FlightSense™ Applications Enabled by ST's Time-of-Flight

Imaging Division

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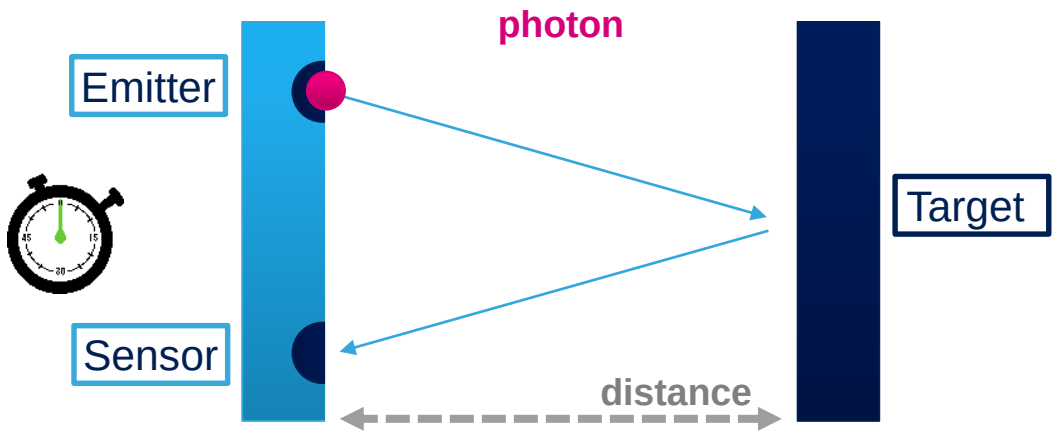
Santa Clara, CA

Flightsense™ Breakthrough Technology

Measurement at the speed of light!

FlightSense™ Principle



Measured distance = Photon travel time / 2 x Speed of light

Key benefits:

Direct distance measurement
Independent of target size, color & reflectance

Fully Integrated Time of Flight Module
ST #1 World Wide Supplier

Very fast (few ms)

Low power

Light is 1 million times faster than sound!

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Flightsense™

Optical Time-of-Flight Product Family

ST is Worldwide
#1 ToF supplier

Proven track record in manufacturing

>800Mu products shipped

300% AAGR

Single Photon Avalanche Diode
Ultra fast time resolution enabling Direct ToF processed in ST CMOS SPAD process

ST Proprietary Time-of-Flight IP
Best compromise of cost, complexity & power vs performance

All-in-one system
Sensor, filters, optics, VCSEL and driver integrated
Fully calibrated system

Optimized and reliable supply chain
High volume & low cost

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FlightSense™ Product Longevity

7-years Commitment Extended

FlightSense™ benefits from ST Longevity Program

- 7-years **MORE** longevity starting from Jan 1, 2019
  - VL6180
  - VL53L0X
  - VL53L1X

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FlightSense™ Product Descriptions

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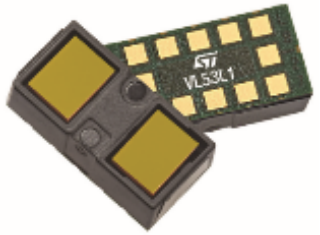
FlightSense™ Mass-Market Products

VL6180X	VL53L0X	VL53L1X



- 1st Gen FlightSense™ Sensor
- Proximity/ALS sensor up to **60cm**

- 2nd Gen FlightSense™ Sensor
- Ranging sensor up to **2m**

- 3rd Gen FlightSense™ Sensor,
- Ranging sensor up to **4m**, with programmable **FoV**

Main use-cases: **proximity, distance measurement, user / object detection, robotics, lighting control, basic gesture…**

