# Combining Ultra-Low-Power Proximity Sensing and Ranging to Enable New Applications

Armita Abadian

Sr. Technical Marketing

STMicroelectronics/Imaging Group

# Home Grown Imaging and Optical Sensors Manufacturing

**Vertical Integration Benefits Include: Technology, Quality, and Cost Control**



**Research and Development, Design and Fab,  Grenoble France**

# STMicroelectronics Imaging Products
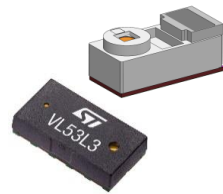
## Proprietary Technologies
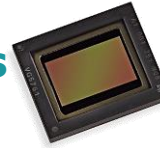
Innovative Sensor Technology

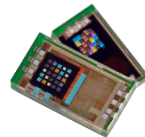ST Owned Advanced Fabs

## Unique Products and Services

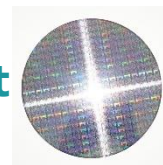- Direct and Indirect Time of Flight Sensing

- Global Shutter Imagers

- Ambient Light Sensing

- Custom and Collaborative Optical Sensors Development through our Foundry

## Focus Applications

Automotive     AR/VR     Laptops

## Growing Applications

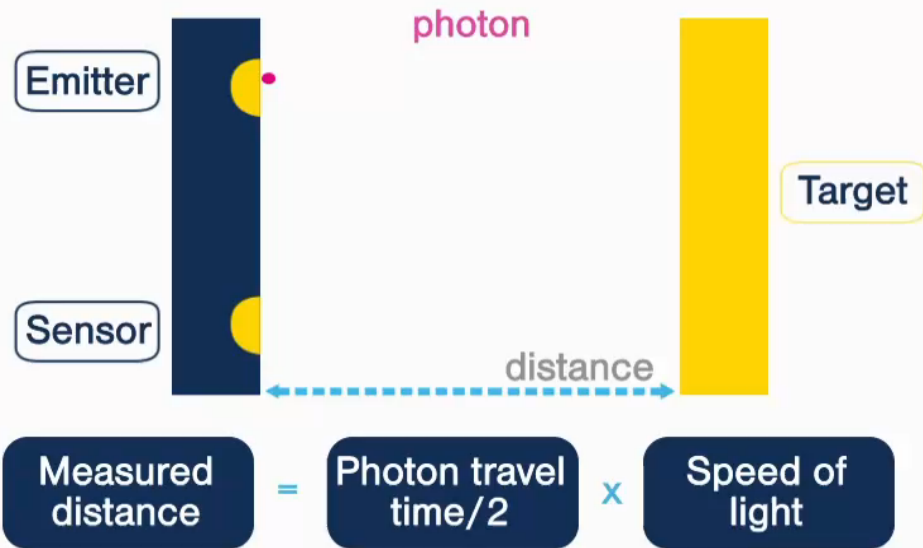Industrial     Wearable & IoT     Robots

Smart home     Smart Farming     Drones

# FlightSense™ … Making Light Work

## Time-of-Flight Principle



- ST proprietary F**light**Sense* technology
- True distance measurement
- Independent of target size, color & reflectance
- Fast and low power
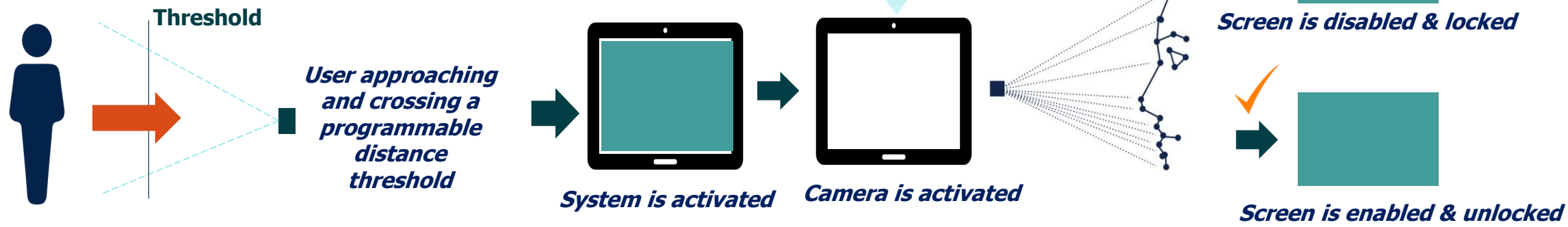- Truly invisible 940 nm illumination

