



life.augmented



Gesture Recognition Based on ST FlightSense™ ToF sensors

26 April 2022



Agenda

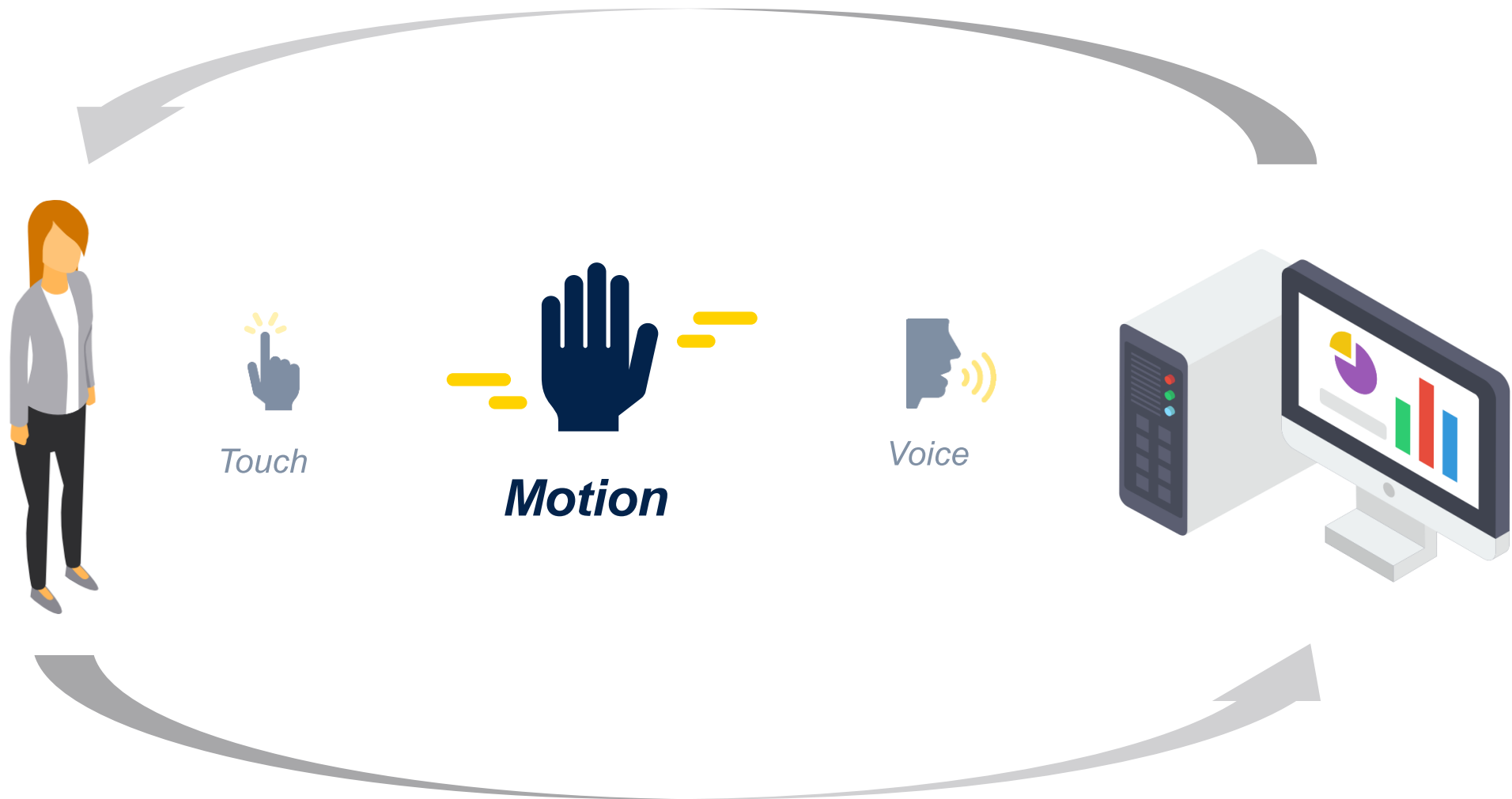
1 What is Gesture Recognition?

2 Why use Gesture Recognition?

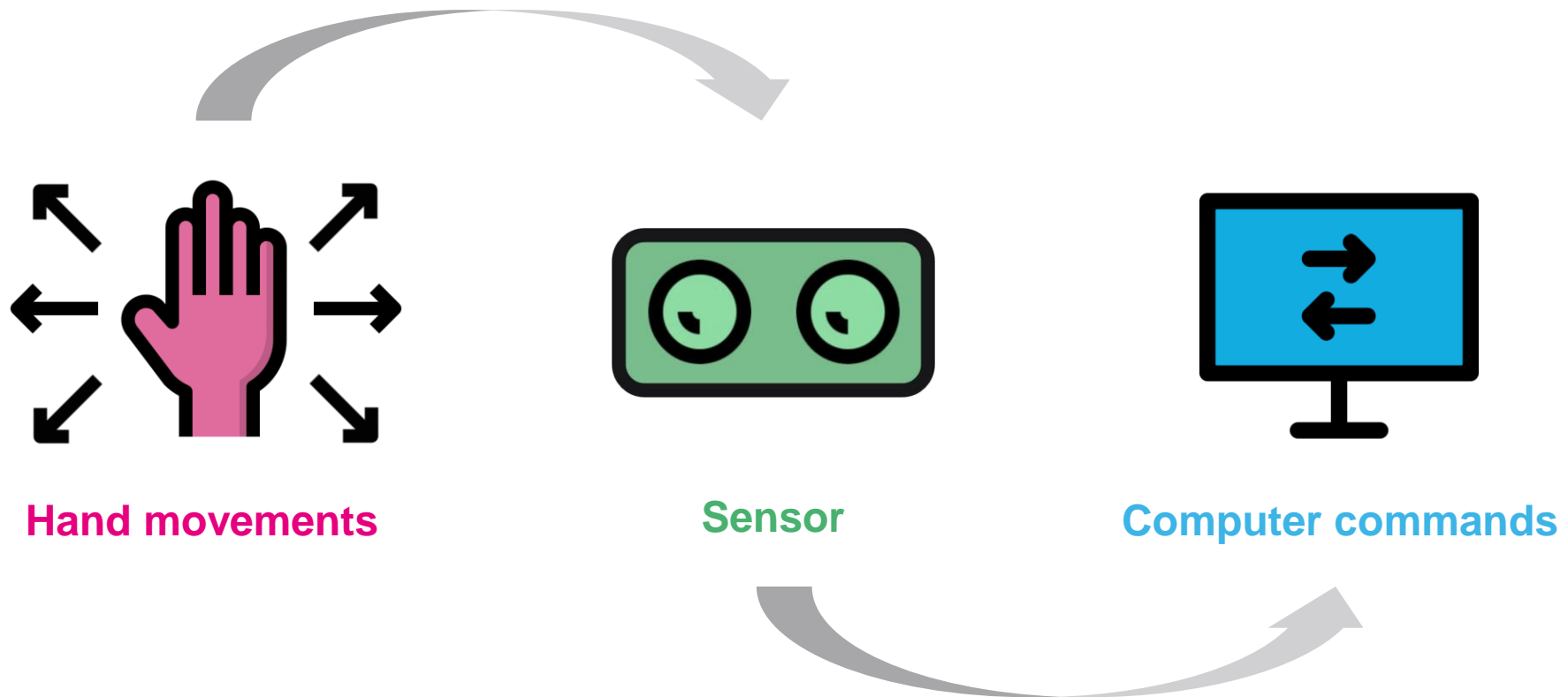
3 What is available?

