1 'PapaBear'

2 illumination ref designs for best use-case fit

672
804
0.5 Mpix

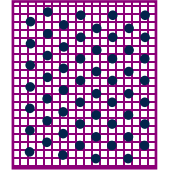
Thanos
Flood illumination

Leveraging native high resolution...



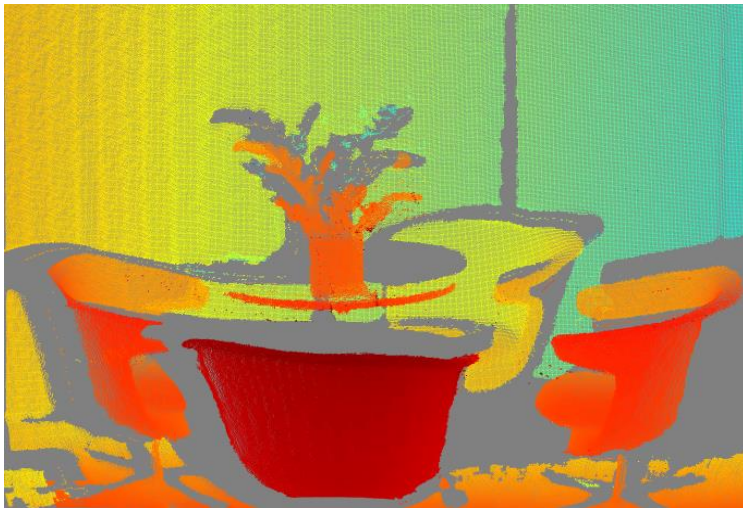
VD55H1 – 0.5 MPix

... & ST metasurface optics



Cyclops
Dot illumination
~1,380 points

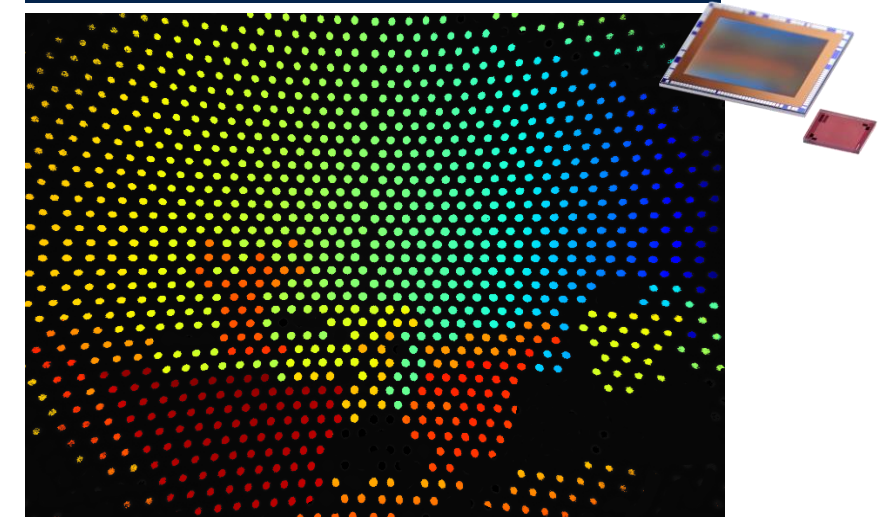
High resolution, short / medium distance



Up to 500k depth points, <5m



Low resolution, Long distance (LIDAR)



1,380 dots, >5m ranging under ambient
longer ranging + improved ambient resilience +
lower power consumption

3D content creation

VR headsets



- Hands modeling
 - Real time 3D rendering of user's hands
- 3D reconstruction
 - Real time 3D rendering of the environment
- Object occlusion
 - Definition of the relative position of objects



3D webcam



- 3D avatars & 3D conference calls
 - Real time 3D realistic rendering of the user
- Face recognition
 - For a password free professional environment
- User tracking
 - For gaming and advanced user interface

Applications

Machine Vision

Robotics

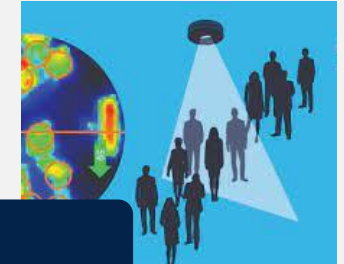


- Support to navigation
 - Object detection and safety
- Gesture and human interaction

Industrial 3D cameras

- Volume measurement
- In-line sensing

Human tracking









- People detection
 - Safety and intrusion detection
 - People counting and mapping
 - SOS call in hospital and house
 - Head and ears localization

