



# Gesture and hand posture recognition AI based on ST FlightSense technology

11th March 2025



# Speakers' introduction

# Industry demand





# Evolution in HMI (human-machine interaction)

Cap to a new world!

TODAY



Touchscreen



Keyboard



Mouse

Etc.

FUTURE



Wave a hand



Thumb up

Endless possibilities!



# Evolution in HMI (human-machine interaction)

Cap to a new world!

TODAY



Touchscreen



Keyboard



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Etc.

FUTURE



Wave a hand



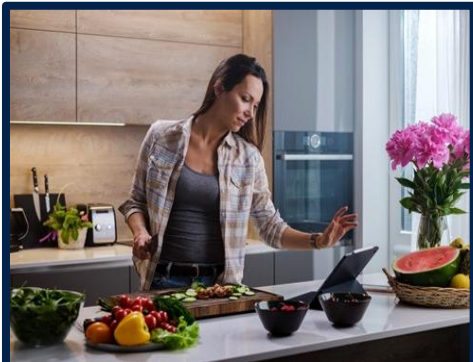
Thumb up

Endless possibilities!



# Why gesture and hand posture recognition?

## Revolutionizing HMI



### Improved human-computer interaction

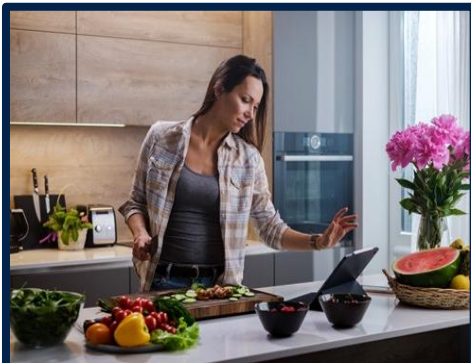
Reduces reliance on physical input devices like keyboard and mouse





# Why gesture and hand posture recognition?

## Revolutionizing HMI



### Improved human-computer interaction

Reduces reliance on physical input devices like keyboard and mouse



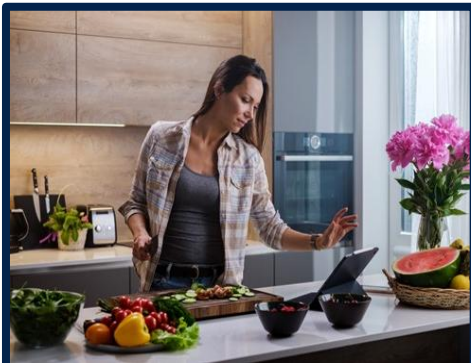
### Enhanced user experience

Immersive and interactive experiences



# Why gesture and hand posture recognition?

## Revolutionizing HMI



### Improved human-computer interaction

Reduces reliance on physical input devices like keyboard and mouse



### Enhanced user experience

Immersive and interactive experiences



### Improved sanitation and hygienic

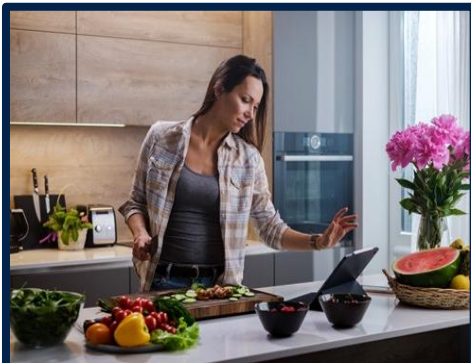
Minimizes contamination risks





# Why gesture and hand posture recognition?

## Revolutionizing HMI



### Improved human-computer interaction

Reduces reliance on physical input devices like keyboard and mouse



### Enhanced user experience

Immersive and interactive experiences



### Improved sanitation and hygienic

Minimizes contamination risks



### Efficiency and safety

Intuitive system control and reduced physical contact



# Gesture & hand posture recognition

Let's picture it!





# Unlimited markets

## Innovation



Thermostats



Switch



Service robots



Smart speakers /  
assistants



Laptops



Tablets



Smartphones



# Unlimited markets

## Innovation



Thermostats



Switch



Service robots



Smart speakers /  
assistants



Laptops



Tablets



Smartphones

## Hygienic



Digital Signage



Sanitary



Elevators



Vending machines



ATMs



# Unlimited markets

## Innovation



Thermostats



Switch



Service robots



Smart speakers /  
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Smartphones

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Elevators



Vending machines



ATMs

## Safety



Kitchen appliances



Industrial robots



Production lines



# Unlimited markets

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Kitchen appliances



Industrial robots



Production lines

## Entertainment



Toy robots



Gaming



AR/VR





# Unlimited markets

## Innovation



Thermostats



Switch



Service robots



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Kitchen appliances



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Production lines

## Entertainment



Toy robots



Gaming



AR/VR



Personal electronics, home appliances, industrial systems, robots & toys

+ Many more...