What is Gesture Recognition?

Human-Machine Interaction



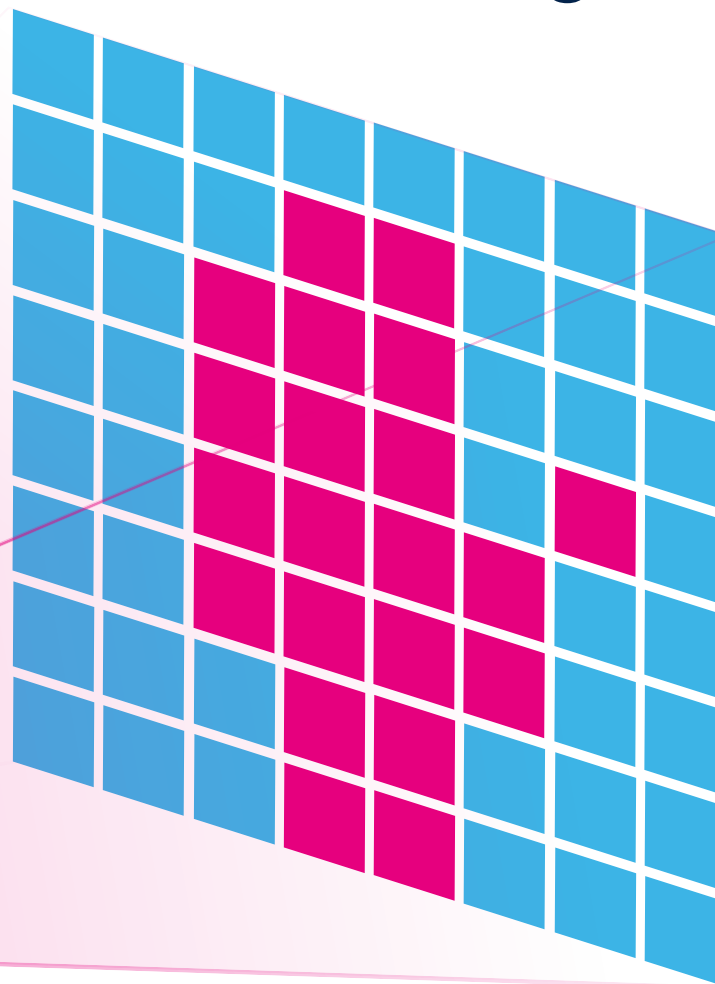
Natural human interaction enabler





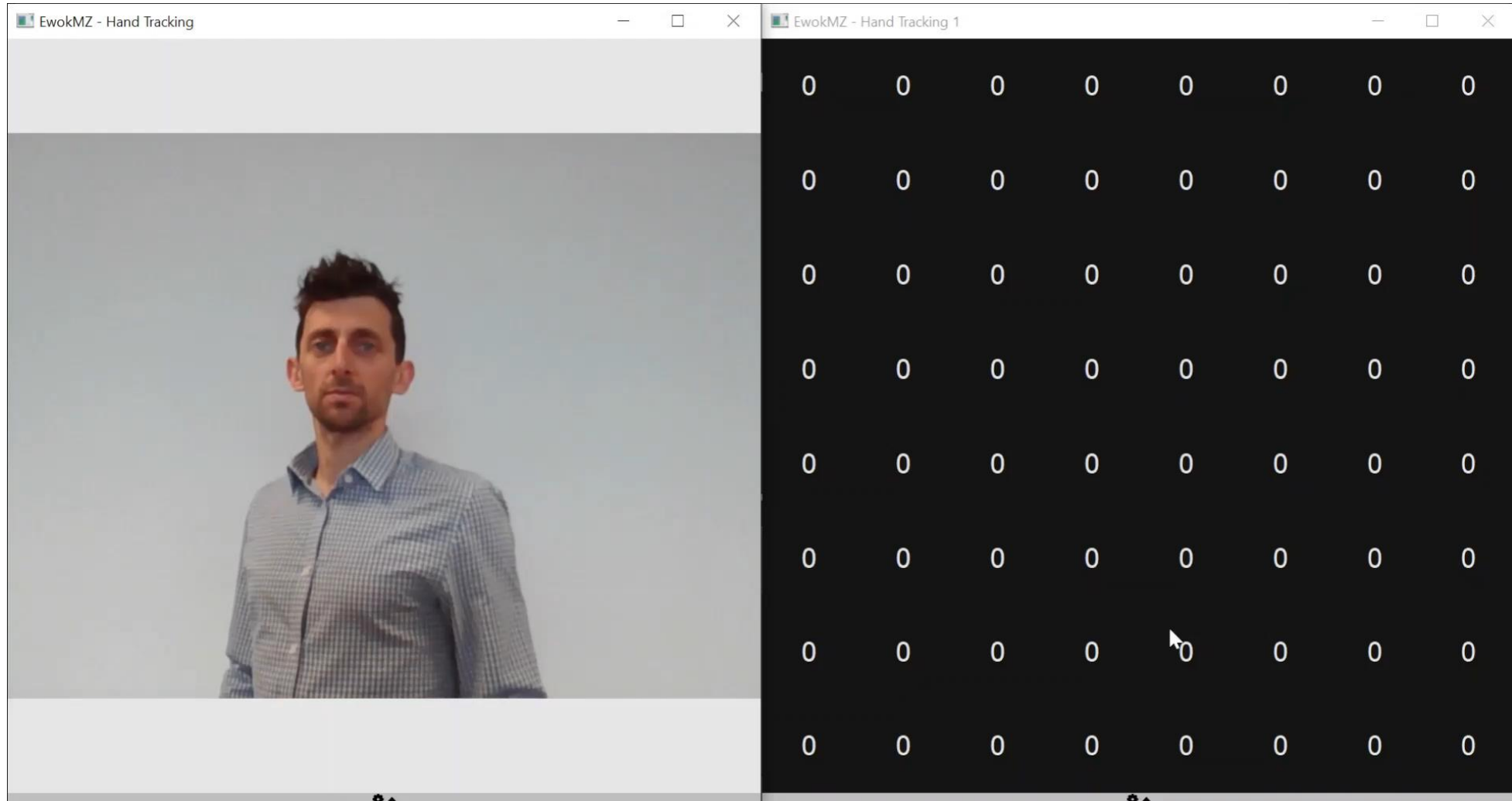
Time-of-Flight technology

Time-of-Flight
sensor



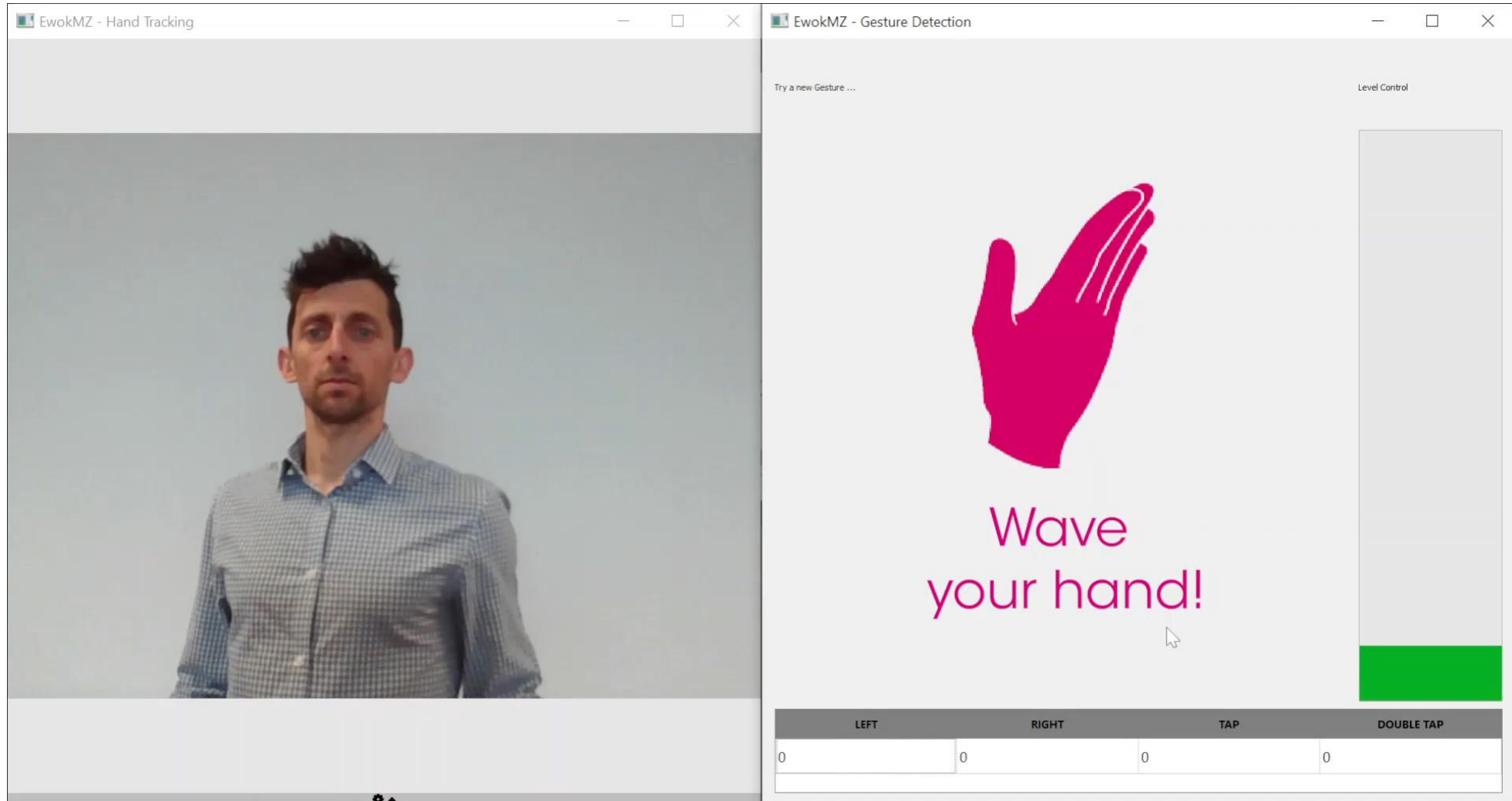


Step1: Hand tracking





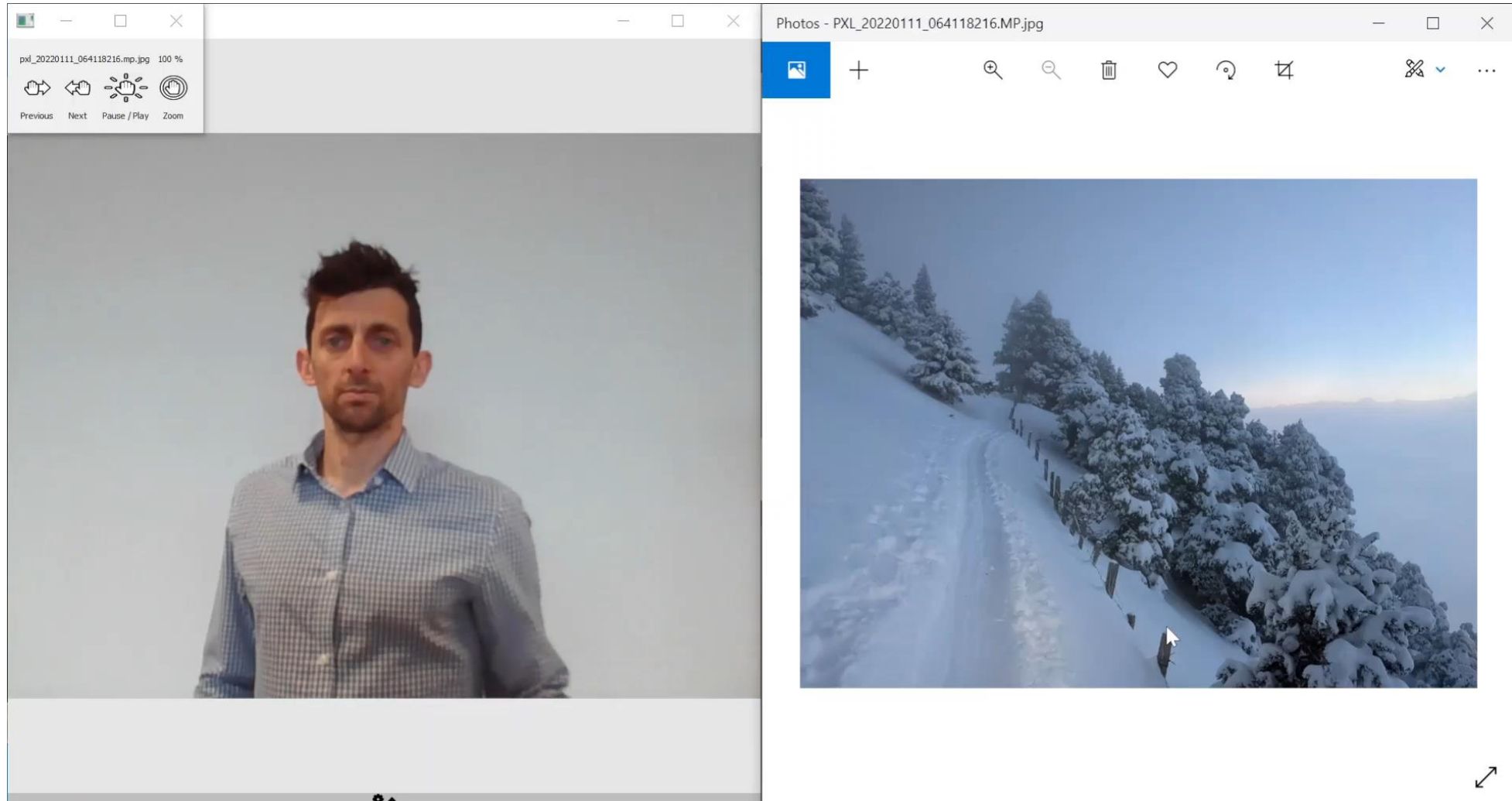
Step 2: Gesture recognition



using the ST Gesture_EVK



