



From vision to perception: ST imaging and Time-of-Flight sensors empowering robotics

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ST solutions can be found in a wide range of robotics applications

Industrial robots and cobots



Manipulators
Object detection
Industry 4.0

Robots in healthcare



Surgical robots
Actuated & sensory prostheses
Exoskeletons

Service robots



Vacuum cleaner robots
Disinfection robots
Lawn mower robots

Drones and mobile robots



Agriculture
Inspection
Delivery (AMR)

ST enabling technology solutions

Sensors

Power
management

Security and safety

Motor drivers,
actuator, control

Connectivity

Edge AI



Imaging solutions for humanoid robots



Robots / cobots interaction

Gesture recognition, safety, pick and place



Smart robots

Object recognition & segmentation, small object detection, robot arm guidance



Environment awareness

Complete room mapping (lidar)



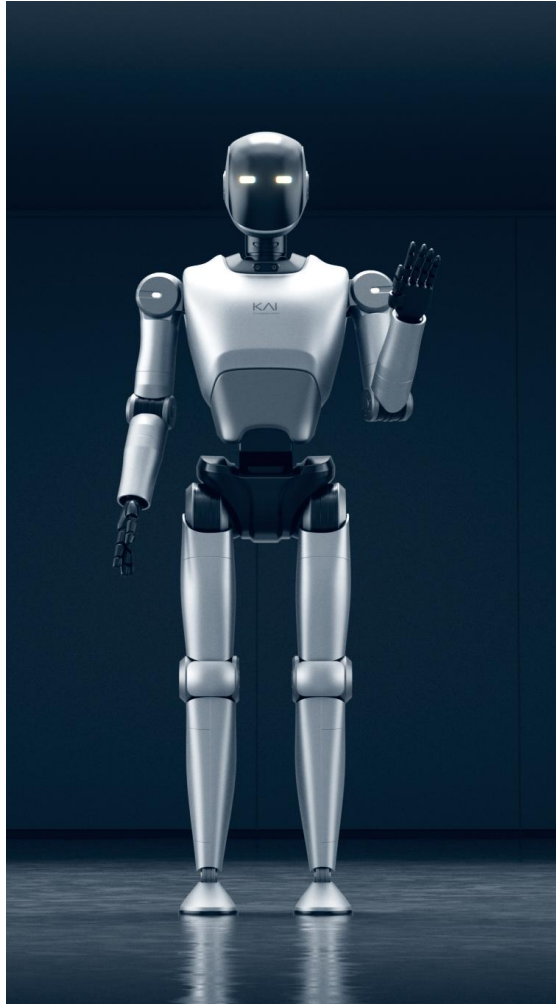
Safe and fast moving

Fast obstacle avoidance, real time distance detection



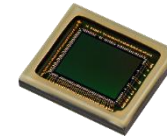
24/7 detection guarantee

Night vision, flicker removal



Time-of-Flight sensors

Measure distance to map rooms, adjust focus, detect presence, recognize, measure, or avoid objects....



CMOS image sensors

Capture images to record videos, analyze motion, read characters, inspect & measure parts, or recognize features – Color, Mono & NIR ...



Ambient light sensors

Measure light and color information for checking color parts, adapting display settings, or removing flicker effects.



Compatible with STM32 ecosystem



ST turnkey solutions

ST CMOS image sensors for humanoid robotics





ST 2D image sensors product roadmap

Tiny and best quality image sensors from 0.4 MP to 5.1 MP to enhance the robot's vision

	Mono	RGB	RGB IR	Dual
5.1 MP	VD5943 2560 x 1984 GS+RS pixel		VD1943 2560 x 1984 GS+RS pixel	
1.5 MP	VD56G3 1124 x 1364 Global shutter	VD66GY 1124 x 1364 Global shutter	VD16GZ 1124 x 1364 Global shutter	
0.6 MP	VD55G1/4 800 x 700 Global shutter	VD65G4 800 x 700 Global shutter		VD25G4 800 x 700 Global shutter
0.4 MP	VD55G0 640 x 600 Global shutter			