# Exploring the hardware & software





# Turnkey solution portfolio

A complete ecosystem in an all-in-one solution



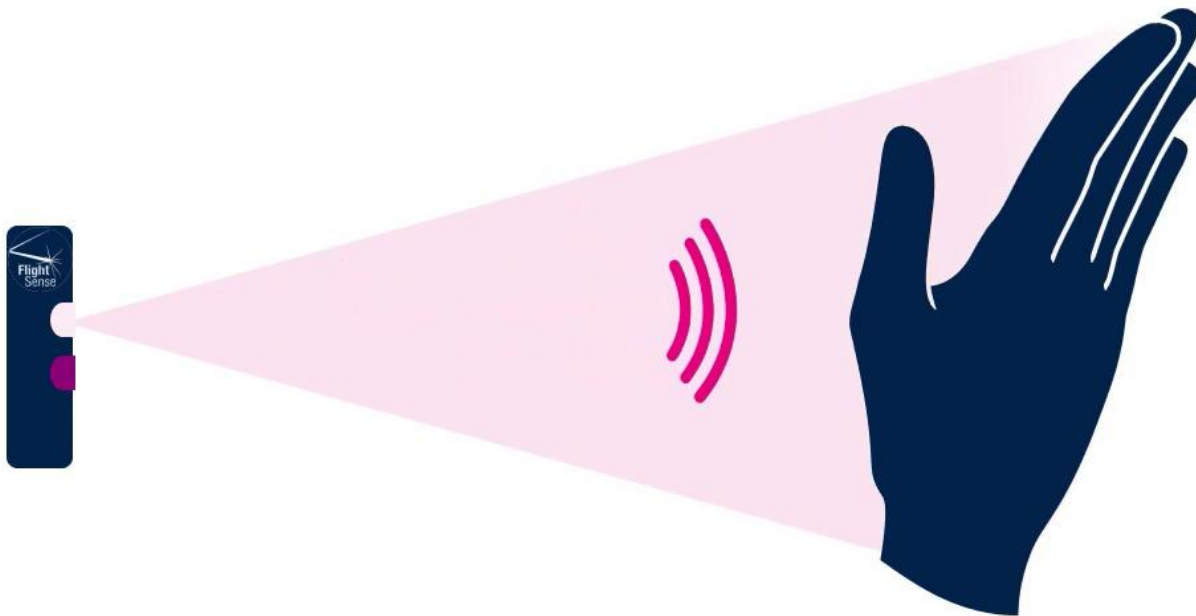
# Deep dive in Time-of-Flight sensors





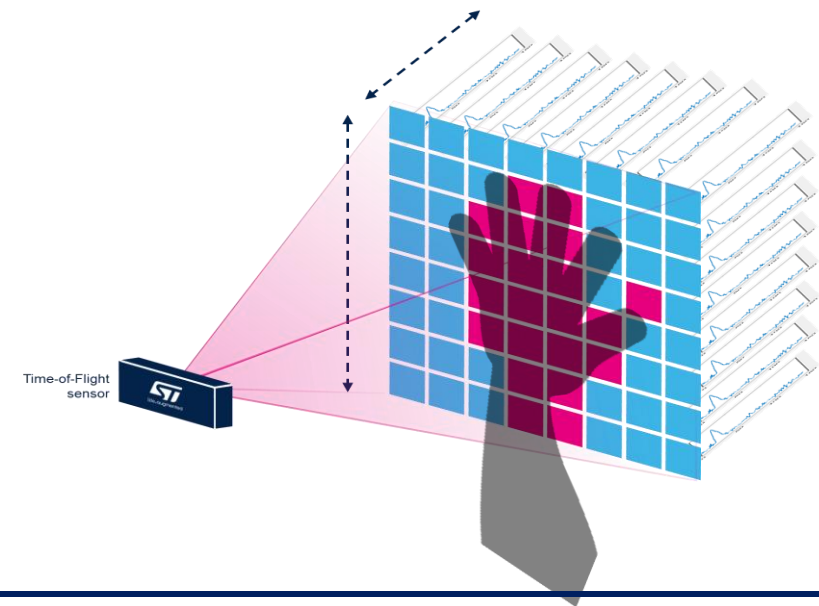
# FlightSense & Multi-zone ToF principle

## Time-of-Flight Principle



## Multizone ToF Principle

A multi-zone Time-of-Flight sensor divides the field of view into multiple zones, allowing it to capture depth information from several points simultaneously.