Step 3: Application Control



Why use Gesture Recognition?



Enhance your devices



User-friendly

Control your devices when you cannot touch it with your hands

Hygiene

Touchless interface to avoid spreading germs



— *What's yours?* —



Entertainment

Playful solution for human-like interaction

Safety

Protection distance from hot, cold and sharp items





Unlimited markets

User-friendly



Thermostats



Switch



Service robots



Smart speakers /
assistants



Laptops



Tablets



Smartphones



AR/VR

Hygiene



Digital Signage



Sanitary



Elevators



Vending machines



ATMs

Safety



Kitchen appliances



Industrial robots



Production lines

Entertainment



Toy robots



Gaming

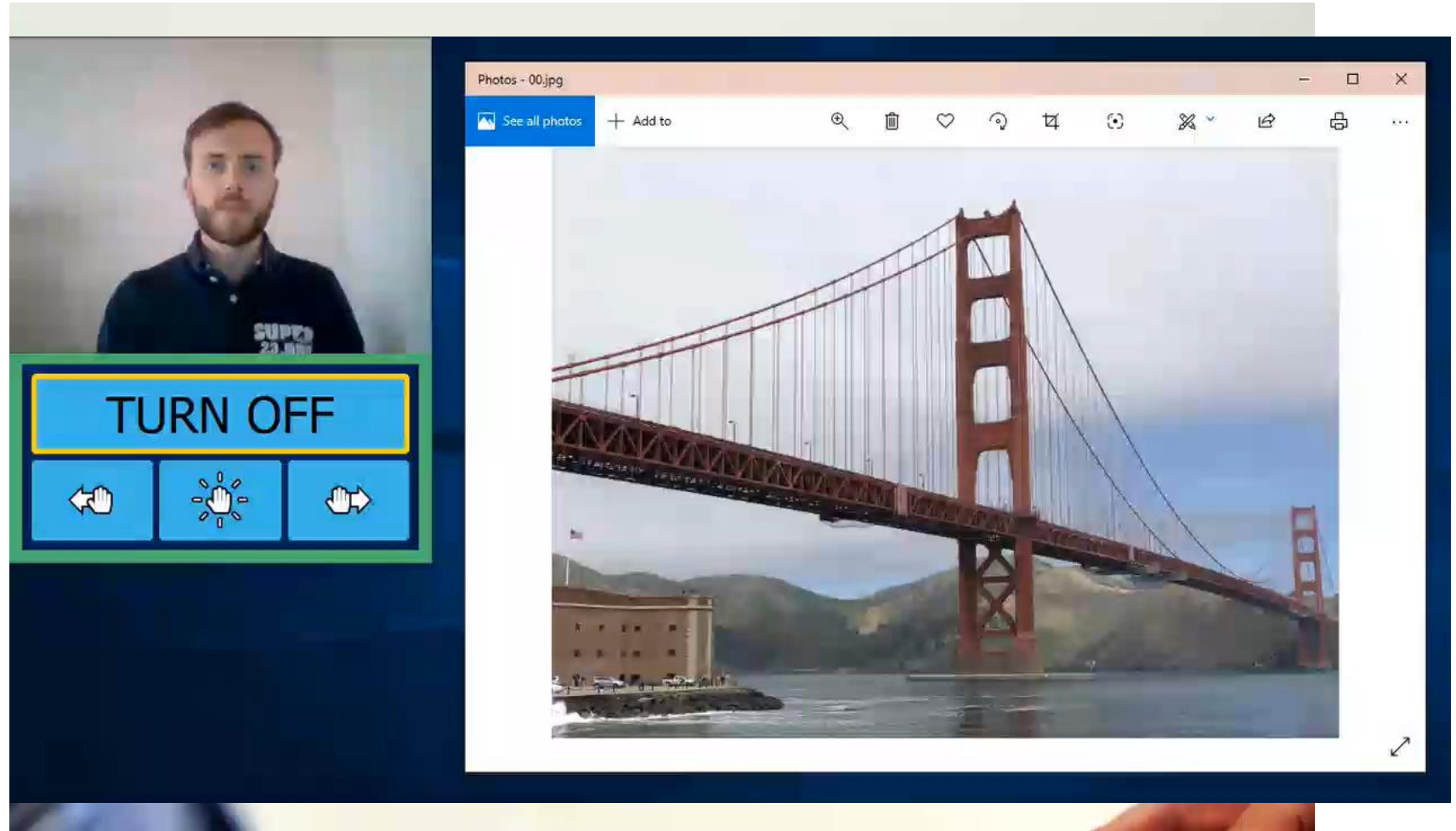
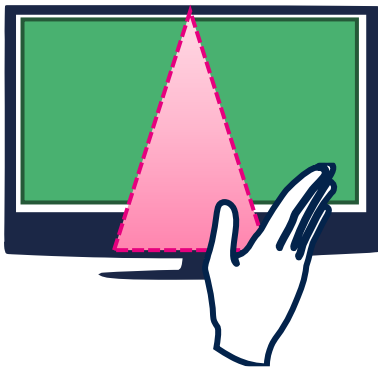