BSI with CDTI
Stacked 40 nm

2.6 μm
GS

BSI with CDTI
Stacked 40 nm

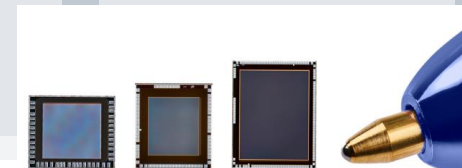
2.16 μm
GS

BSI with CDTI
Stacked 40 nm

2.25 μm
GS+RS

GS: Global shutter
GS+RS: Global + rolling shutter

Mass market ready



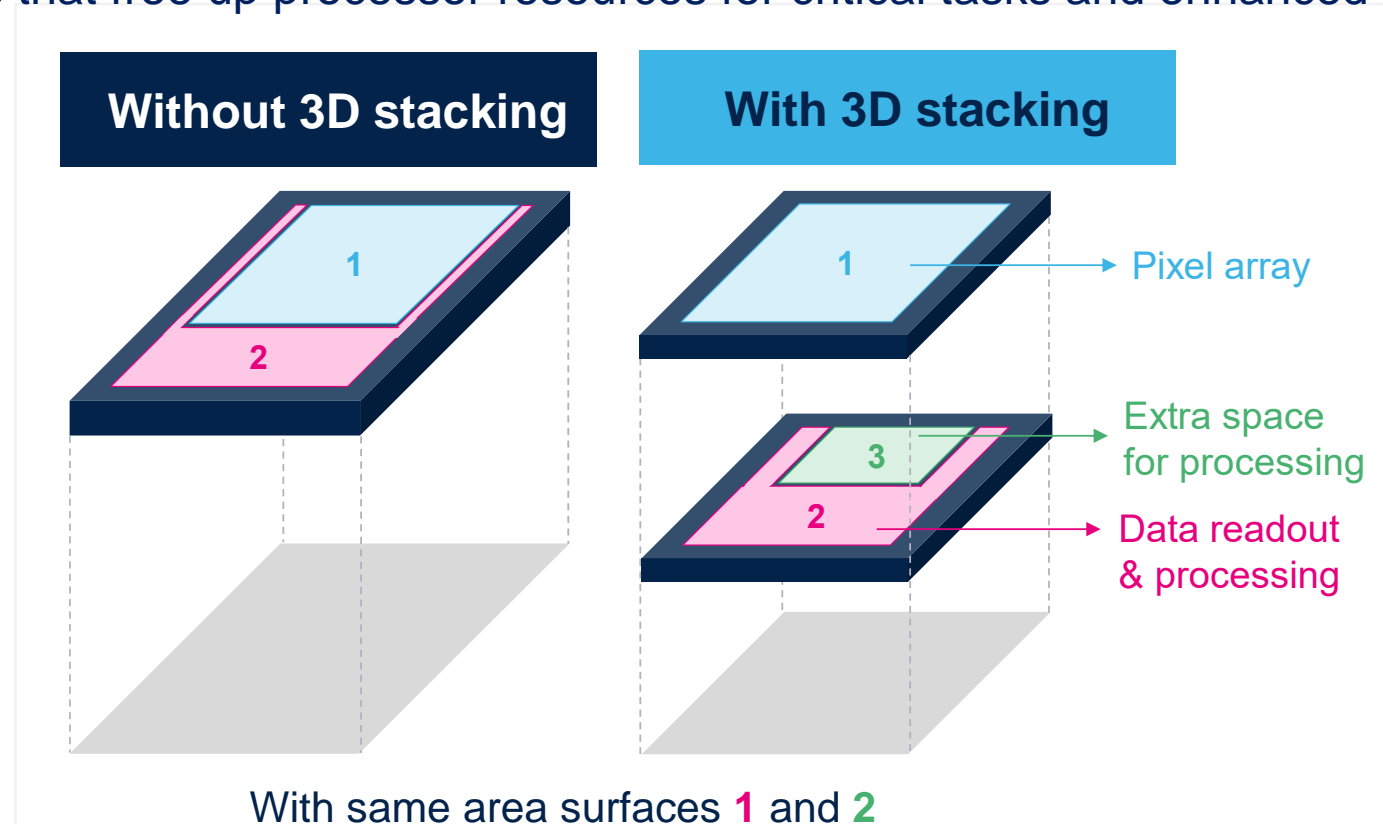
ST image sensors Feature-rich for humanoid robots



Complete toolbox of on-chip features

Enabling smarter and low-power system designs

ST BrightSense products feature further **3D-stacking** technology through **advanced image processing features** that free up processor resources for critical tasks and enhanced functionality in a reduced footprint.



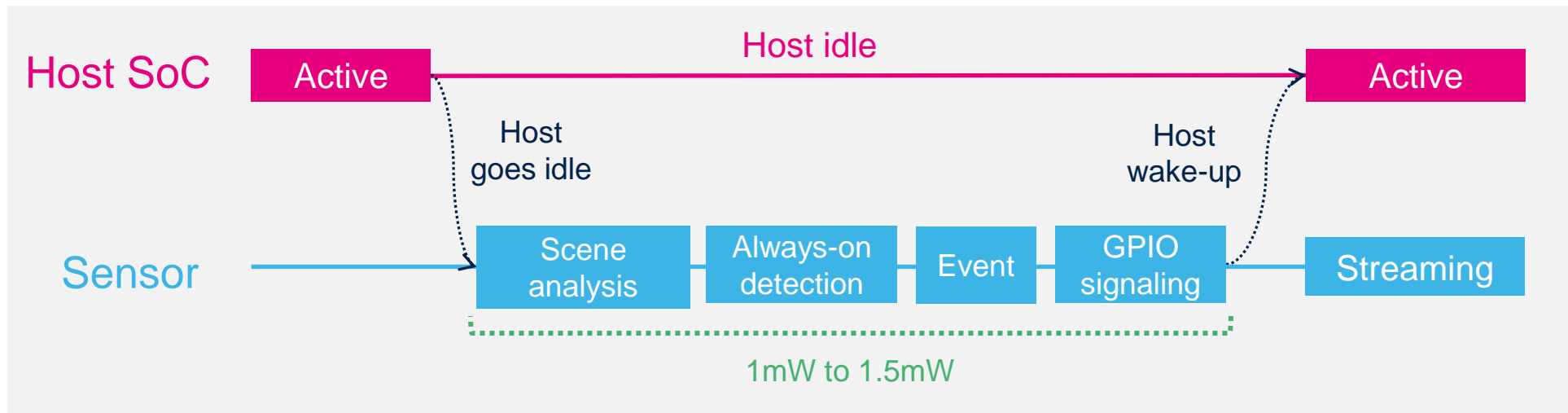
On-chip features

- Autoexposure
- Auto Wake-Up
- Background removal
- Binning
- Context management
- Defective pixel correction
- HDR
- Image difference mode
- Noise reduction
- ...



With auto wake up embedded feature

With **auto wake-up**, the sensor **autonomously detects actions or scene changes in low power**; while the host remains idle state to reduce power consumption at system level.