# 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

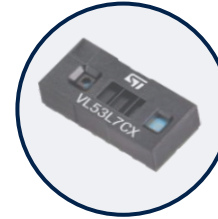
≠ Camera



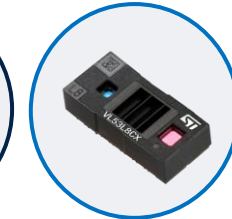


# Compatible with two multi-zone ToF sensors

**VL53L7CX**

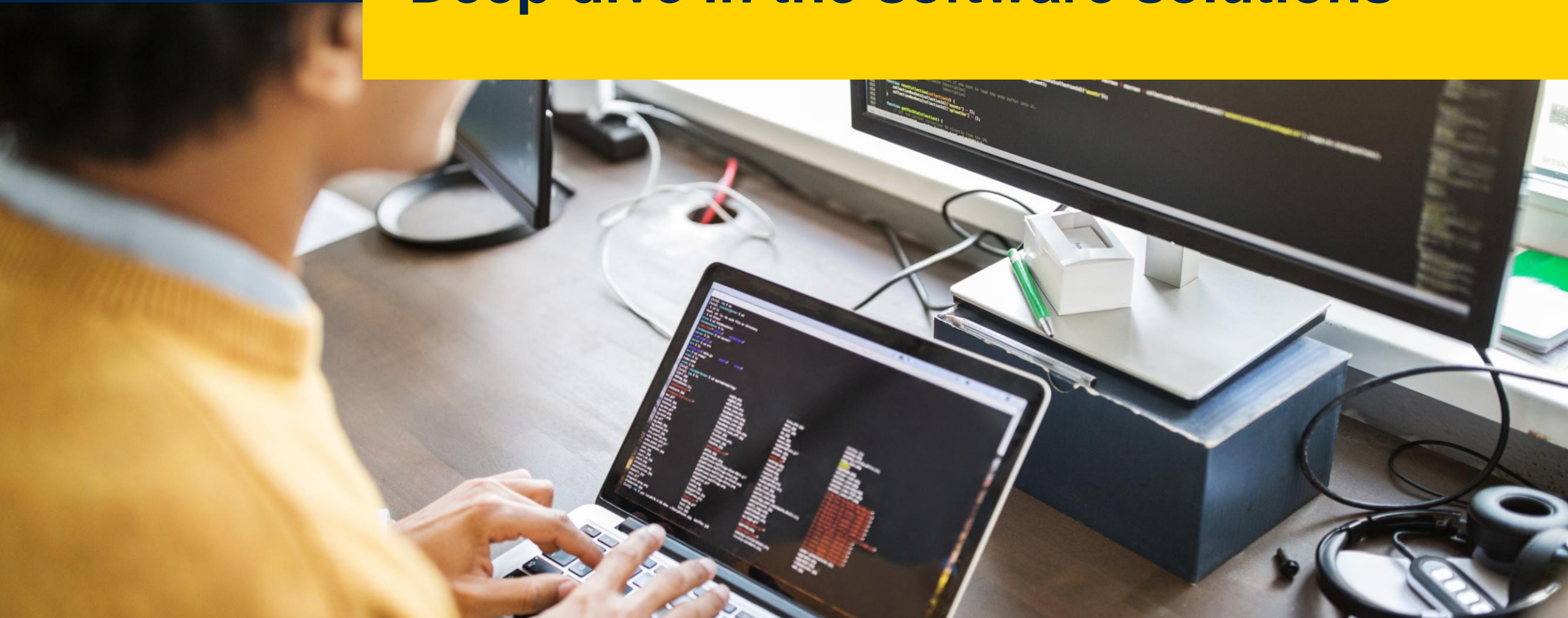


**VL53L8CX**



Field of view		60° x 60° (90° diagonal)	45° x 45° (65° diagonal)
Resolution		Up to 8x8 (64 zones)	
Common features		Autonomous low power mode	
Additional features			External synchronization pin
Driver		100% compatible	
Interfaces		I <sup>2</sup> C (1 MHz)	I <sup>2</sup> C (1 MHz) and SPI (3 MHz)
Distance ranging	Dark condition	350 cm	400 cm
	Under ambient light*	65 cm	285 cm
Power consumption**		4.5 mW	1.6 mW
Module size		6.4 x 3.0 x 1.6 mm	6.4 x 3.0 x 1.75 mm