Application example

Interface control

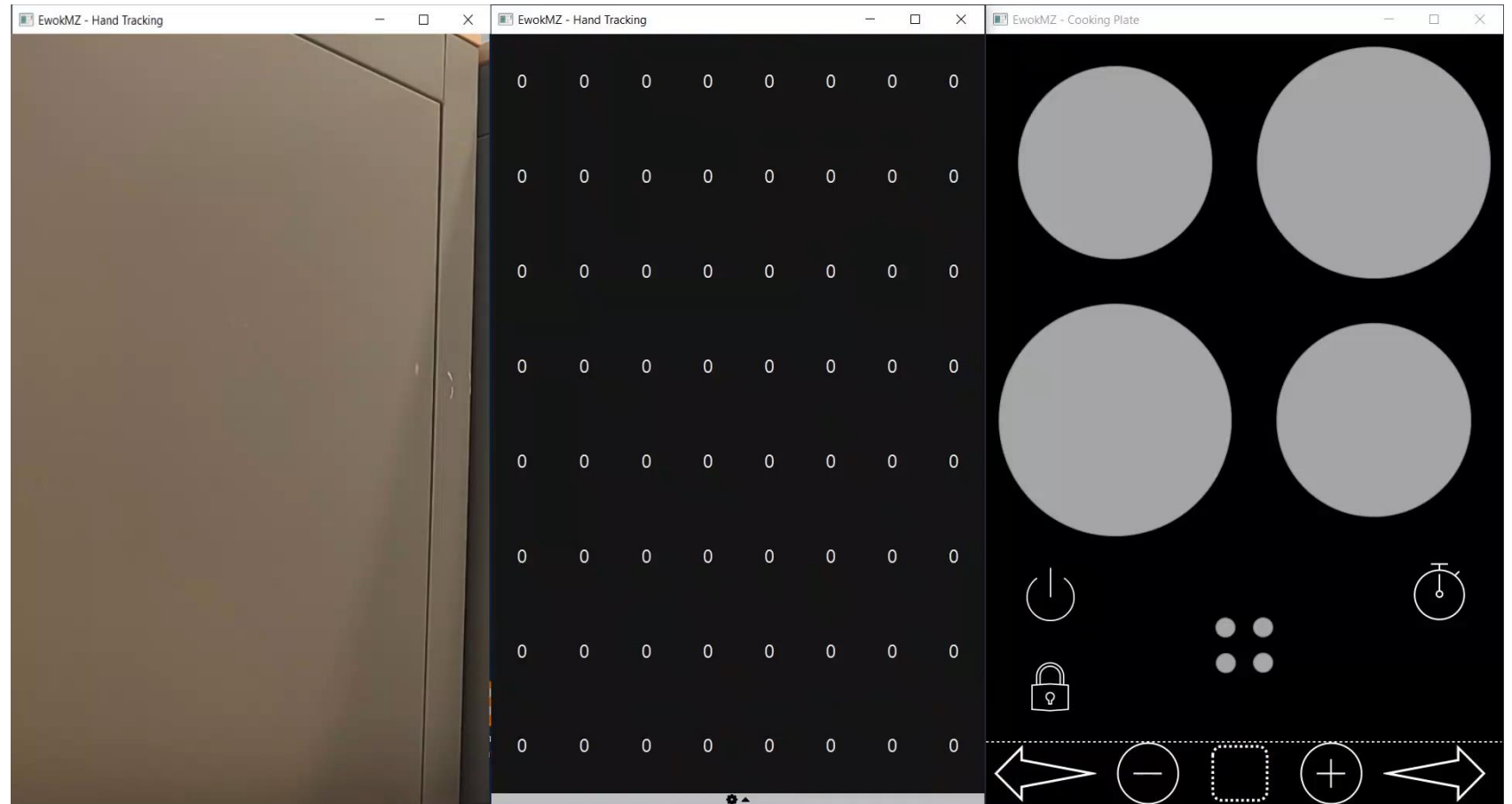
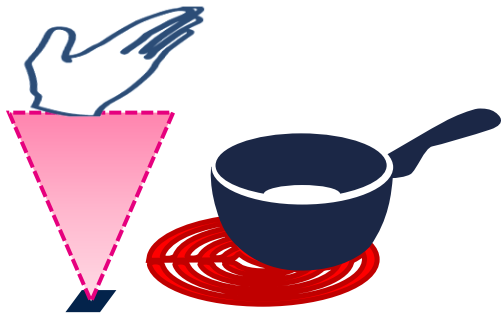
Present your **slideshow**
hands-free even with multiple
presenters