ST IMG GS Image Sensor

ST Global Shutter sensors

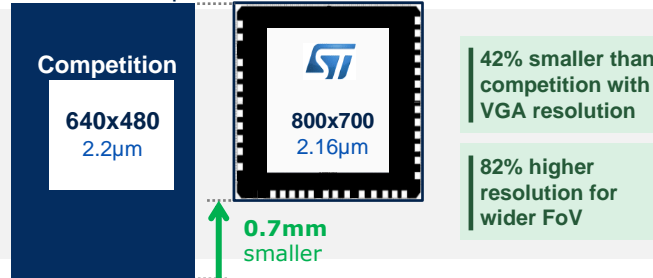
ST Global Shutter

Resolution	5.1Mp Maneki	2560 x 1984 GS + RS	 VD1941 RGB IR
	1.5Mp Fox	1360 x 1120 Global Shutter	 VD56G3 Mono/Nir  VD66GY RGB  VD16GZ RGB IR
	0.6Mp Wolfy	800x700 Global Shutter	 VD55G1 Mono/Nir
	0.4Mp Foxy	640x600 Global Shutter	 VD55G0 Mono/Nir

VD55G1 Wolfy

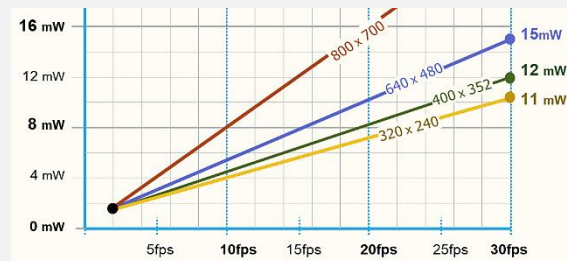
Smaller GS sensor than other VGA !

- Useable as a VGA and up to 800x700
- Smallest pixel 2.16µm vs 2.2µm or 2.8µm



Very & ultra-low power sensor

- Always-on 1mW scene change detection
- VGA 15mW @30fps with high Image Quality



Smart
storage



Biometric ID
Readers



Factory
management



Industrial
robots



Home
assistants



Pet
Robots



Laptops



AR/VR



Service
Robots



Cleaning
Robots



Smartphones

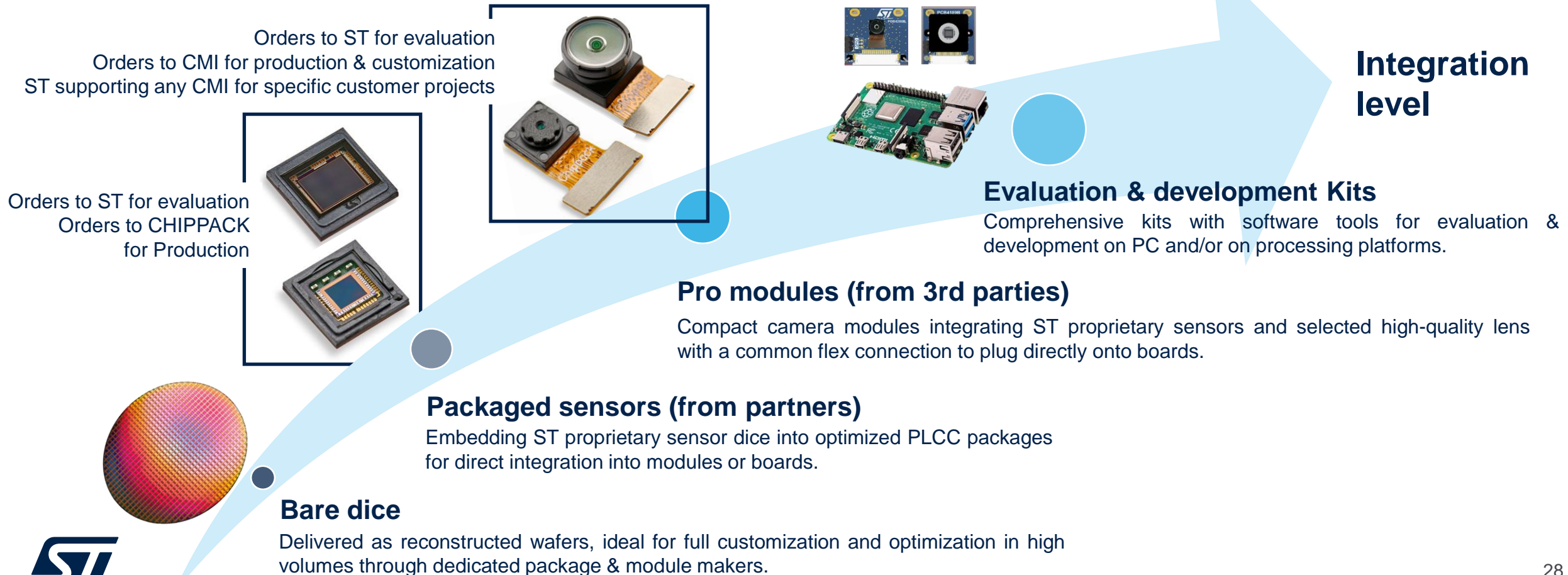
Multiple spec camera promo-modules (using G0, G3, GY & G1 global shutter sensors) available to support sensor promotion and evaluation



...