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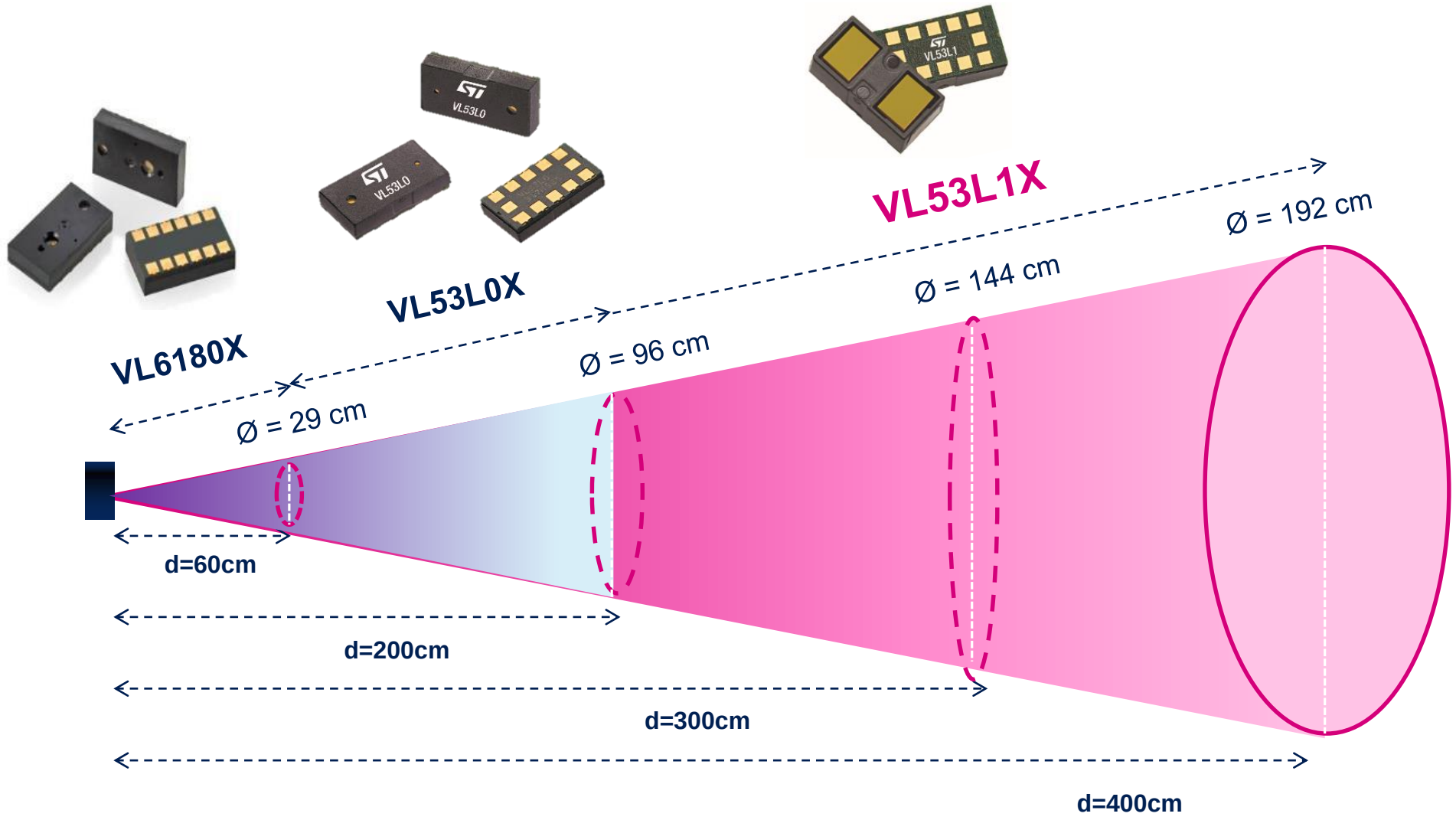
Detection Cone



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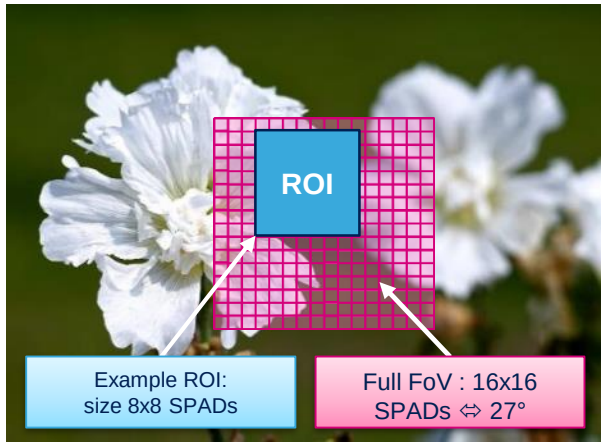
VL53L1X

Custom Field-OF-View (FOV) aka Custom ROI

- No fixed pre-defined size for the sensing array (Region of Interest)
  Unlike other sensors on the market or VL53L0X
- Sensing array is composed by 16x16 SPADs (Single Photon Avalanche Diodes) that **can be selected by customer**
- VL53L1X returns the distance to object covered by the ROI FoV
- **User defines the 2 corners of the array**, through SW driver (API) or the Eval Kit GUI.
  It could even be rectangular. Only condition is to have a minimum of 4x4 SPADs array.
- The change of ROI can be done “on the fly” by the host



Changing the ROI by software allows to virtually reduce the FoV

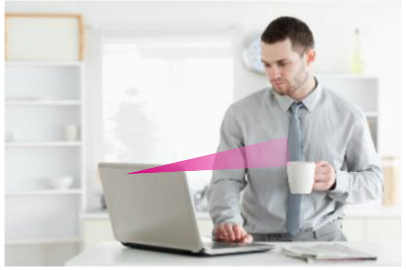
Please come at our demo stand,
you can see SmartShelves application based on custom ROI

VL53L1X

Autonomous Low-Power User Detection

Save Power When No User Detected, and Easily Wake-up Your Device for <1mW

- The ToF sensor must consume as little as possible, just to detect if someone is approaching the device in sleep mode
- VL53L1X includes an Autonomous low-power mode, specially defined for this application