Browse through your
multimedia album



Home appliance

Adjust the **stovetop** temperature without touching the hot surface

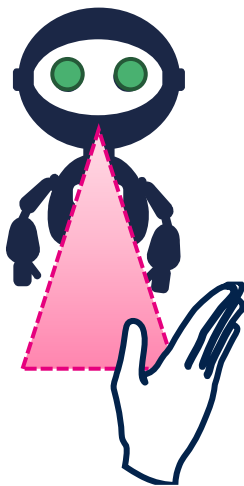




Application example

Seamless interaction

Human to machine interactions that **feel real and enjoyable**

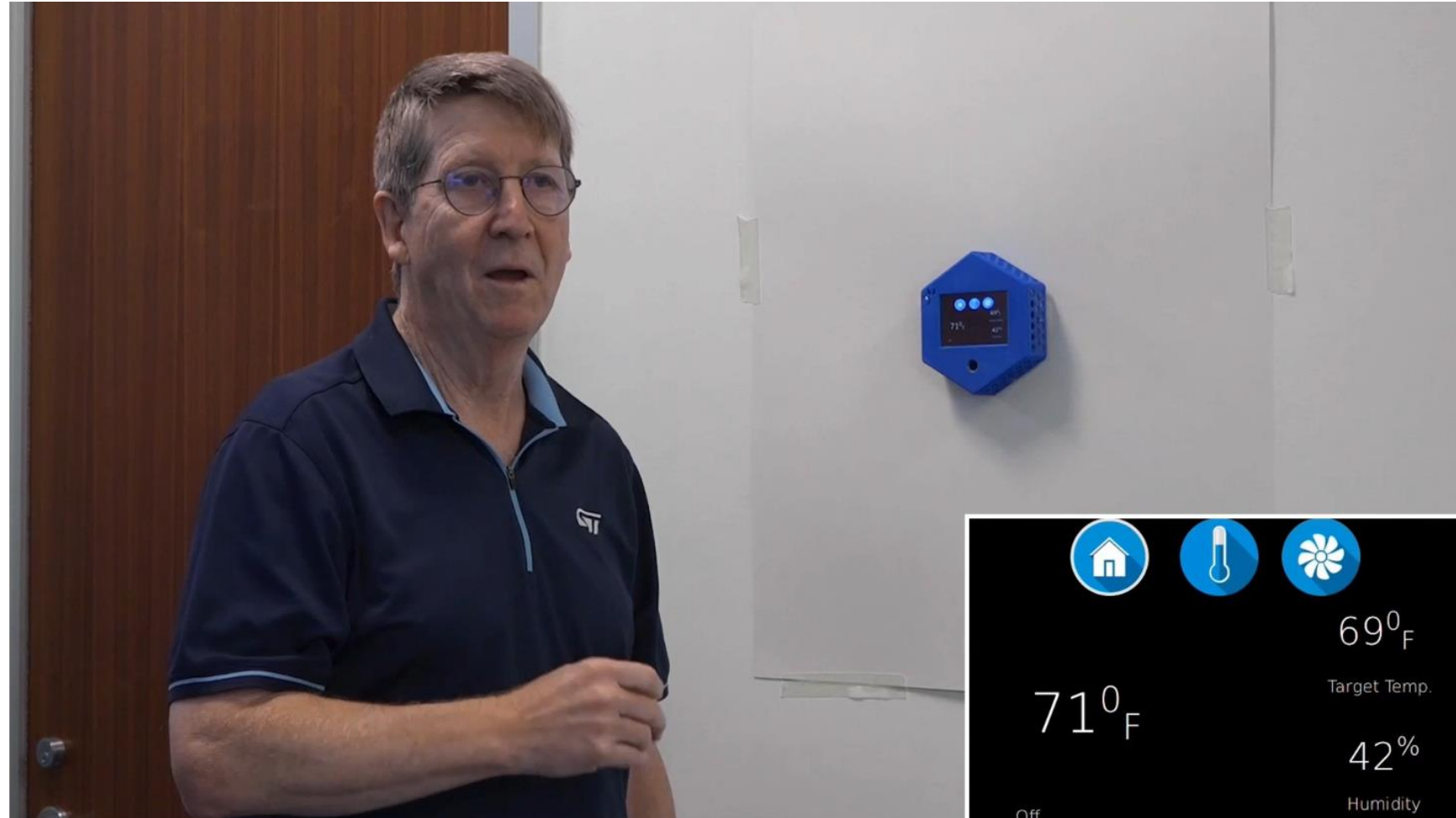
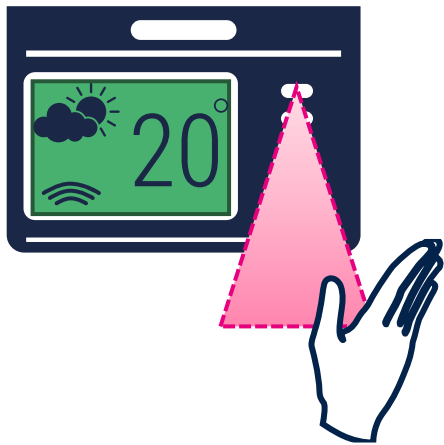




Application example

Smart home

Quickly interact with the
thermostat interface

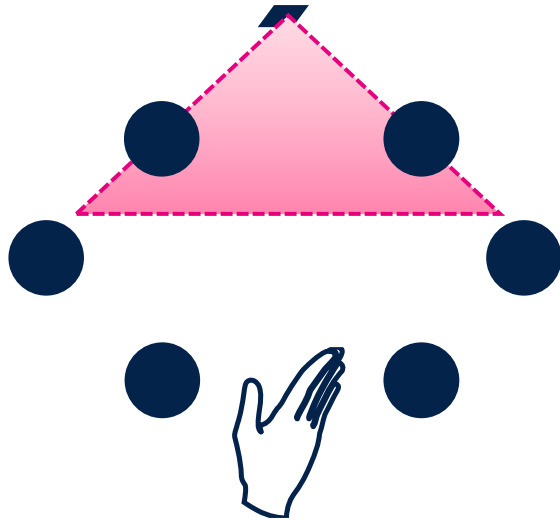




Application example

Beverage dispenser

Contactless interface to **avoid spreading germs**





And many more...