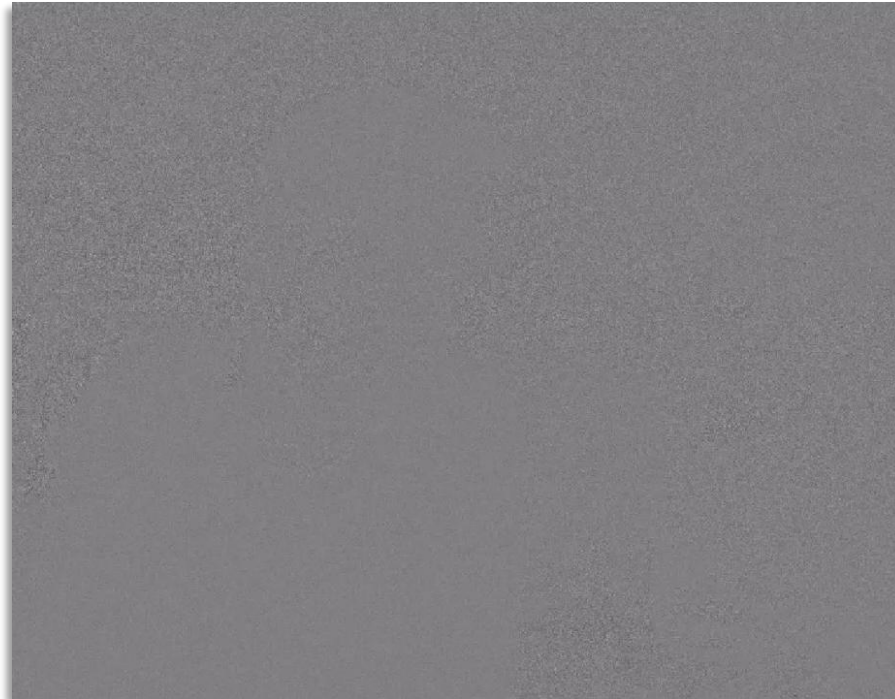
Once a change is detected, a GPIO signal raises an event to the host, which can then enable the full streaming of the image.



Image difference mode

Output event-like images in a synchronous manner

With **image difference mode**, the sensor outputs frames highlighting **only pixel changes**. This feature enables **event-like synchronous image** capture for eye tracking, activity detection, or object tracking.

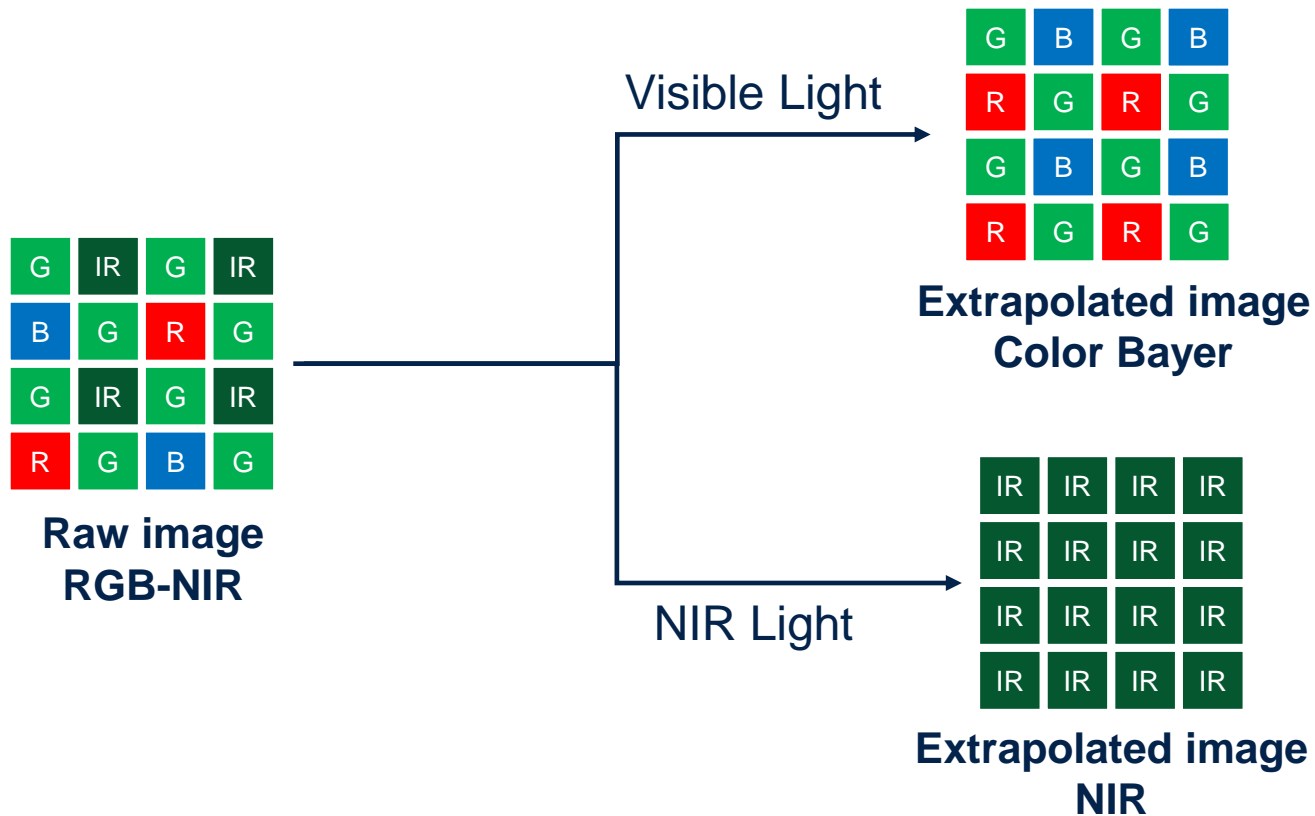


Products: VD55G1, VD55G2, VD55G4, VD65G4, VD25G4



A camera to see rooms in color and at night

With RGB-NIR CMOS image sensors



Product: VD1943



Promodules

Selecting evaluation camera modules

Turnkey vision extensions to get started right away

Promodules are turnkey evaluation camera modules including ST BrightSense image sensor, lens holder, lens and plug-and-play flex connection in a tiny format.