Embedded low-power MCU

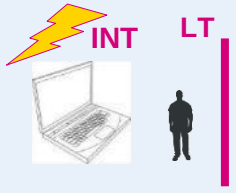
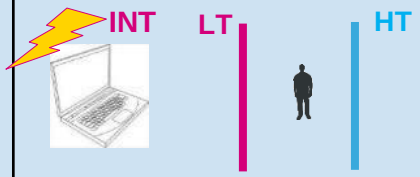
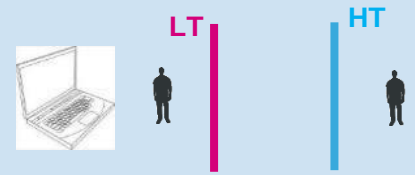
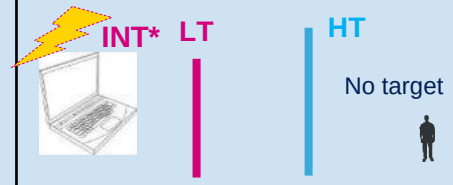
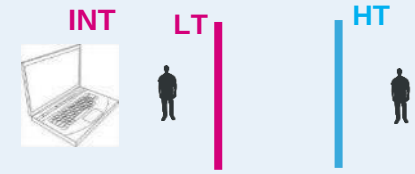
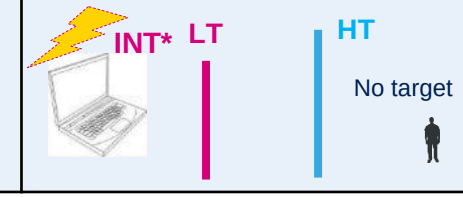
- **Programmable** thresholds and repetition rate
- **Autonomous** state machine in VL53L1X
- Once target detected, an interrupt is sent on GPIO1 pin to wake-up the host (no need of i2C)

Example of Energy Saving:

- **VL53L1X in low-power autonomous mode: 0.9mW** (1Hz, 20ms ranging operation)
- Tablet (iPAD3): Active: 40W, Sleep Mode: 0.4W
- Laptop (iMAC 27”inch): Active: 80W, Display off: 20W, Sleep mode: 1W

VL53L1X

Autonomous Mode & Thresholding

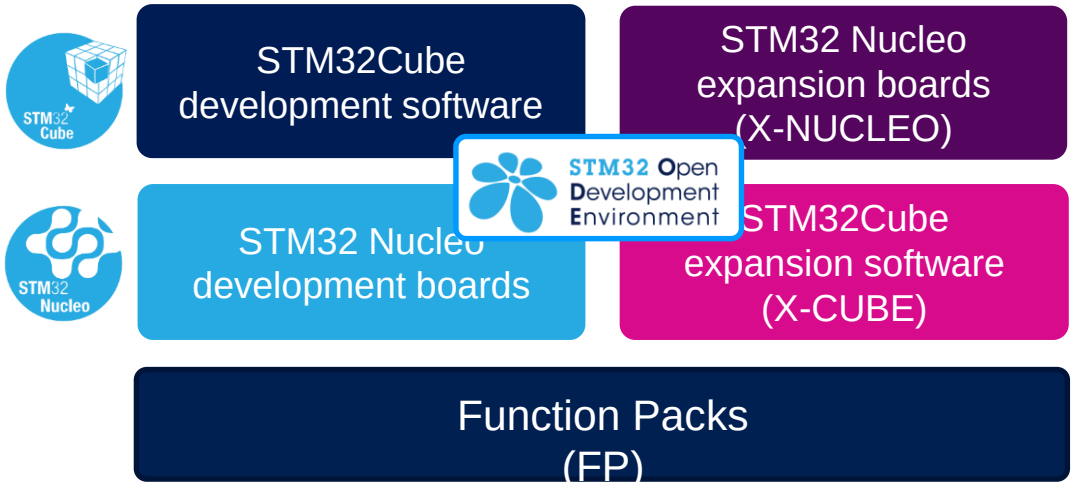
Threshold condition	Human & device situation and Interrupt raised by VL53L1X		
“Above HIGH” (> High)			
“Below LOW” (< Low)			
“In Window” (>= Low AND <= High)			
“Out of Window” (> High OR < Low)			

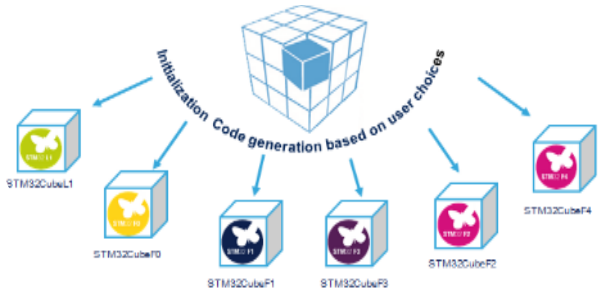
INT* (optional interrupt), customer choice

Complete Development Tools

- STM32 NUCLEO boards and GUI

- STM32 Open Development Environment





- X-CUBE SW Package

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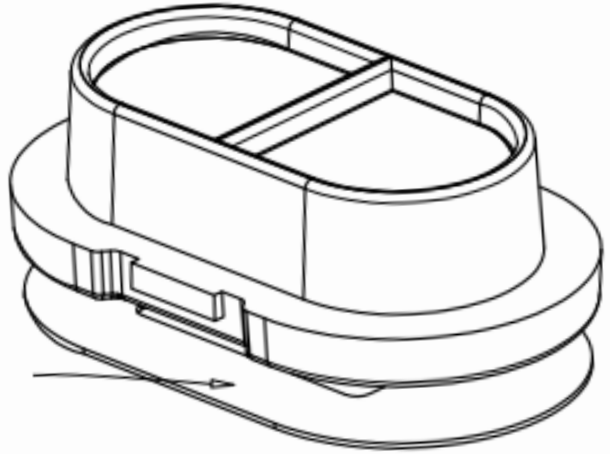
Accessories Updates

