Sub-track III –
IoT & Connectivity Presentation
ST ToF enriches smart living

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Sr. Technical Marketing Manager
STMicroelectronics
Market leading smart optical sensing solutions

- **dToF module**
  - Single point to multizone
  - All-in-one module
  - SPAD 40 nm process

- **iToF sensor**
  - High resolution
  - Indirect & direct ToF
  - 3D stacked BSI 40 nm

- **ALS & combo**
  - ALS & proximity sensor
  - High sensitivity
  - Under OLED operation

- **Global shutter**
  - High sensitivity
  - Smallest size
  - Ultra low power

- **Sensors sold**
  - 2 Bu ToF sensors sold
  - 500 Mu ALS sensors sold
  - 1 Bu Global shutter sensors sold
At t0, 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 (t1).

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.

Measured distance = Photon travel time /2 \times Speed of light

1cm round-trip at 67ps!
FlightSense
unlimited markets & applications
# FlightSense Industrial & Mass Market Portfolio

## Multi-zone

<table>
<thead>
<tr>
<th>Product Variant</th>
<th>Features</th>
</tr>
</thead>
</table>
| **VL53L5CX** | 65° FoV  
64 zones (8x8)  
400cm dark / 170cm amb |
| **VL53L7CX** | 90° FoV  
64 zones (8x8)  
350cm dark |
| **VL53L8CX** | 65° FoV  
64 zones (8x8)  
400cm dark / 285cm amb  
Low Power Consumption |
| **VL53L8UX** | 65° FoV  
256 zones (16x16)  
300cm dark  
Low Power Consumption |

## Single zone

<table>
<thead>
<tr>
<th>Product Variant</th>
<th>Features</th>
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</table>
| **VL53L0CX** | 25° FoV  
200cm dark |
| **VL53L1CX** | 27° FoV configurable  
400cm dark / 130cm amb  
ULP mode |
| **VL53L1CB** | 27° FoV configurable  
800cm dark / 160cm amb  
Sequential 2x2 zones |
| **VL6180V1** | 25° FoV  
60cm dark  
10mm linearity |
| **VL6180X** | 18° FoV  
130cm dark  
1mm linearity  
ULP mode |
| **VL53L4CD** | 18° FoV  
130cm dark  
1mm linearity  
ULP mode |
| **VL53L4CX** | 18° FoV  
600cm dark / 180cm amb  
10mm linearity |
| **VL53L4ED** | 27° FoV configurable  
800cm dark / 160cm amb  
10mm linearity  
ULP mode |

## Legacy, Recent, and Coming soon

<table>
<thead>
<tr>
<th>Product</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
<td>VL6180V1</td>
<td>Legacy</td>
</tr>
<tr>
<td>VL6180X</td>
<td>Recent</td>
</tr>
<tr>
<td>VL53L0CX</td>
<td>Recent</td>
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<tr>
<td>VL53L1CX</td>
<td>Coming soon</td>
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<tr>
<td>VL53L1CB</td>
<td>Coming soon</td>
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<tr>
<td>VL53L4CD</td>
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<td>Coming soon</td>
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<tr>
<td>VL53L5CX</td>
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<tr>
<td>VL53L7CX</td>
<td>Recent</td>
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<tr>
<td>VL53L8CX</td>
<td>Recent</td>
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<tr>
<td>VL53L8UX</td>
<td>Recent</td>
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<tr>
<td>VL53L0CX</td>
<td>Recent</td>
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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 (Schedule TBC)
Delivering more than hardware
ST software solution
Infinite numbers of applications

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

<table>
<thead>
<tr>
<th>Cup detection</th>
<th>Presence detection</th>
<th>Projectors</th>
<th>Others</th>
</tr>
</thead>
</table>
| • Diameter estimation  
  • Height measurement  
  • Liquid level monitoring  
  • ... | • Wake-on-Approach  
  • Passing-by filtering  
  • Walk-away lock  
  • ... | • Autofocus  
  • Eye protection  
  • Keystone correction  
  • ... | • Drones  
  • Cameras  
  • Laptops/Tablets  
  • Industrial |

ST delivering **turnkey solutions** for gesture recognition, liquid level and cup detection, autonomous and ultra low power system activation, content management, robotics, and more to come
STGesture – Gesture 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

**BENEFITS**

- **Cost effective**
  - Inexpensive system architecture, and development

- **Privacy**
  - No image unlike camera. Only ranging distance

- **Ready to use**
  - No image unlike camera. Only ranging distance

- **Low power**
  - Low power ToF compared to other technology
# Non-intrusive liquid level monitoring solutions