- Get rid of the effort of selecting and supplying a lens
- Lens focused, glued & tested in a clean environment using accurate equipment
- Tiny footprint from 5 to 9 mm²
- Several promodules with different lens options available for each ST BrightSense image sensor
- Additional module customization available from ST Partners



Evaluation tools | Ordering codes

Ordering codes for ST BrightSense ecosystem

Category	Item	Webpage	Variant	Ordering code
Evaluation kit	EVK Main	STEVAL-EVK-U0I	/	STEVAL-EVK-U0I1
Development kits	P-Board	STEVAL-CAM-M0I	/	STEVAL-CAM-M0I1
	VD56G3 S-Board	STEVAL-56G3MAI	/	STEVAL-56G3MAI1
	VD66GY S-Board	STEVAL-66GYMAI	/	STEVAL-66GYMAI1
	VD55G0 S-Board	STEVAL-55G0MBI	/	STEVAL-55G0MBI1
	VD55G1 S-Board	STEVAL-55G1MBI	/	STEVAL-55G1MBI1
Evaluation camera modules	VD56G3 promodules	CAM-56G3	Promodule with VD56G3 sensor, 73° DFOV, clear filter	CAM-6G3-073CLR
			Promodule with VD56G3 sensor, 84° DFOV, clear filter	CAM-6G3-084CLR
			Promodule with VD56G3 sensor, 152° DFOV, clear filter	CAM-6G3-152CLR
	VD66GY promodules	CAM-66GY	Promodule with VD66GY sensor, 73° DFOV, NIR-cut filter	CAM-6GY-073VIS
			Promodule with VD66GY sensor, 84° DFOV, NIR-cut filter	CAM-6GY-084VIS
			Promodule with VD66GY sensor, 152° DFOV, NIR-cut filter	CAM-6GY-152VIS
	VD55G0 promodules	CAM-55G0	Promodule with VD55G0 sensor, 79° DFOV, clear filter	CAM-5G0-079CLR
			Promodule with VD55G0 sensor, 158° DFOV, clear filter	CAM-5G0-158CLR
	VD55G1 promodules	CAM-55G1	Promodule with VD55G1 sensor, 160° DFOV, clear filter	CAM-5G1-160CLR



Selecting development kits

Two options for integrating ST BrightSense products onto embedded processing platforms

For integrating ST BrightSense solutions onto embedded processing platforms equipped with MIPI CSI or I3C interface, ST offers two types of development kits. Both types of solution feature the same mechanical outline, connector and pinout making them totally replaceable by one another at any time.



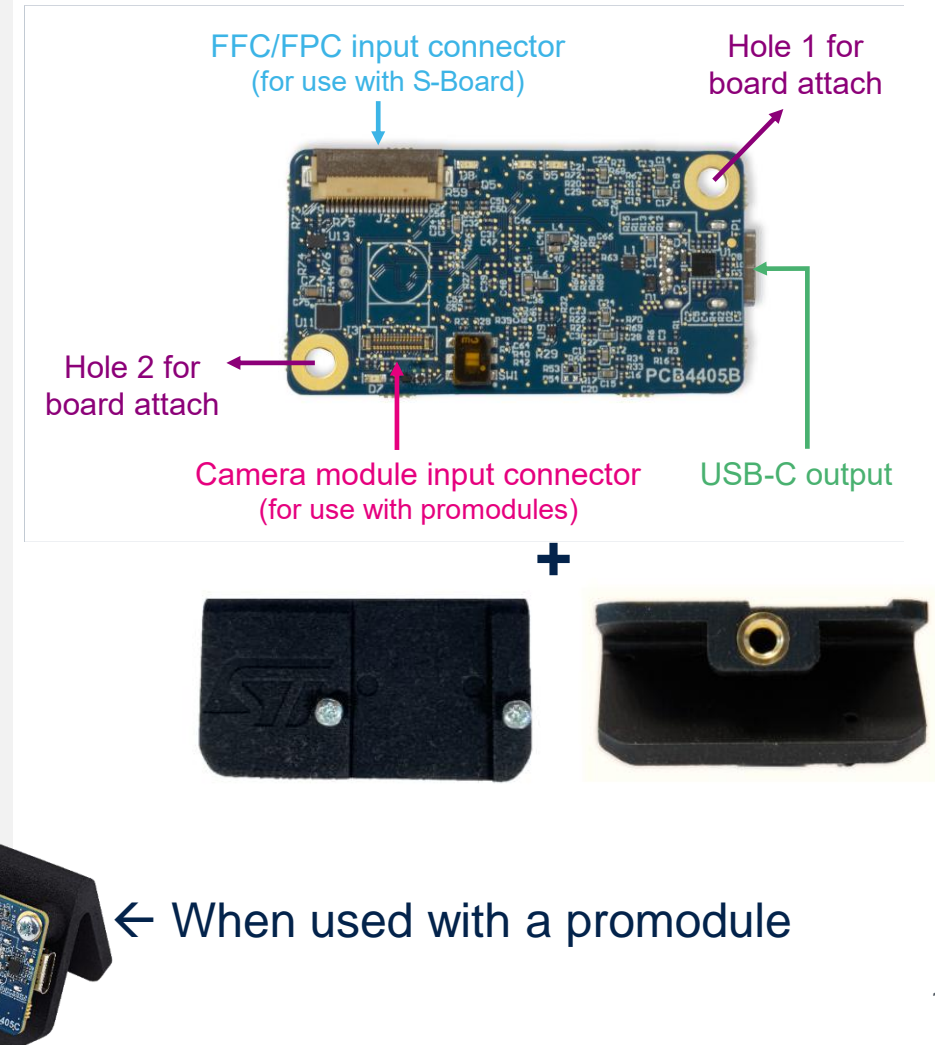
P-Board for integrating turnkey camera modules