We are continuously working on
new use-cases & demos!

There is more to come...



What's yours?



What is available today?

VL53L5CX at a Glance

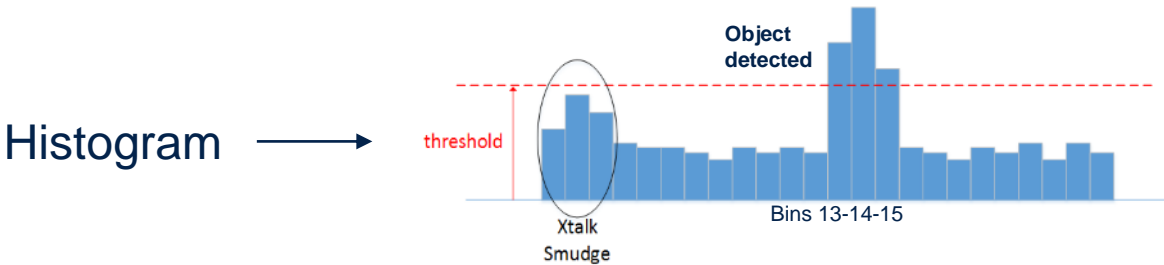
First Multi-zone (64 zones) Time-of-Flight ranging sensor

Highlights

- **Parallel multizone ranging** output:
 - **4x4 or 8x8 zones** separate regions of interest
- **Wide FoV:** 45° x 45° (**63° diagonal**)
- Up to **400 cm ranging**
- **Multi-target detection** and distance measurement in each zone
- **60 Hz** (4x4 zones) frame rate capability
- **Immunity to cover glass cross-talk** beyond 60cm



Package size : 6.4 x 3.0 x 1.5 mm
Square FoV : 45° x 45° (**63° diagonal**)
Multi-zone (8x8)

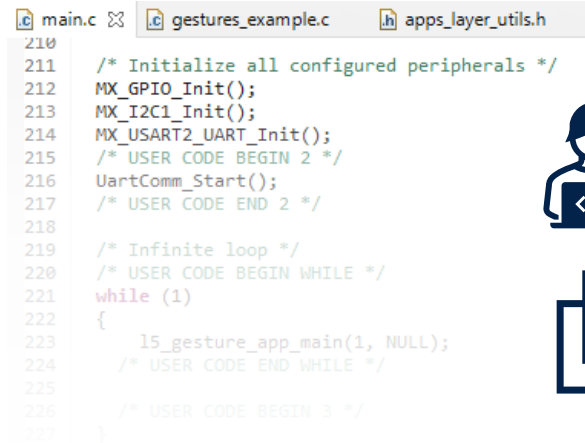


Max Distance measurement	4 meters
Close distance linearity	>2cm
Performance under ambient light (5klux)	+++ (170cm)
Multi-target detection (Histogram)	Yes, in each zone
Crosstalk / Smudge immunity	Immunity >60cm <60cm: Smudge compensation
Power Consumption	95mA (continuous ranging) 1.3mA in Low power mode



Software

GUI Gesture EVK





Gesture Software STSW-IMG035_EVK

Evaluate the potential of Gesture Recognition with the user-interface STSW-IMG035_EVK

& data logging lets developers record and replay sequences for debugging

The screenshot displays the STSW-IMG035_EVK software interface, version 1.0.0. The main window features a menu bar with 'User manual' and 'Gesture EVK Release notes'. Below this is a 'Com port' dropdown set to 'COM4 - USB Serial Device (COM4)'. A 'Sensor driver' dropdown is also present. A 'Preset' dropdown is set to 'npz'. A '0 sec' timer is visible. A 'Data display' section includes 'Flip / rotate', 'Colorscale', 'Camera', and 'FoV alignment' options. A 'distance_mm' dropdown is set to '10e0', and a 'Medium' dropdown is set to 'Basic'. A 'Basic' dropdown is also visible. A 'Connect new sensor' button is at the bottom. A 'Slide Show control' panel is at the bottom left, with buttons for 'Previous', 'Next', 'SlideShow', 'Play Media', and 'Exit'. A 'LEFT SWIPE' gesture icon is shown in the center. A 'Hand Tracking' window is on the left, showing a hand being tracked. A 'Data display' window is on the right, showing a grid of data points. The grid is a 10x10 matrix of numbers, with some cells highlighted in red and others in black. The numbers range from 177 to 1332. The grid is divided into four quadrants by a vertical line. The left half contains numbers, while the right half is mostly black with some numbers. The numbers are arranged in a pattern that suggests a sequence or a specific data set. The grid is titled 'Data display' and has a '10e0' multiplier. The 'Basic' dropdown is set to 'Basic'. The 'Medium' dropdown is set to 'Medium'. The 'distance_mm' dropdown is set to '10e0'. The 'Com port' dropdown is set to 'COM4 - USB Serial Device (COM4)'. The 'Sensor driver' dropdown is set to 'npz'. The 'Preset' dropdown is set to '0 sec'. The 'User manual' and 'Gesture EVK Release notes' buttons are at the top. The 'Connect new sensor' button is at the bottom. The 'Slide Show control' panel is at the bottom left. The 'LEFT SWIPE' gesture icon is in the center. The 'Hand Tracking' window is on the left. The 'Data display' window is on the right.