## Home Security System

# Wake up Camera System for Human Detection and Face Identification



Threshold

User approaching and crossing a programmable distance threshold

**System is activated**

**Camera is activated**

X
**Screen is disabled & locked**

✓
**Screen is enabled & unlocked**

# Displays Activates as the Person Walks Up...

**Time-of-Flight sensors with distance detection activates the system**

Threshold

User Approaching
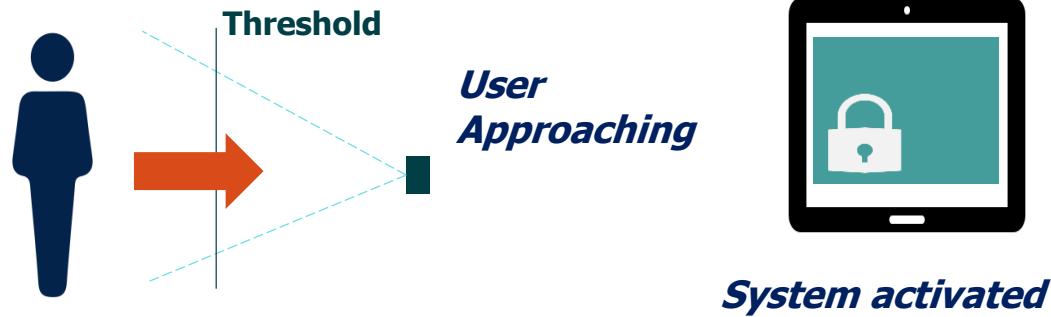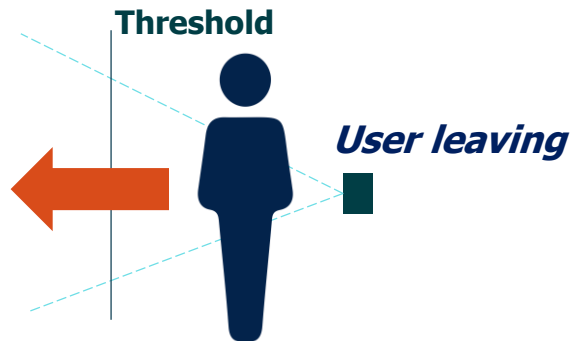
*Displays wakes up from low power mode as the person walks up*

**System activated**

**Time-of-Flight sensors with distance detection deactivates the system**
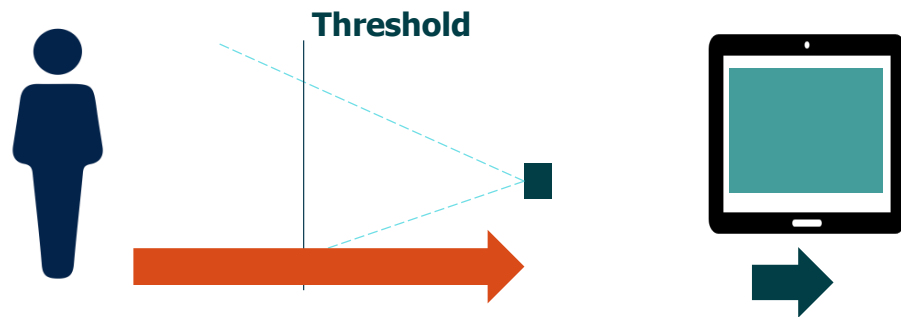
Threshold