S-Board for integrating sensors with any M12 lens

Starting with an evaluation kit

- **Comprehensive hardware kit including:**
 - EVK main board with USB Type-C output.
 - Mechanical holder for stable image capture in various configurations.
- **Benefit from a seamless evaluation on PC:**
 - USB3 output for straightforward PC connection.
 - Ready to stream images live or perform accurate image testing.
 - Compatible software available for free download on st.com.
- **Modular and reusable kit:**
 - Compatible with all ST BrightSense image sensors and promodules.
 - Evaluate sensors as turnkey promodules.
 - Evaluate sensors with any off-the-shelf M12 lens using an S-Board.
- **Versatile mechanical holder enabling various setups:**
 - On a flat surface such as a desk or a test bench.
 - Inserted on a laptop screen acting as a webcam.
 - Fixed on a tripod.



ST Time-of-Flight portfolio for humanoid robotics

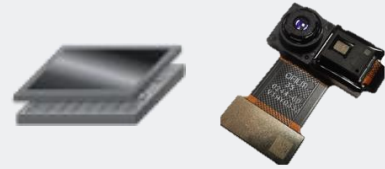




ST Time-of-Flight and ambient light sensing (ALS) portfolio

World leading dToF & ALS products and state-of-the-art 3D vision solutions to ensure reliable, safe, and efficient robot's interaction

3D depth



VD55H1
500k points
iToF sensor
& ref design



VL53L9
2300 points
dToF lidar
All-in-one module

dToF modules



VL53L0 / L3



VL53L1



VL53L4

SinglePoint ToF, up to 8 m



VL53L5



VL53L7 / L8

64~256 zones ToF, up to 5 m

ALS



VD6283
6-channels
& flicker gen2



3D sensing for humanoid robotics





3D sensing for humanoid robotics

Enhance your robot sensing capabilities with 3D depth



Enable a full and comprehensive room mapping of the scene

High resolution enables a larger field of view and an excellent angular resolution for all corners' detection

Long distance and real-time room mapping

Objects distance measurement for better obstacle avoidance



Empower unmatched performances with an excellent detection accuracy

Active flood illumination for small object detection (cables, small cubes...)

High resolution, excellent accuracy & precision for object identification



Enable your robot going beyond sensing

User's gesture recognition and modeling enabling user's interaction with the robot

3D + 2D IR images for segmentation and classification





VL53L9 | lidar & 3D module for humanoid robots

Lidar for robotics: Room/Environment mapping

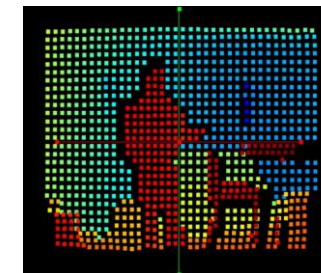
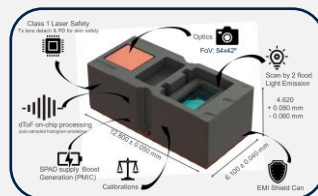
2.3k zones | 1° per zone angular resolution
Long distance detection 9.3m | High frame rate 60fps | Excellent accuracy
150mW total system power, with on-chip depth processing

Beyond sensing: object & gesture detection, segmentation and classification

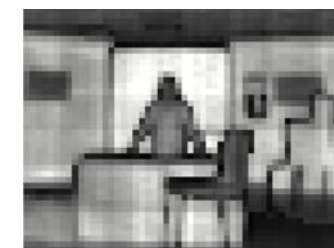
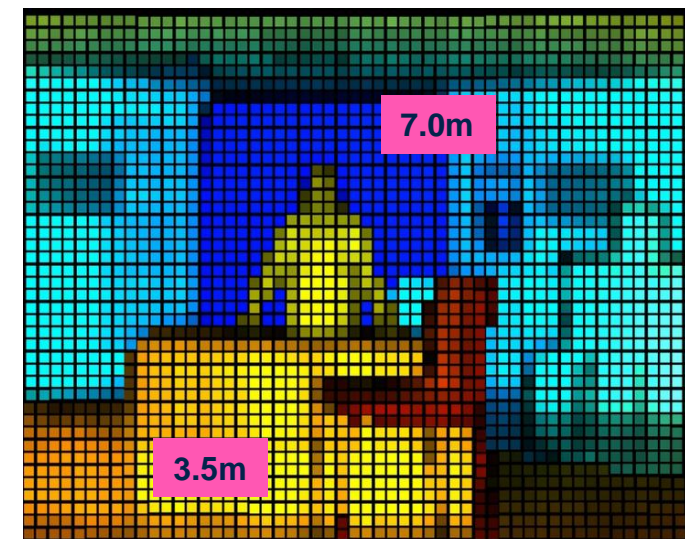
Flood illumination for thin edges and objects detection
2D IR + Depth output for AI or analytic processing
Motion artefact robustness from fast-moving scenes

True All-In-One lidar dToF module

On-chip dToF processing & distance over MIPI or I3C
Calibration free, no extra system cost
Reflowable module for easy integration