177	168	177	172	175					
179	185	189	188	519					
196	200	200	232	571					
207	211	211	271	600	678			1332	
213	220	227	341	654	656	648	1287		
225	226	267	618	618	637	646	624		
269	403	567	582	581	584	625	622		
	640	574	575	571	596	604			



Gesture Firmware STSW-IMG035

Develop your own application with ready-to-use example code and libraries

Example code

- For STM32F401RE microcontroller: *STSW-IMG035_F401*

Libraries

- For M0+ ARM Cortex: *STSW-IMG035_M0p*
- For M4 ARM Cortex: *STSW-IMG035_M4*
- New libraries in development to cover other ST MCU

<https://www.st.com/en/product/stsw-img035>

```
main.c gestures_example.c apps_layer_utils.h
210
211 /* Initialize all configured peripherals */
212 MX_GPIO_Init();
213 MX_I2C1_Init();
214 MX_USART2_UART_Init();
215 /* USER CODE BEGIN 2 */
216 UartComm_Start();
217 /* USER CODE END 2 */
218
219 /* Infinite loop */
220 /* USER CODE BEGIN WHILE */
221 while (1)
222 {
223     l5_gesture_app_main(1, NULL);
224     /* USER CODE END WHILE */
225
226     /* USER CODE BEGIN 3 */
227 }
```



Gesture Hardware Multi-Zone FlightSense™ ToF benefits

Cost effective

- ✓ **Inexpensive** sensor, system architecture, and development
- ✓ **Short timeframe** easy to integrate, all-in-one solution

Low power consumption

- ✓ **Low power ToF** compared to other technology
- ✓ **Light gesture algorithm** can be run on low power MCU

Low processing complexity

- ✓ **Light data flow** unlike radar & camera
- ✓ **General purpose MCU** already embedded in most architecture

≠ Radar

Independent

- ✓ **Not subject to external factors:** target color, shape & size

≠ Traditional Infra-Red

Privacy

- ✓ **No image** only multiple distance measurement



≠ Camera

— **For VL53L5CX** —



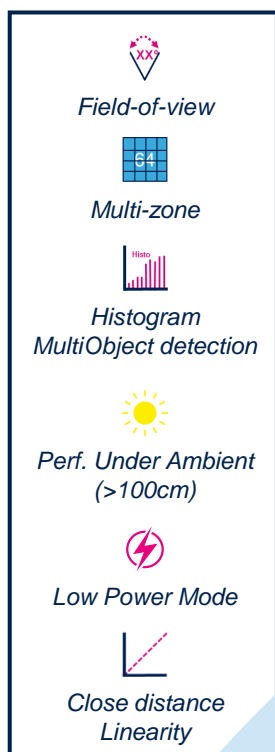
Gesture Hardware VL53L5CX ecosystem

Go to st.com/VL53L5CX or contact your usual distributor

Item	Picture	Commercial Product (= Order Code)	Comments
VL53L5CX sensor		VL53L5CXV0GC/1	Delivery in T&R MOQ: 3.6ku With protective liner
VL53L5CX Expansion board		X-NUCLEO-53L5A1/	To go along with STM32F401 Nucleo board. Comes with cover-glass holder, cover-window sample, 3x spacers
Pack: VL53L5CX Nucleo™ Expansion board + STM32F401 NUCLEO		P-NUCLEO-53L5A1/	X-NUCLEO-53L5A1 expansion board delivered together with STM32F401 NUCLEO board
VL53L5CX Breakout boards		VL53L5CX-SATEL/1	2x Breakout boards delivered



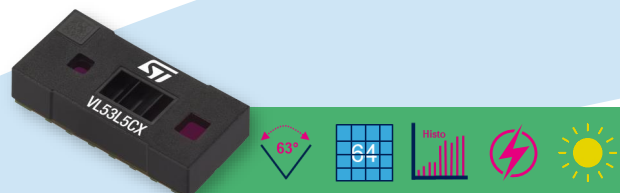
Gesture Hardware Roadmap



VL6180V1

Currently in Mass-Production

- Tap
- Left/Right swipe (two sensors required)



VL53L5CX

New in Mass-Production

- Hand tracking
- Tap/Double-tap
- Level control
- Right/Left swipe



VL53Lxxxx

Coming-soon

- Hand tracking
- Tap/Double-tap
- Level control
- Right/Left swipe
- Up/Down swipe
- More gestures
- More gestures
- More gestures
- More gestures

Gesture complexity





STGesture™ summary

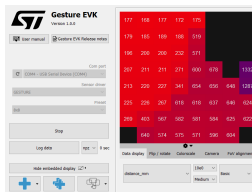
Leader on Direct ToF



1st

Turnkey gesture solution

Graphic User Interface



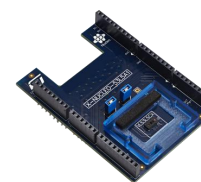
Example code & Libraries

```
main() {
  /* Initialize all configured peripherals */
  MX_GPIO_Init();
  MX_I2C1_Init();
  MX_SPI2_Init();
  /* USER CODE BEGIN 2 */
  MX_GPIO_Init();
  /* USER CODE END 2 */

  /* Infinite loop */
  /* USER CODE BEGIN WHILE */
  while (1)
  {
    /* USER CODE BEGIN WHILE */
    /* USER CODE END WHILE */
  }
}
```



Evaluation boards



Many benefits



Privacy



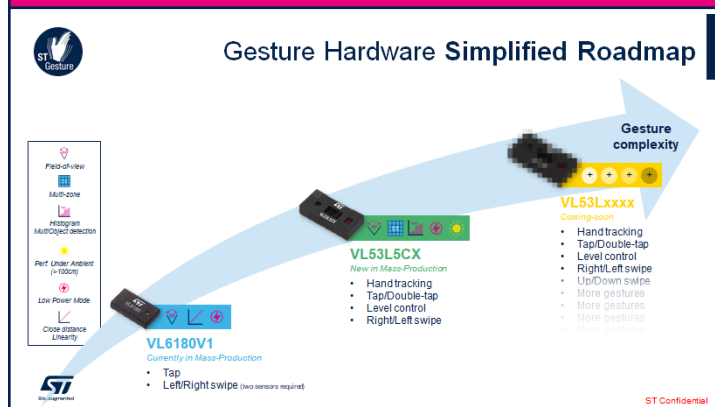
Simple

Intuitive

Robust



Continuous improvement



Unlimited markets & applications



Laptops



Gaming



Service robots



Switch



Sanitary



Production lines



ATMs



AR/VR



Toy robots



Industrial robots



Kitchen appliances



Elevators



Vending machines



Tablets



Digital Signage



Sanitary



Smart speakers /
assistants



Thermostats

Our technology starts with You



Find out more at www.st.com/VL53L5CX

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