User leaving

Displays sleeps ( going to saving power mode) as the person walks away

System is disabled & locked

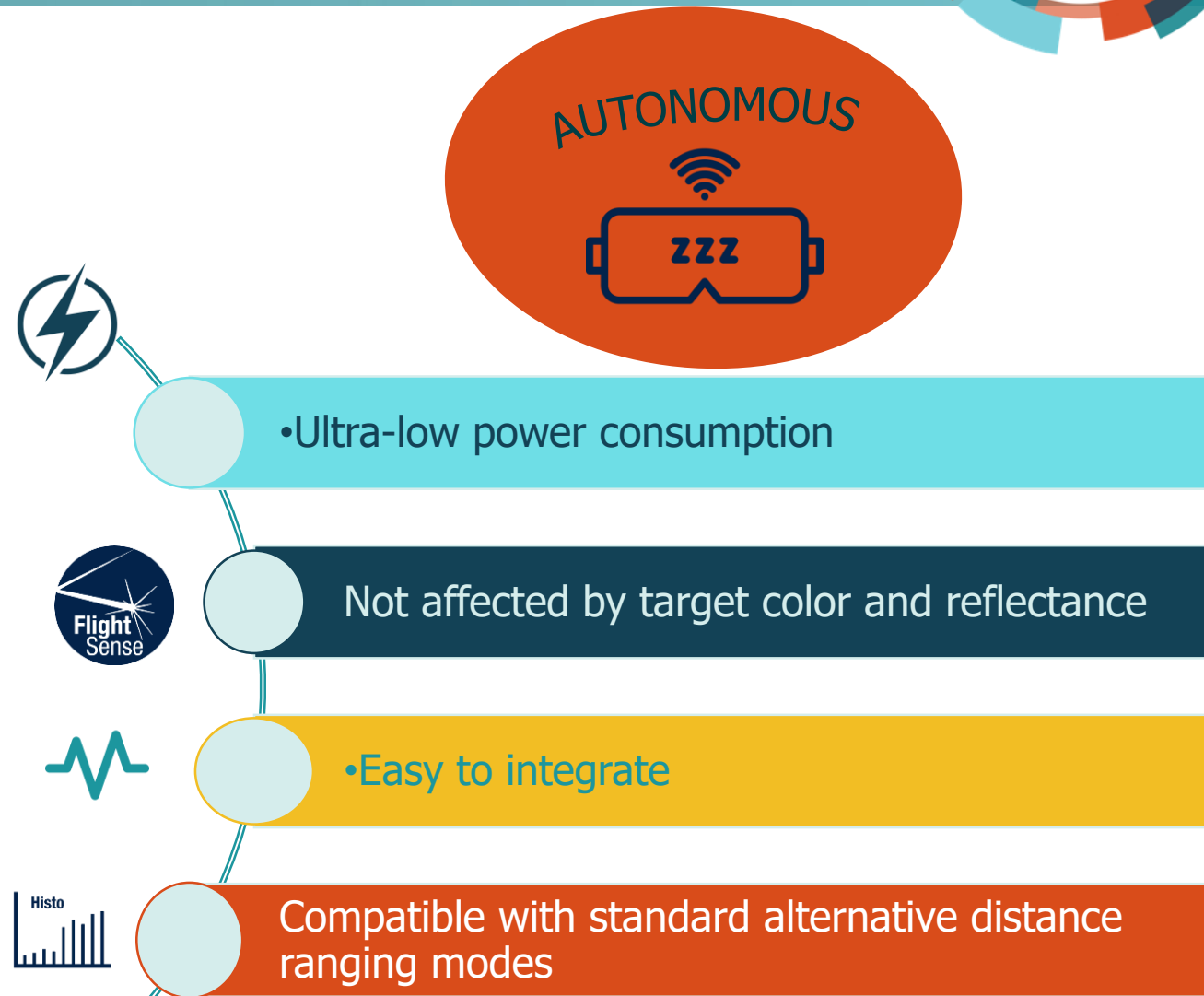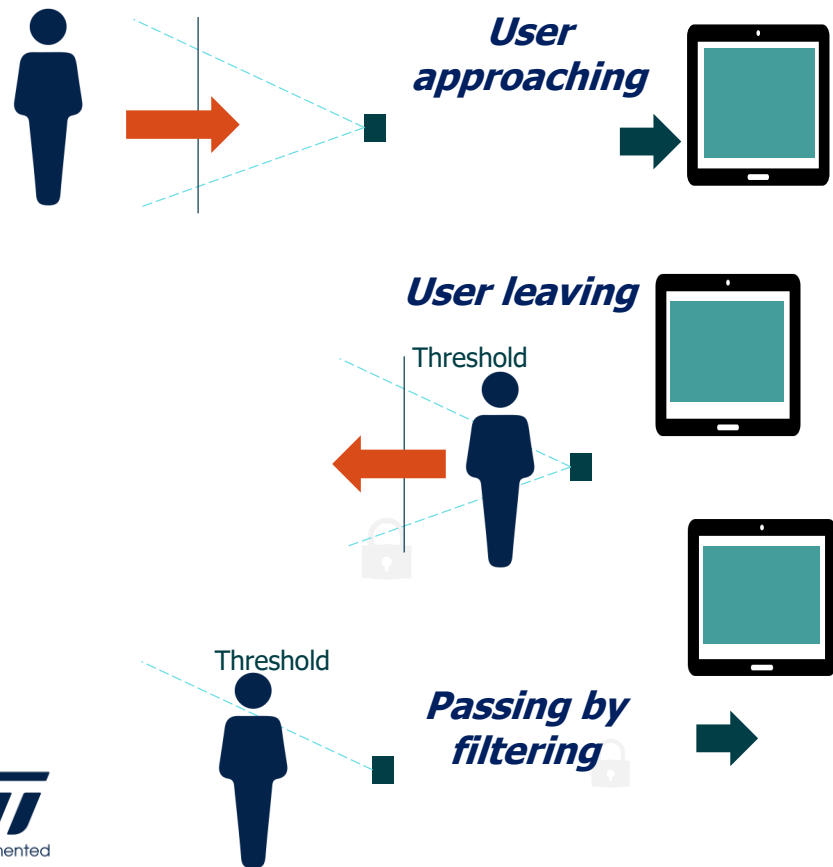**Display doesn't wake-up if the person is passing by**