- Hornix Announces a new coverglass optimized for dusty environments.
- This completes its coverglass portfolio for FlightSenseTM products

www.hornix.com.tw

Add other coverglass designs for VL6180 or VL53L0X



Endless New Applications

Drones

PC & Tablet

Vacuum cleaners

Sanitary

Smart home

Printers

Medical

Service Robots

White Goods

AR/VR

Industrial

Wearable & IoT

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FlightSense™

… making light work

Camera Assist

- Instant focus
- Scene understanding
- AWB & light flicker rejection

Face Identification Assist

- Face anti-spoofing
- Cost, power, size optimized
- All-in-one depth sensing

Presence, User Detect

- Security
- Comfort
- Power saving
- Eye protection
- Wellness

Ranging & Proximity

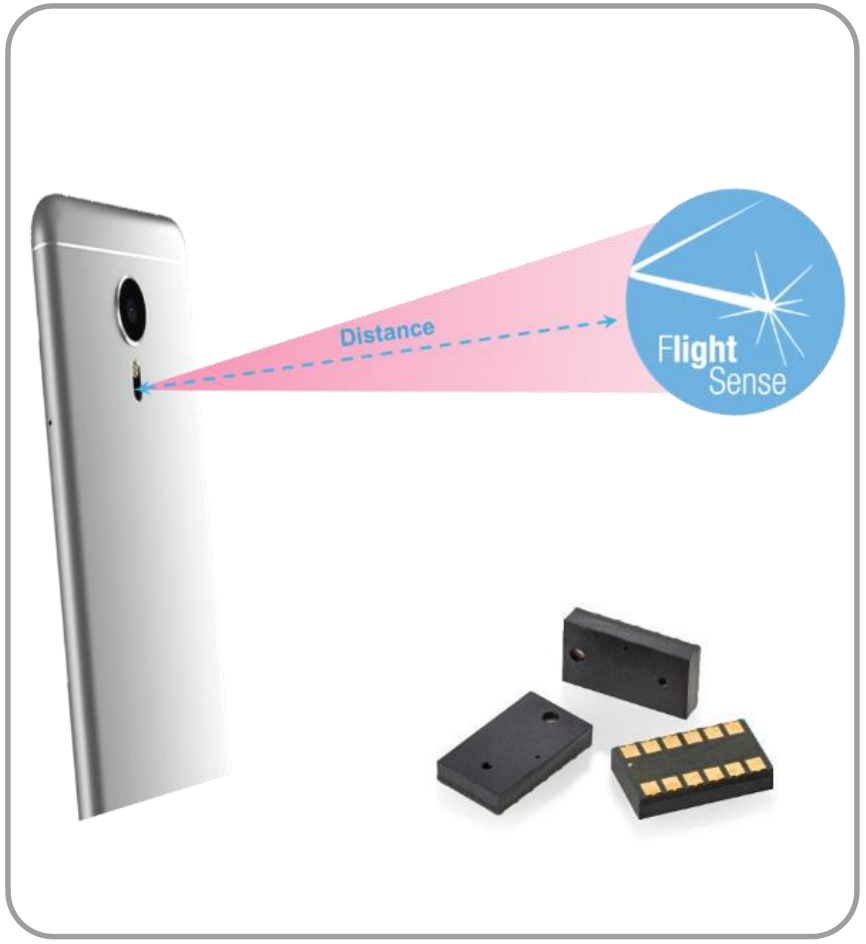
- True distance
- Up-to 4m
- Robotics
- Storage load
- Vending machines
- Lighting control
- Sanitary

Gesture

- Power, size & performance
- New ways to interact
- White Goods
- Home appliances

Auto Focus Camera Assist

Smartphones



Typical functions

Almost “instant focus” over full focus range

Most of our 800M units go into this market

Cheek detect
Immediate screen on/off disable hang-up

Auto focus assist
Fastest solution for low light & low contrast scenes

FlightSense™ Use-cases

Presence Detection

A rising use-case in Personal Electronics & Industrial

Typical functions

Security
Immediate log-off or lock, log-in assist

Power saving
Immediate screen on/off

Eye protection
Warning when user is too close from screen

Audio/User interface enhanced control
Adjust mic/speaker mode based on distance

Simple and robust gesture
Tap & Swipe

Human vs Object

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Presence Detect

Typical use

While in shutdown, the Sensor pings once or twice a second looking for a user.
When the user shows up, the Sensor sends the PC a wake-up
When the user goes away, the Sensor sends a sleep command to the PC
And so ends <cntl><alt><delete>

Key Tech Advantage

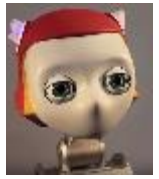
What happens if someone puts a chair in front of the sensor?
Chairs don’t breathe! And we can tell.

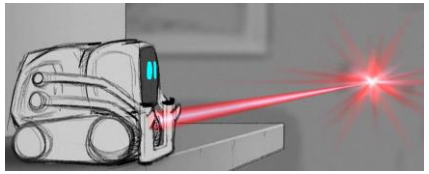
FlightSense™ Use-cases

Robotics

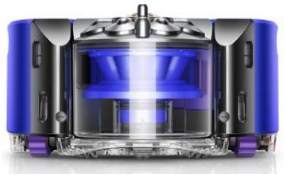









Service Robots




Vacuum Cleaners

Typical functions

Security

Cliff detection

Detection

Wall tracker

Obstacle & object detection

Robotics - continued

Mistyrobotics.com

Typical use

Robots need sensors

- Forward looking to avoid walls and chair legs
- Backward looking to locate the charger
- Drop sensors to keep from falling down the stairs

But the big deal is how cheap the sensors are

- Cameras cost money, and need big CPUs to interpret the data.
- A ToF sensor, delivers distances and an alert. No programming required.