Chair legs & edge detect



Room mapping & 2D images





VD55H1 | 0.5 Mpix depth map

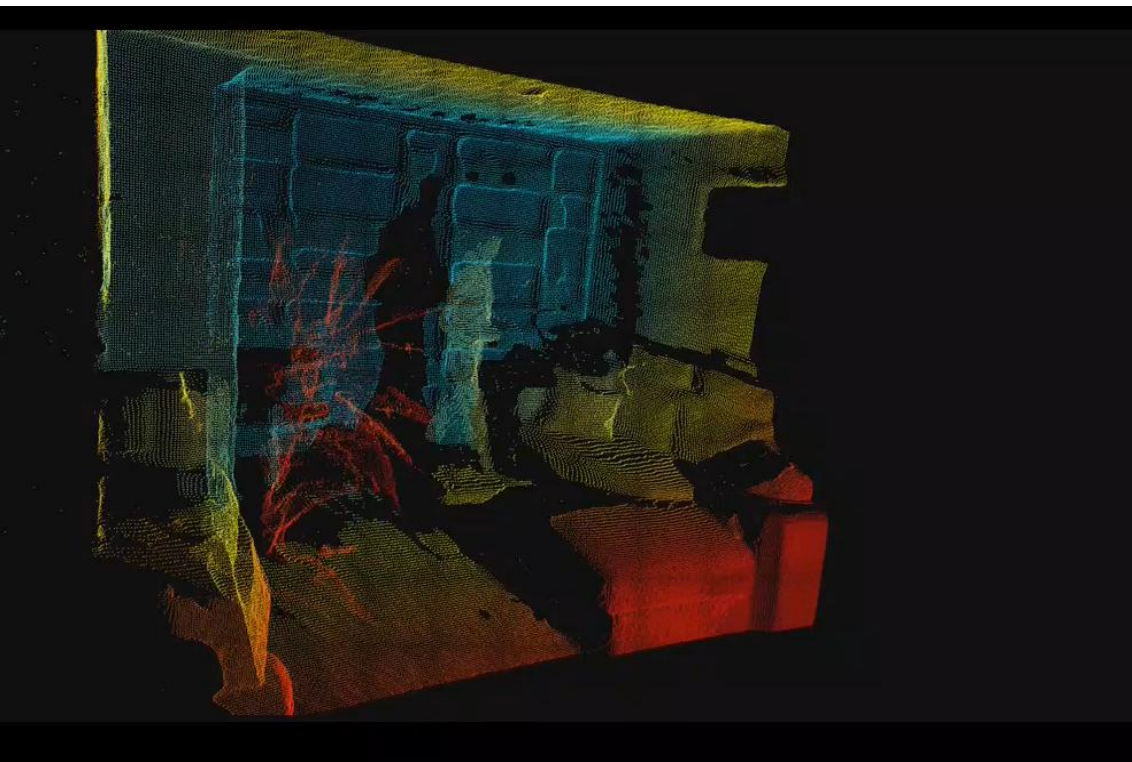
High resolution, low noise 3D sensing



World-facing



User-facing



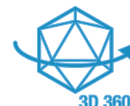
Room mapping



AF assist



Secure face authentication



Object scanning

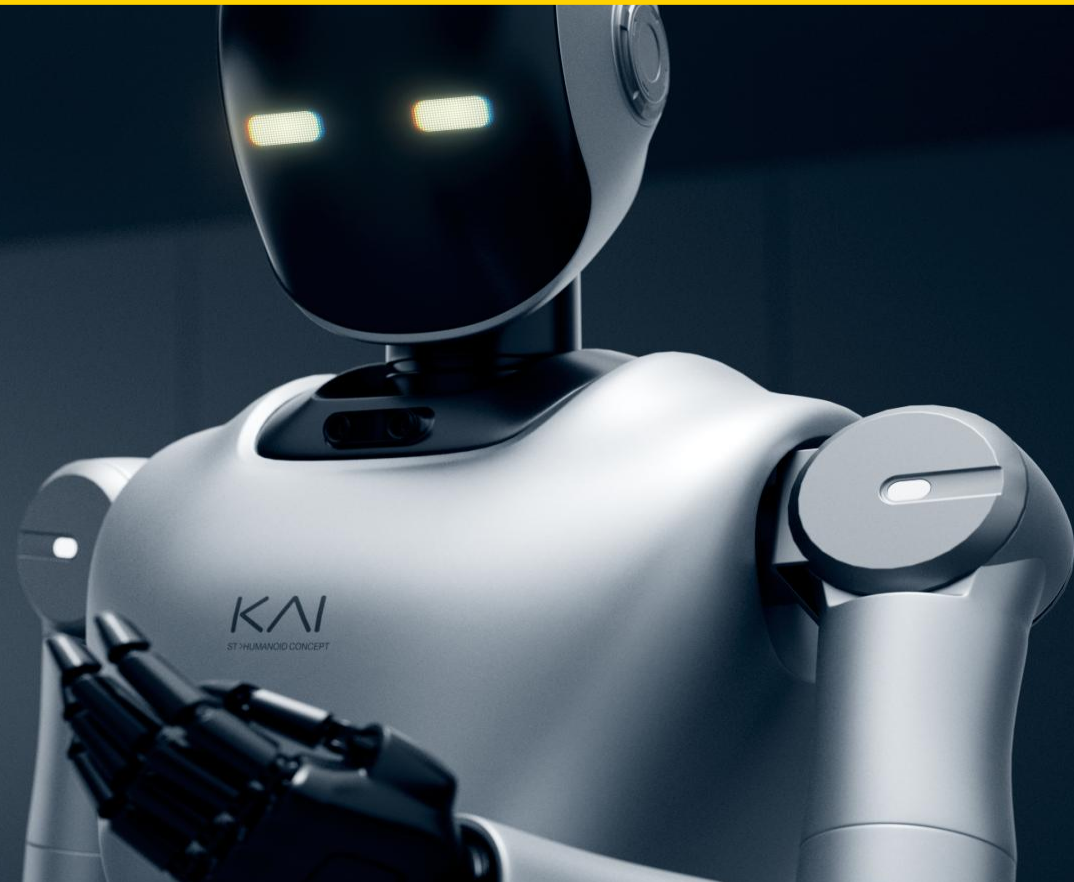


Bokeh segmentation



3D avatars

Time-of-Flight solutions for humanoid robotics



Focus on robotics

ST Time-of-Flight sensor enhances robot performance and multiplies use cases

Applications

- Cliff prediction
- Small object detection
- Collision avoidance
- Ceiling detection
- Water level monitoring
- Safe docking assist
- Wall tracking
- SLAM
- Clearance detection