Threshold

*Passing by filtering:*
*System not activated and stays locked*

# ToF Ranging Sensor in "Ultra-Low-Power" Mode as Detector Sensor



AUTONOMOUS

*User approaching*

*User leaving*

Threshold

Threshold

*Passing by filtering*

- Ultra-low power consumption
- Not affected by target color and reflectance
- Easy to integrate
- Compatible with standard alternative distance ranging modes

Flight Sense

Histo

# Other Applications for "Ultra-Low-Power" Time of Flight

## Detector Sensors Embedded in Sanitary Market
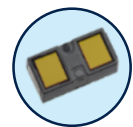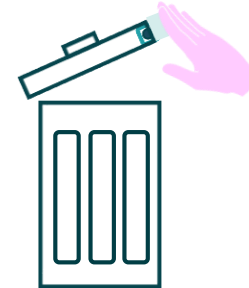
**Best sensor for this application**

**VL53L1CX**

**VL53L3CX**

### Smart urinal

70-90 cm

Flush with specific time delay after user approach
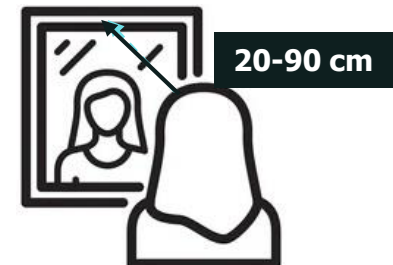
### Smart bin

Open the bin when user is approaching his hand

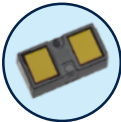### Toilet Flush

Flush the toilet when hand or foot is detected
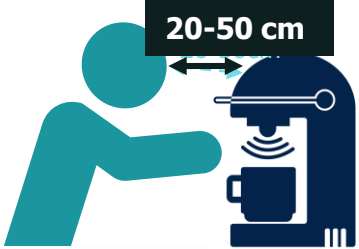
### Smart mirror