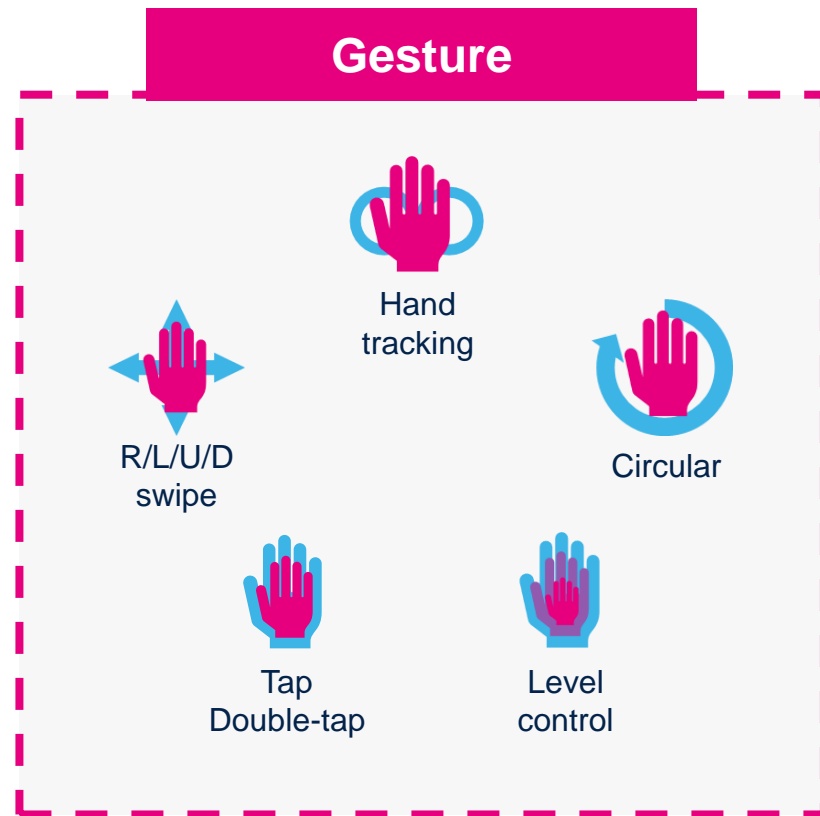
# Deep dive in the software solutions





# Turnkey solution portfolio

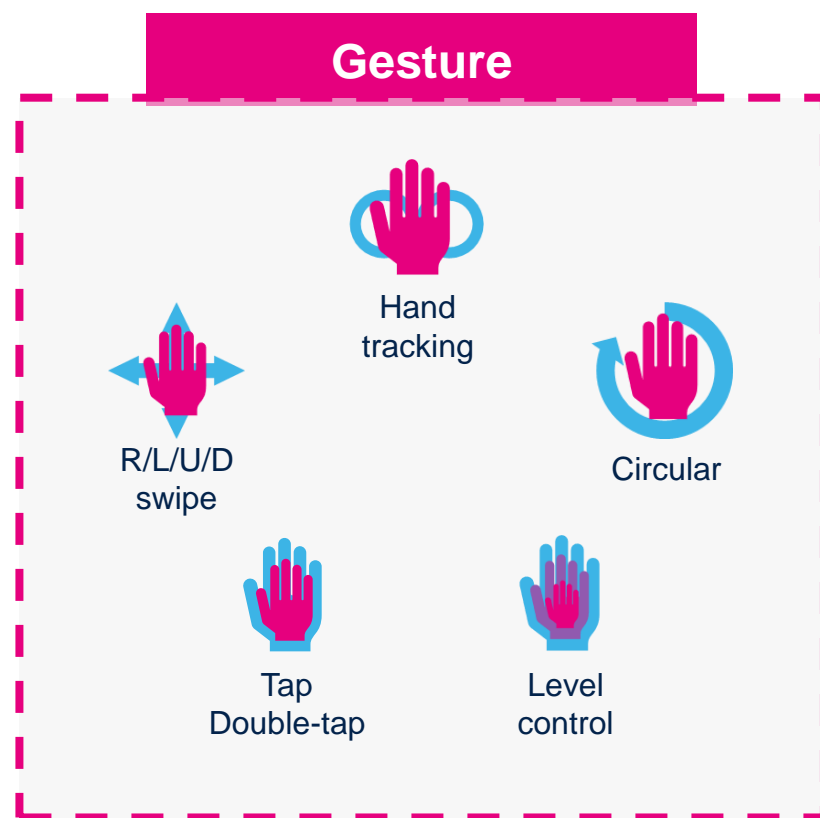
## Two ST solutions for contactless HMI