Key technical Advantage – Small enough to put anywhere.

FlightSense™ Use-cases

Drop Sensor

Typical use

Safety

- All those robotic vacuum cleaners have trouble with stairs.
- To keep the robot from falling, a ToF sensor is used to insure there is still a floor in front of the wheels.
- Key Technical Advantage is speed!
- The faster the sensor goes, the faster the vacuum can go.
- And with a little help from a coverglass, we are not affected by dust – much.

FlightSense™ Use-case

Smart Home - Sanitary - White Goods

Typical functions

Touchless operation
Presence or action detection

Power saving
Timely operation/ display on/off

Light adjustment
User convenience and comfort

User interface enhanced control
Objects detection

Simple and robust gesture
Tap & Swipe

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Completely Automatic Bathroom

Things you know about

auto-flush toilets

automatic faucets

automatic towel dispensers

New ideas

Mirrors that light up when you look into them

Auto opening garbage cans

Shower heads that cut down the flow when you step away to soap up.

Key technical advantage

Battery life

One really cannot connect 110v to a faucet

Consoles and Thermostats

Typical Use

There are a whole class of things that should remain off until someone wants to interact with them.

A thermostat in a bedroom should really be dark, unless one wants to change something.

But how to find it in the dark?

Just wave at it or come close, and it automatically comes alive!

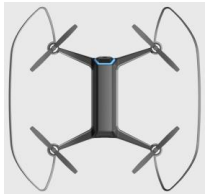
Key Technical Advantage

Field of View.

You don’t have to know exactly where it is, just get close - near.

FlightSense™ Use-cases

Drones - Toys



Typical functions

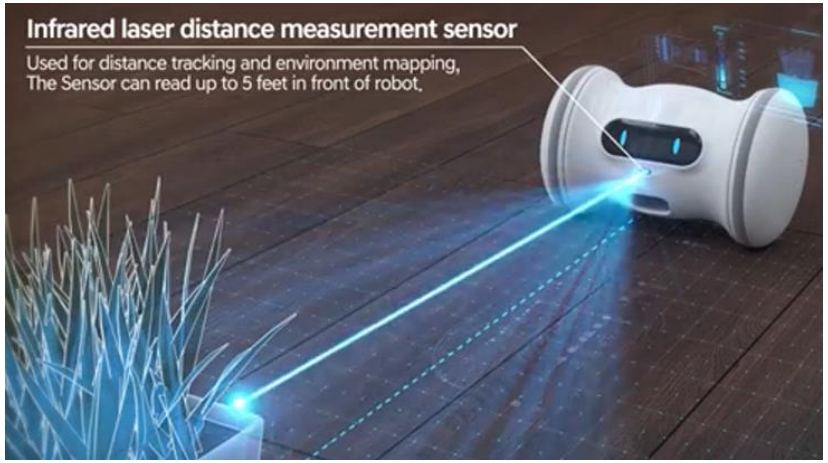
Detection

Obstacle & object detection

Floor/Ceiling detection

Sensing

Environment Mapping



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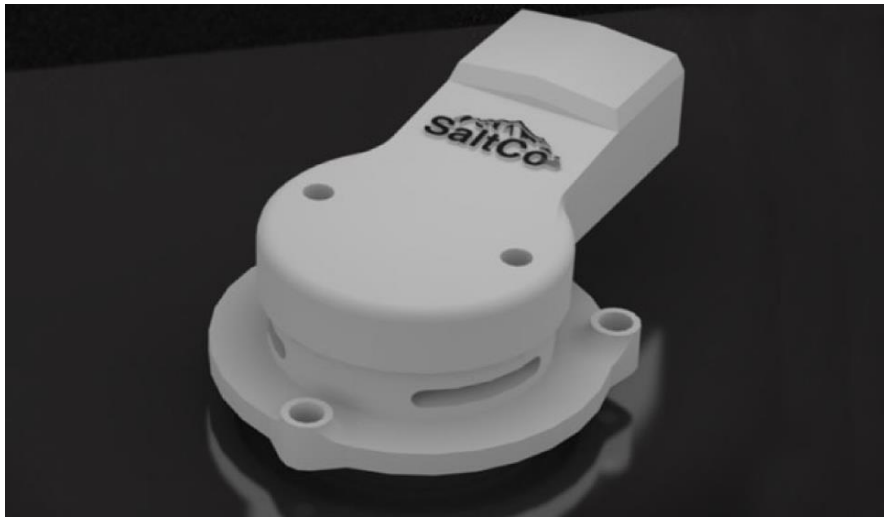
FlightSense™ Use-cases

Level Measurement



Saltco.com

Typical functions

Remote Sensing

Liquid Level

Health

Not intrusive level measurement
Measurement of
Corrosive liquid
Sterilized liquid or
no liquid at all

Key Tech Advantage

Black oil and bright reflective salt both work.