20-90 cm

Switch on, adjust lighting upon user approach

# Other Applications for "Ultra-Low-Power" Time of Flight
## *Detector Sensors Embedded in Home Appliance Market*
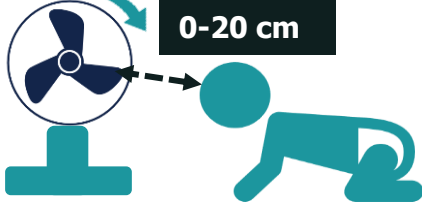
| Best sensor for this application |
|---|
| VL53L1CX |
| VL53L3CX |

### Coffee machine
**20-50 cm**

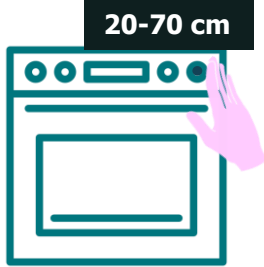Enable coffee machine display on approach

### Fan
**0-20 cm**

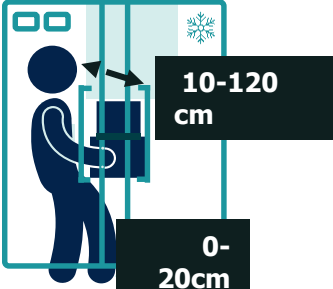Disable rotational fan when person/minor detected