Core benefits

- **Robust to smudge**
 - Excellent under dirty cover glass
- **Fast & accurate ranging**
 - Robust to material variation
- **Performance proven**
 - For challenging industrial designs
- **Multiple sensors in one robot**
 - Ease of integration, wide FoV
- **Low memory footprint**
 - Cost-effective systems

Products

VL53L0CX, L1CX-CB, L3CX, L4CX-CD, L5CX, L7CX, L8CX



Cleaning robot



Air purifier



Home assistants



Service robots



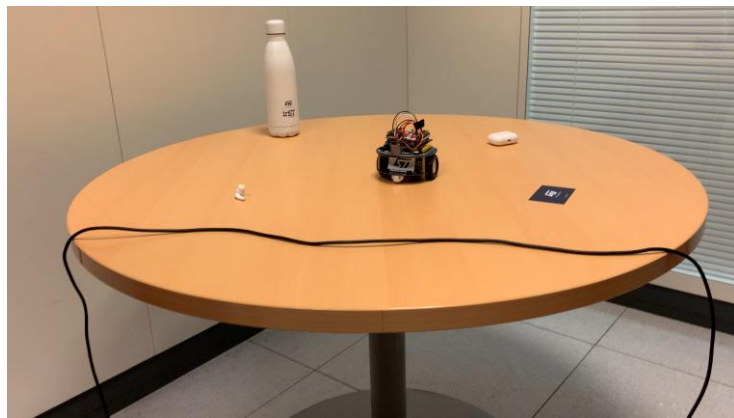
Pet robots

Robotics multi-applications

Only one ST ToF multi-zone sensor supporting up to 6 use-cases

Cliff / edge / slope prediction

Signature change on lower rows can detect approach to stairs/slope



Estimate object size (including flat object & cables) and precise distance in order to avoid them

Small object detection

Other use-cases

Wall tracking



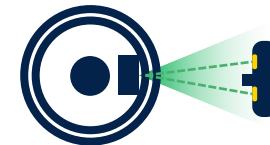
Collision avoidance



Ceiling / gap detection



Safe docking assist





STGesture and hand posture recognition

Gesture recognition

Gesture prediction and hand tracking
Solution based on an analytic algorithm



Tap Double-tap R/L/U/D swipe



Hand posture

Up to 7 hand gestures recognized
AI-based solution



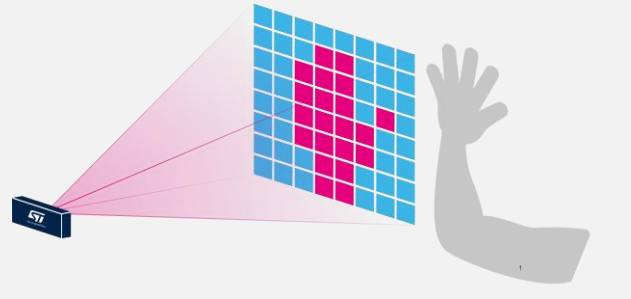
Like/Dislike Raise Love



FlightSense benefits

1. Cost effective
2. 100% Privacy
3. Ready to use
4. Low power

Multizone technology



3 multi-zone Time-of-Flight

VL53L5CX

- 65° FoV
- 400 cm dark/170cm amb

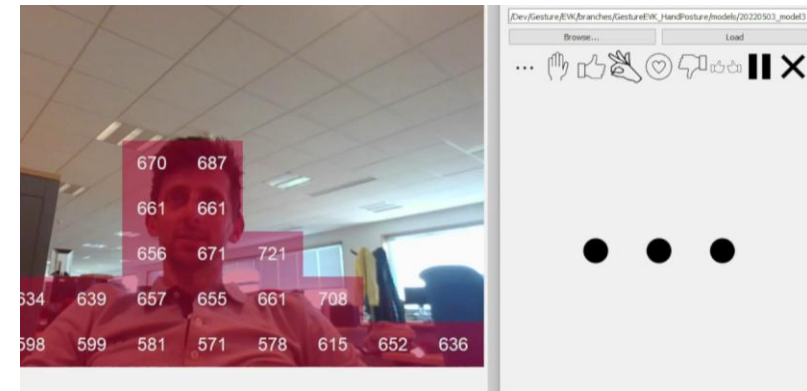
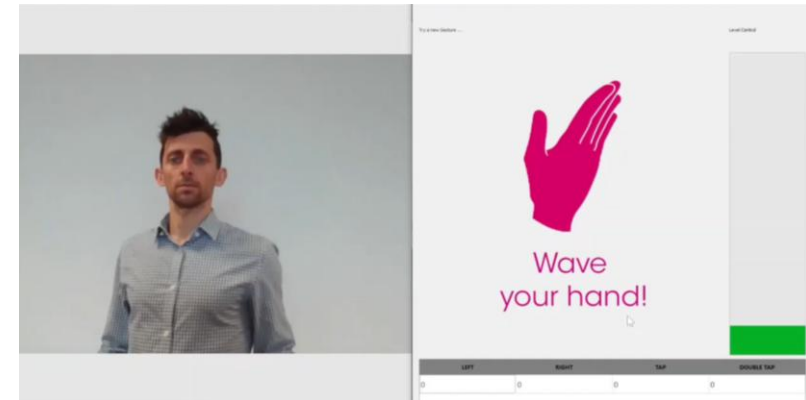
VL53L7CX