NEW: Global shutter sensors broad range of deliverables

Different integration levels to serve every need



Automotive Global Shutter Product Roadmap

Small
FoV
DMS



Safety
Features

**ROBIN
VD5661**

Mono/NIR
Recon Wafer

1.6 Mp
1464 x 1104
3.2 μ m pixel

Qualified (RW)

High MTF // HDR

G/S
FSI

Partial
Safety
Features

**FoxAuto
VB56G4A**

Mono/NIR
OBGA

1.5 Mp
1120 x 1360
2.6 μ m pixel

Qualified

Compact
High Sensitivity

G/S
BSI
3DStack

Pin-to-pin compatible, Optical path compatible

ASIL B
Cyber
security

FoxAuto II

Mono/NIR
OBGA

1.5 Mp
1120 x 1360
2.6 μ m pixel

Samples Q2 2024
Qualified product Q4 2024

Compact
High Sensitivity

G/S
BSI
3DStack

Smaller Pixel,
Smaller die
size

Large
FoV
DMS+OMS



Safety
Features

**ROBIN
VD6763**

RGB
Recon Wafer

2.3 Mp
1944 x 1204
3.2 μ m pixel

Qualified

High MTF // HDR

G/S
FSI

Safety
Features

**ROBIN
Vx1762**

RGB-NIR 4x4
iBGA / Recon Wafer

2.3 Mp
1944 x 1204
3.2 μ m pixel

Qualified (RW)

High MTF // HDR

G/S
FSI

ASIL B
Cyber
security

**SHIBUYA
Vx1940**

RGB-NIR 4x4
OBGA / Recon Wafer

5.1 Mp
2560 x 1984
2.25 μ m pixel

Samples available
Qualified product Q4 2023

G/S and R/S operation
Innovative context mgmt

G/S R/S
BSI
3DStack

More pixel size
and resolution
options



life.augmented

**ROBIN
Vx5761**

Mono/NIR
iBGA / Recon Wafer

2.3 Mp
1944 x 1204
3.2 μ m pixel

Qualified (RW)

High MTF // HDR

G/S
FSI

Safety
Features

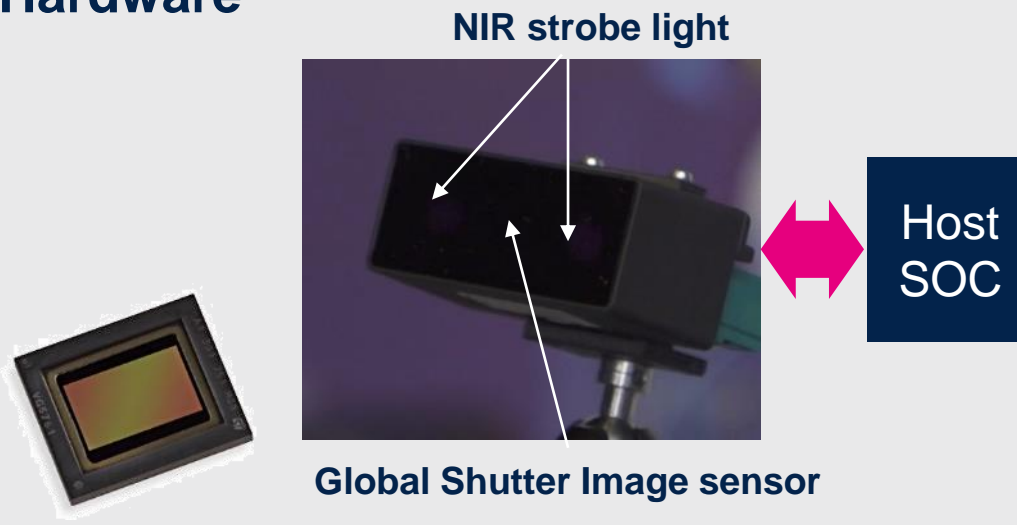
NIR imaging - driver monitoring systems



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



Software



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:

BBABBCDDBBABBCDDBBABBCD....

Our technology starts with You



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