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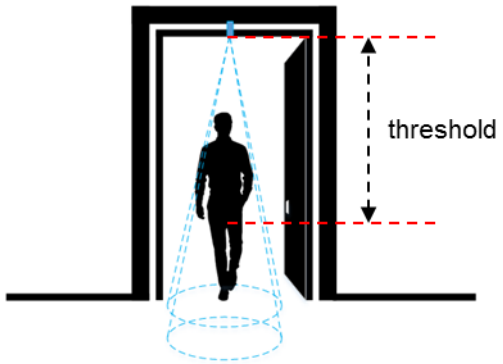
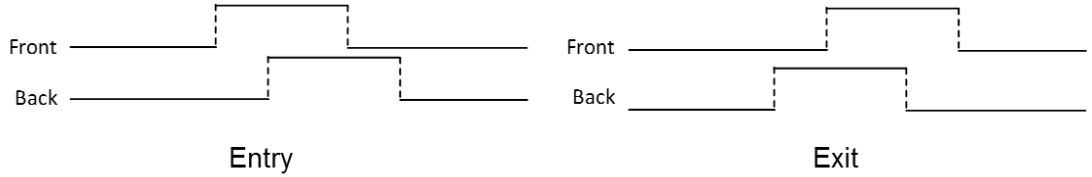
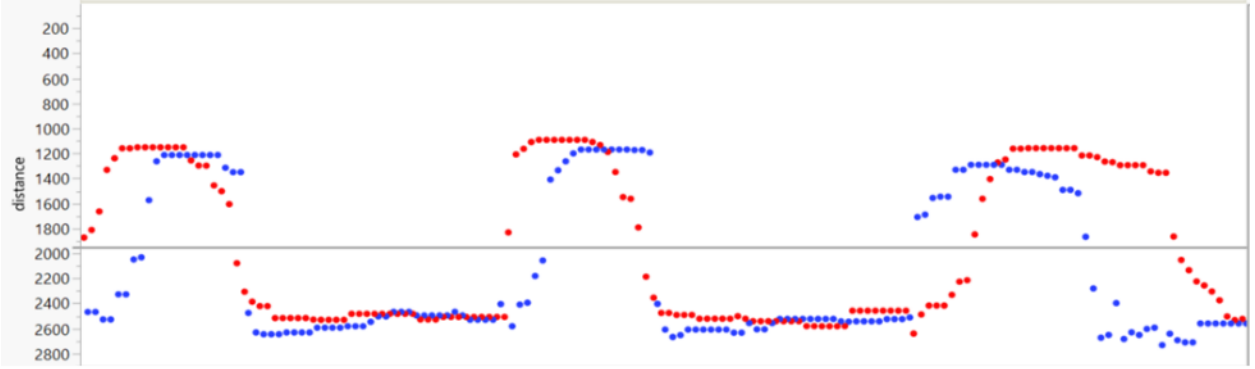
FlightSense™ Use-cases

Building Management System







Typical functions

People Counting
Room occupancy
AC adjustment

Presence Detection
Smart Display
Smart Appliances

Key Tech Advantage
Small and unobtrusive

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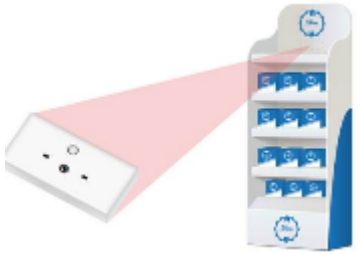
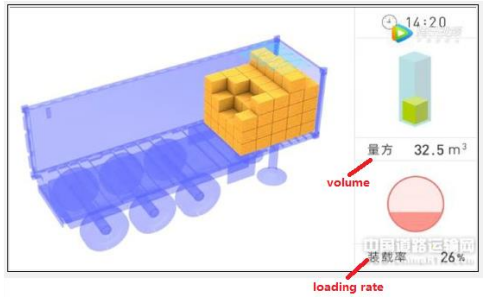
FlightSense™ Use-cases

Smart Shelves - Industrial - Medical





Typical functions

Detection

Objects detection & counting

User Presence

Power saving

Timely operation/ display on/off

Touchless User interface

Basic Gesture recognition

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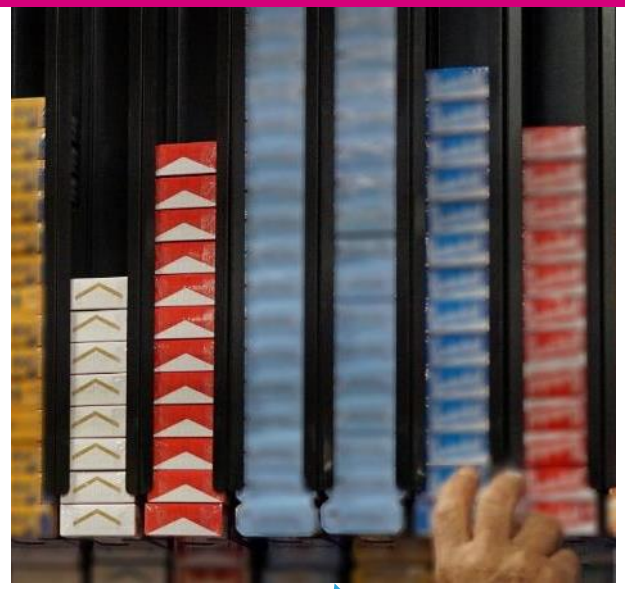
Shelving topologies