- 90° wide FoV
- Up to 350 cm ranging

VL53L8CX

- Ambient light immunity
- Low power
- 65° wide FoV
- Up to 400 cm ranging

Live demo using the VL53L8CX

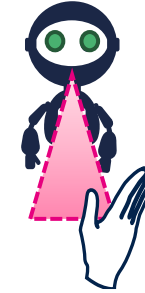




STGesture for humanoid robotics

Human to robot interaction

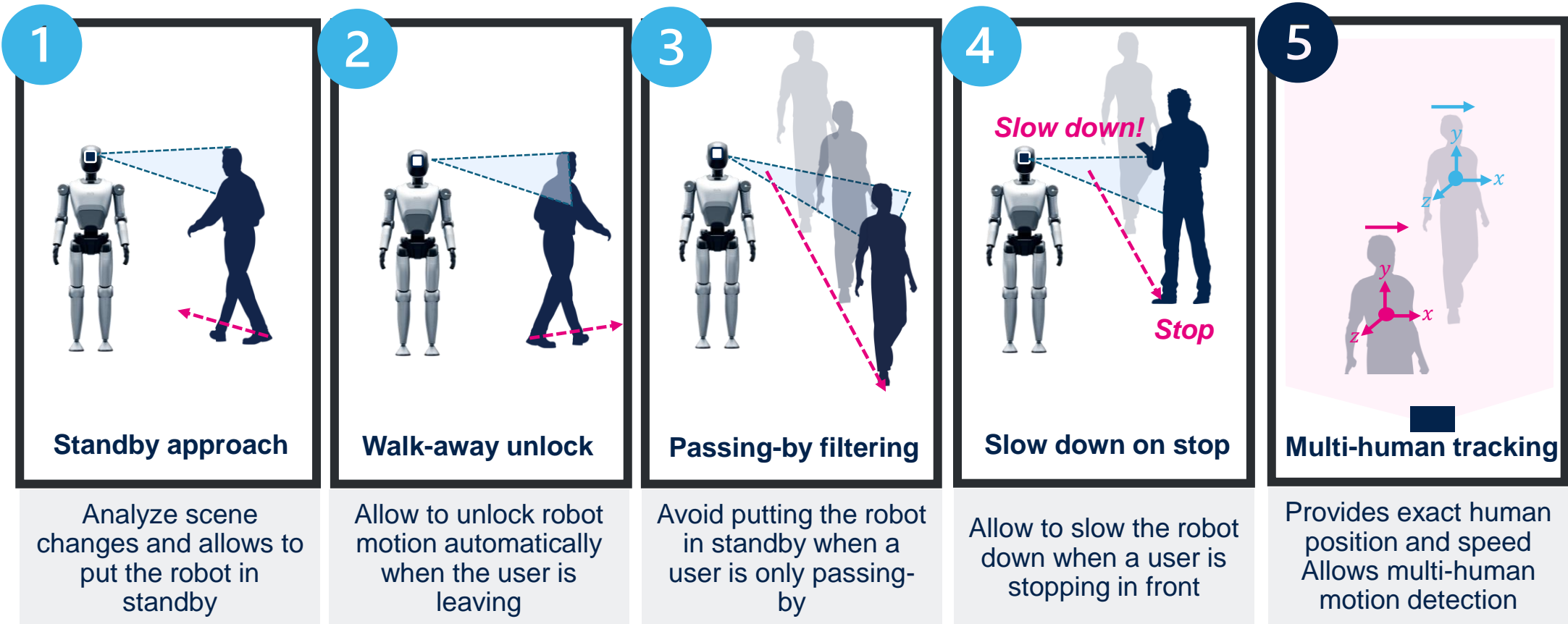
Human to robot interactions to mimic human gestures and to ensure human safety from dangerous situations



Smart presence detection for humanoid robotics

Human to robot interaction

Smart Presence detection, **5** features which make it **smart and ensure safety for human** !



ALS – Color & flicker sensors for humanoid robotics





VD6283TAB

6-channel ambient light sensor with advanced light flicker extraction

Available now!

Accurate Lux and CCT for display and camera management

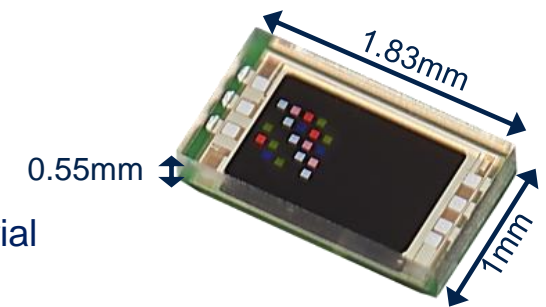
- Immune to light angular variation, thanks to very stable hybrid filters
- 6 channels from 400 to 1100nm: Red, Green, Blue, IR, Visible and Clear

Only sensor in the market with true flicker extraction engine

- Up to 8kHz flicker detection depending on light conditions
- Multiple light sources management

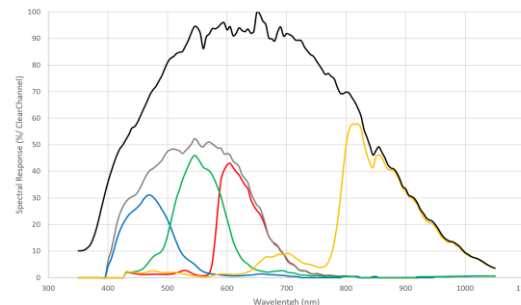
Excellent sensitivity in low light conditions

- Sensitive enough to operate under low transmittance material



Key applications

- Auto white-balance
- Flicker removal
- Brightness management



ALS 1 channel	400uA
ALS 5 channels	500uA
ALS 5 channels + Flicker	800uA



Our technology starts with You



Find out more at www.st.com

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