## A dual throng solution portfolio for best end-system integration adequation

### Two ST Solutions

<table>
<thead>
<tr>
<th>VL53L4CD</th>
<th>VL53L5CX</th>
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</thead>
<tbody>
<tr>
<td>Single-zone sensor</td>
<td>8x8 multizone</td>
</tr>
<tr>
<td>Narrow 18° FoV</td>
<td>65° wide FoV</td>
</tr>
<tr>
<td>120cm max distance</td>
<td>Up to 400 cm ranging</td>
</tr>
</tbody>
</table>

### Applications

- Tanks
- Cleaning Robots
- Toilet flush
- Beverage dispensers
- Coffee machines
- Smart bottle

### Core Benefits

- Not “intrusive”
- Works with all liquids
- Small size

### V53L5CX demo

- Water Level Demo 1.2
- VL53L5 Data to Water
- 628Mcps/spad, 7.3cm

### Want to learn more?

- Go to the landing page:
- Source codes
- Technical documentation
- On-demand webinar

- Coming soon
System activation

Avoid any contact with physical buttons thanks to ToF detection sensors

**Sanitary**
- Smart urinal
- Toilet flush
- Faucet
- Dispenser

**Home automation**
- Smart switch
- Smart doors
- Home appliance

**Access control**
- Elevators
- Thermostat
- Public screen

ToF

ULP mode
Content management

Inventory management, waste management and liquid level control

Markets and applications

- White Goods
- Lockers
- Vending machines
- Tanks
- Warehouse
- ATM
- Trucks
- Dispensers

Core Benefits

- Long distance ranging & multi-object detection
- Accurate distance measurement
- Multi-zone ranging up to 8x8 zones
- From narrow to ultra wide Field-of-View
- Multiple sensors integration
- Low power

Smart Shelves demo

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

**Floor sensing**
- Surface recognition (soft or hard) to support mopping or vacuum mode using VL53L5CX
- [https://stm32ai.st.com/use-case/floor-type-detection-for-vacuum-cleaners/](https://stm32ai.st.com/use-case/floor-type-detection-for-vacuum-cleaners/)

**Other use-cases**
- Wall tracking
- Collision Avoidance
- Ceiling/Gap Detection
- Safe Docking Assist

**Small Object Detection**
- Signature change on lower rows can detect approach to stairs/slope
ST 3D ToF (iToF) with 3rd party module
VD55H1 | ref designs & use-cases

High resolution, short / medium distance

- **Thanos**
  - Flood illumination
  - 0.5 Mpix
  - Up to 500k depth points, <5m

Low resolution, Long distance (LIDAR)

- **Cyclops**
  - Spot illumination
  - VD55H1 – 0.5 MPix
  - 1,330 points
  - 1,300 dots, >5m ranging under ambient

**iToF’s merit = high native resolution**

- Less points but increased local SNR in the dots
  - = longer ranging + improved ambient resilience

**Use-cases**

- FaceID with antspoofing
- Object scanning
- Bokeh Segmentation
- Room mapping
- Room mapping
- AF assist
ST ALS (ambient light sensor)
Ambient light sensors & under OLED combo

VD6283
6 channels
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

VL6285
Under OLED
Color + Proxy

✓ 3-in-1 combo: RGB ALS + Proxy + 2x VCSELs
✓ Totally invisible under OLED screen
✓ High Lux and CCT accuracy
✓ White dot free Proximity
✓ Operates under ultra low transmittance material (down to 1%)

EVK available
MP in Q4 2023
ST GS image sensor & camera w/3rd party
ST global shutter sensors

Multiple spec camera promo-modules (using G0, G3, GY & G1 global shutter sensors) available to support sensor promotion and evaluation.
3D Stereo Camera

Domain-Specific Active Stereo Camera
With ST Micro Global Shutters

<table>
<thead>
<tr>
<th></th>
<th>Ref B3</th>
<th>Ref B6</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASELINE</td>
<td></td>
<td>62 x 48</td>
</tr>
<tr>
<td>SENSOR</td>
<td></td>
<td>90 x 70</td>
</tr>
<tr>
<td>RESOLUTION</td>
<td>VD55G0 [644 x 604]</td>
<td>VD56G3 [1124 x 1364]</td>
</tr>
<tr>
<td>F O V</td>
<td>Up to 640 x 480</td>
<td>Up to 900 x 1200</td>
</tr>
<tr>
<td>DEPTH</td>
<td>3CM</td>
<td>6CM</td>
</tr>
</tbody>
</table>
Our technology starts with You