Two ways to get products always available in front until empty



Gravity feed

Pusher tray

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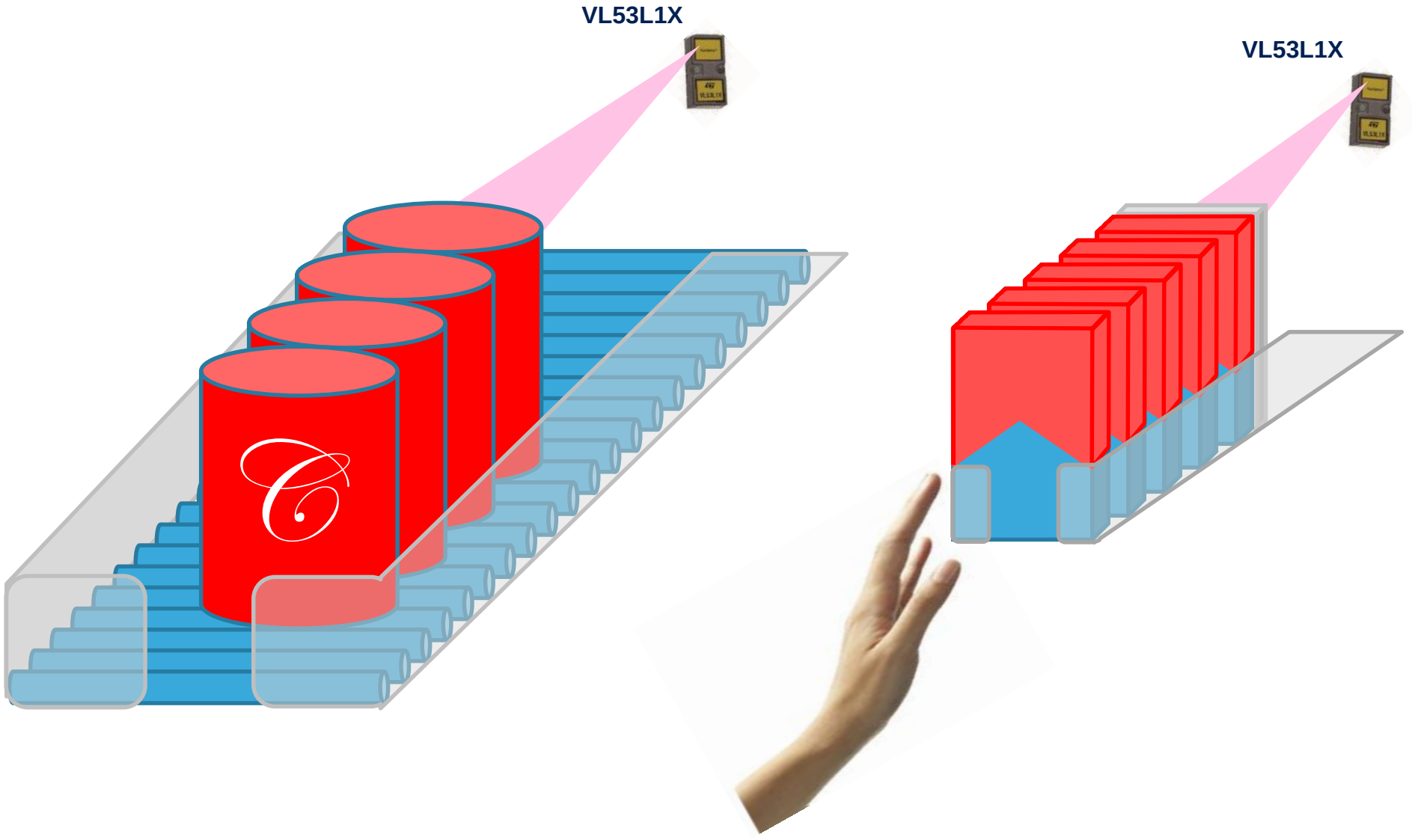
« Automatic » Content monitoring

VL53L1X ToF sensor solution

A key to reduce out-of-stock loss

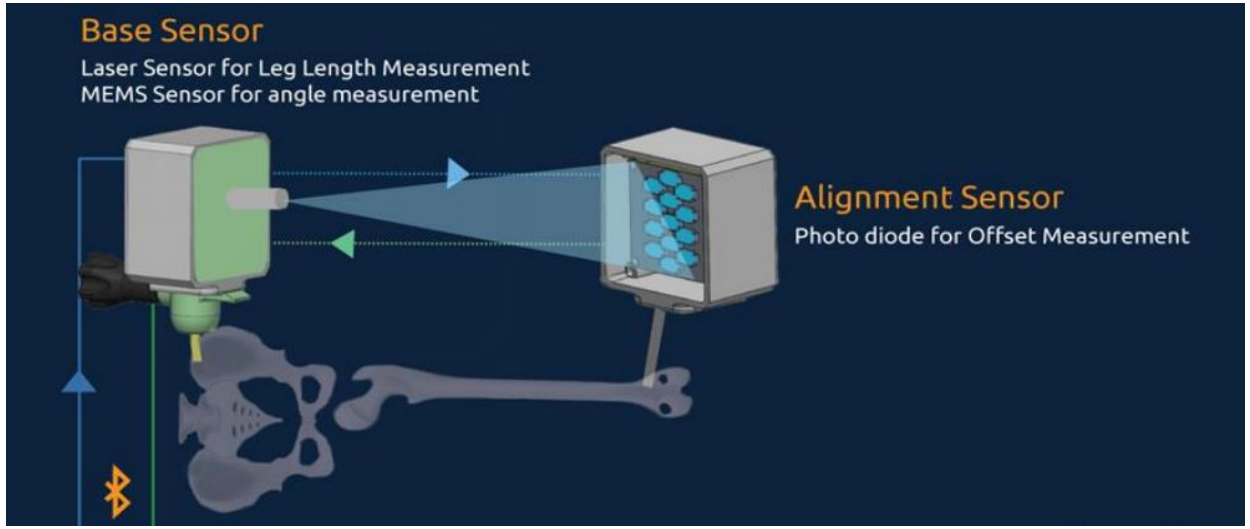


Smart Shelf

By ranging the empty space, one can know how many items are left Simple.