### Oven
**20-70 cm**
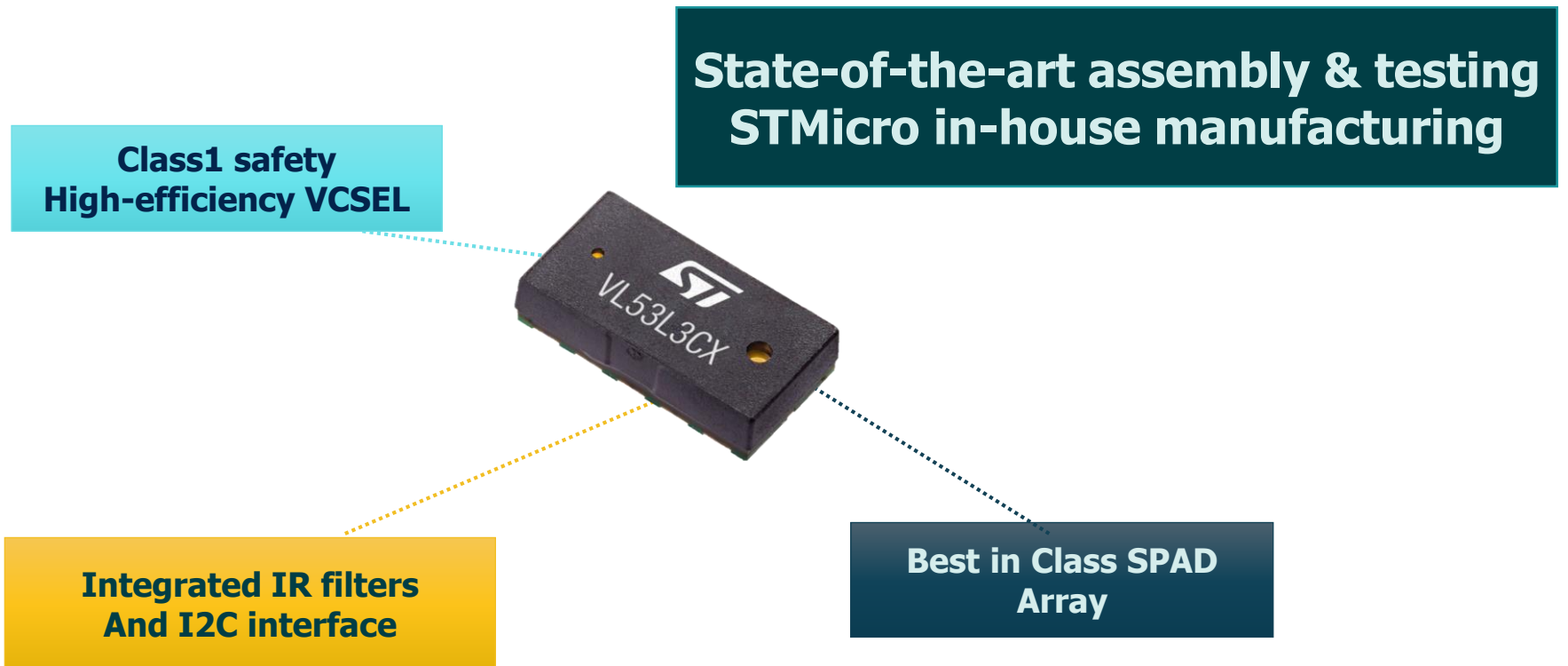
Enable home control console display

### Fridge
**10-120 cm**

**0-20cm**

Open fridge door when user detected

© 2022 STMicroelectronics

life.augmented

**All-in-One (illumination & sensor) Time-of-Flight system for optimized size, performance, and cost**

**State-of-the-art assembly & testing STMicro in-house manufacturing**

**Class1 safety High-efficiency VCSEL**

VL53L3CX

**Integrated IR filters And I2C interface**

**Best in Class SPAD Array**

# VL53L1CX with Ultra-Low-Power (ULP) Configuration

## Lowest power consumption and Standard Mode

**Package size** : 4.9 x 2.5 x 1.56 mm
**FoV** : 27°
**Single zone**

| 1 Hz frequency | Lowest consumption | Max Distance |
|---|---|---|
| White Target 88% | 65 µA >800 mm | 300 µA >1400 mm |
| Grey Target 17% | 65 µA >250 mm | 300 µA >1150 mm |

**Benefits of the standard mode use**

- **Max distance ranging : 400 cm+**
- **High ranging frequency (50 Hz)**
- **Programmable Region-of-Interest (RoI)**

## Lowest power consumption and Standard Mode

**Package size** : 4.4 x 2.4 x 1 mm
**FoV** : 25°
**Single zone**

| 1 Hz frequency | Lowest consumption | Max Distance |
|---|---|---|
| White Target 88% | 55 µA >230 mm | 240 µA >840 mm |
| Grey Target 17% | 55 µA >100 mm | 240 µA >310 mm |

VL53L3CX

### Benefits of the standard mode use

- Histogram processing
- Max distance ranging : **500 cm+**
- **Multi-target distance measurement**
- **Immunity to cover glass cross-talk** beyond 80 cm
- Automatic **fingerprint smudge compensation**

Histo

life.augmented

# Switching from Detection Sensor to Ranging Sensor

## Switching from low power detection to ranging ToF Sensor

### Detection sensor – ultra low power driver

- Detection based **hardware interrupt**

- **Fast detection** rate

- **Programmable detection** distance

- **Autonomous** streaming

### Ranging sensor – standard driver

- Accurate **distance** measurement

- **Fast** measurement
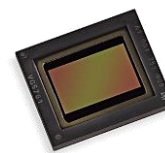
- **Long** distance ranging

- **Continuous** streaming

**Detection sensor can be used in ULP standalone mode and then switched to standard mode in order to perform ranging measurement**

# Imaging Products Applications Embedded Vision Systems



• **Time of Flight Sensing**

• **BSI Global Shutter Imagers**

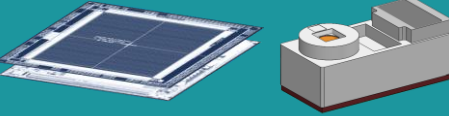• **Ambient Light Sensing**

# Imaging Products & Applications

**dToF modules**

Laser Autofocus | Object Detection and Gesture | Presence Detection
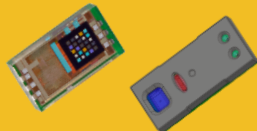
**3D Depth**

3D depth sensing | Face ID | Mini Lidar

**2D camera**

AR / VR/ MR headsets | Windows Hello FaceID | Robotic, Industrial & IoT

**ALS & Combo**

Ambient light & Color | Under OLED Combo | Flicker

# Our Technology Always Starts with You

**2022 Embedded Vision Summit**

Find out more at www.st.com/Time-of-Flight
www.st.com/Ambient-light-sensors
www.st.com/CMOS-Image-Sensors