Key technical Advantage – Field of View, battery life.

Come at our Demo Stand to see SmartShelves application at work

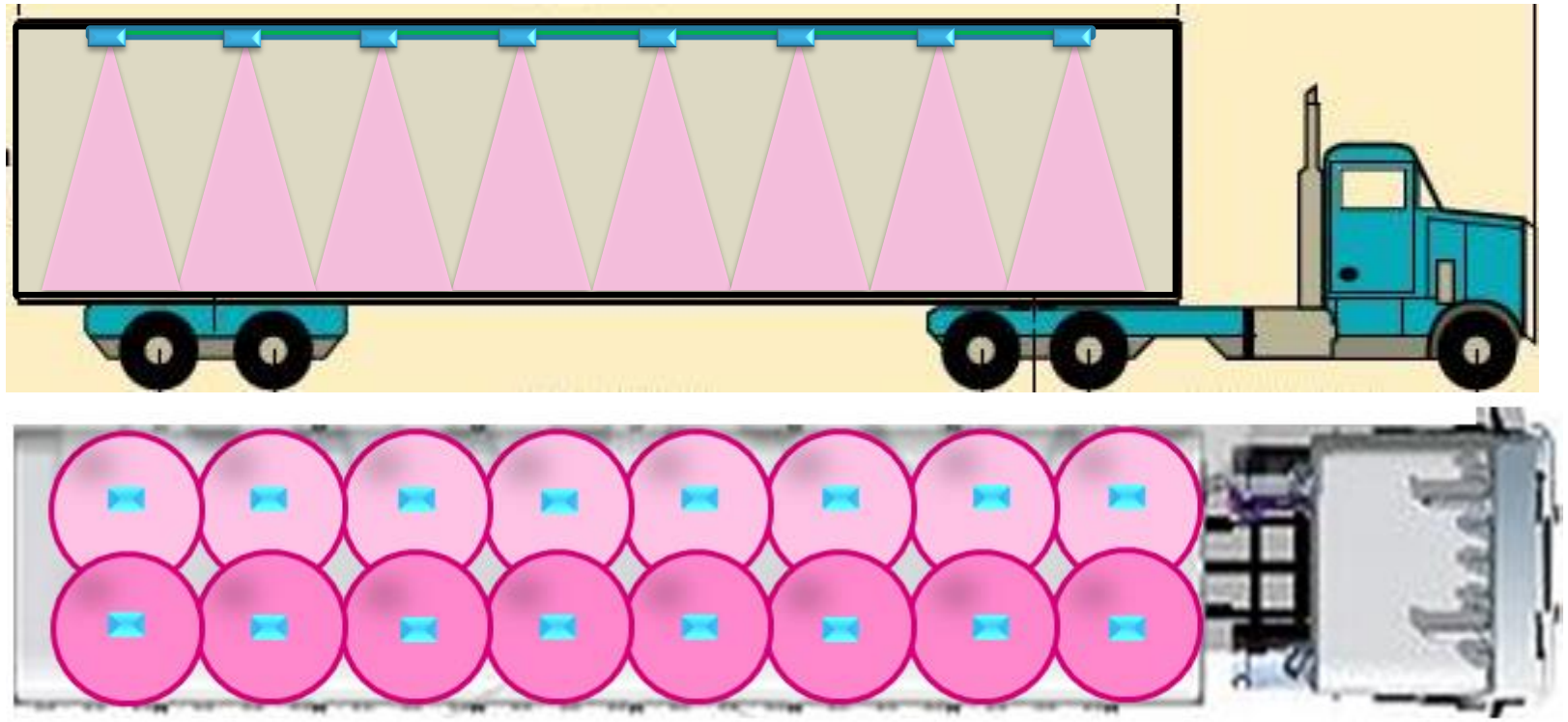


PathPartner.com

X-ray positioning sensor

Key technical Advantage: Accuracy

Truck Loading



With a number of sensors looking down, one can tell how well a truck is loaded.

Cameras are too expensive, too data intensive, and don't give distance data.
By ranging the empty space, one can know how many items are left Simple.

Key technical Advantage – Field of view

Taking Out the Garbage

Abmbed.com

KS Technologies 3300

This is one of a class of sensors where distance is combined with Bluetooth or Sigfox.

Attach it to a dumpster, and one can know a fullness level. Only roll the truck when you need it.

Key technical Advantages –

Dust Immunity

Low power

Watching the Grass Grow

Farmote.com

By aiming down and only taking measurements at night, a farmer can know if the cows have lots of grass left, or if it's time to move them to a different pasture.

Allows the farmer to adjust fertilizer depending on the growth of each field corner

Farmote chose to add a lot more sensors, giving complete weather data, delivered via cell phone technology.

Key technical advantages
Field of view, accuracy