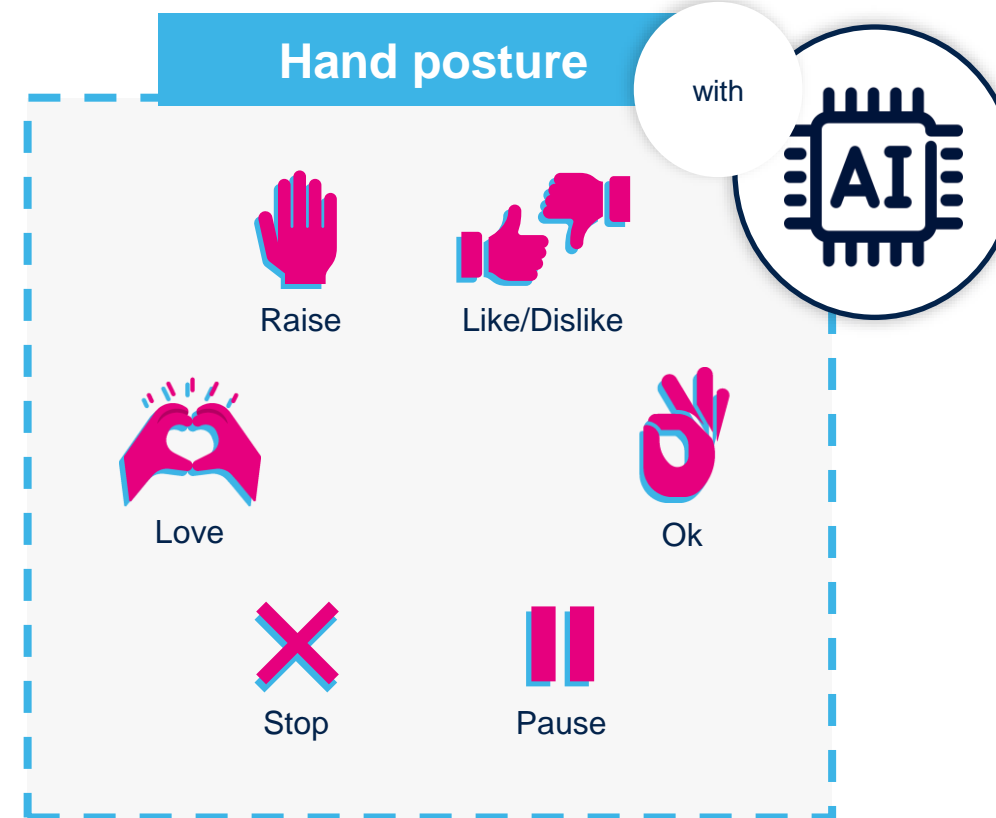


# Turnkey solution portfolio

## Two ST solutions for contactless HMI



 **MOTION** Algorithm

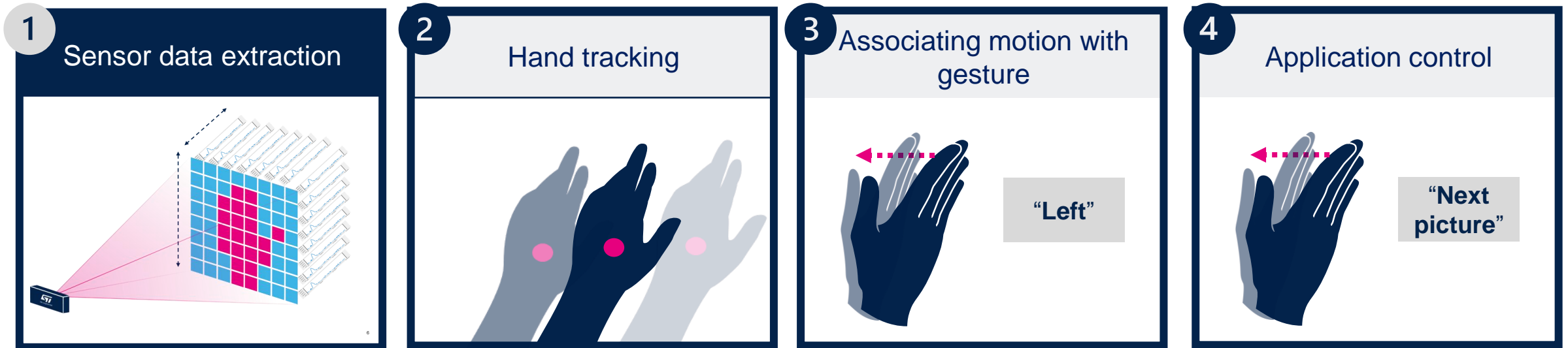


 **POSTURE** Processing

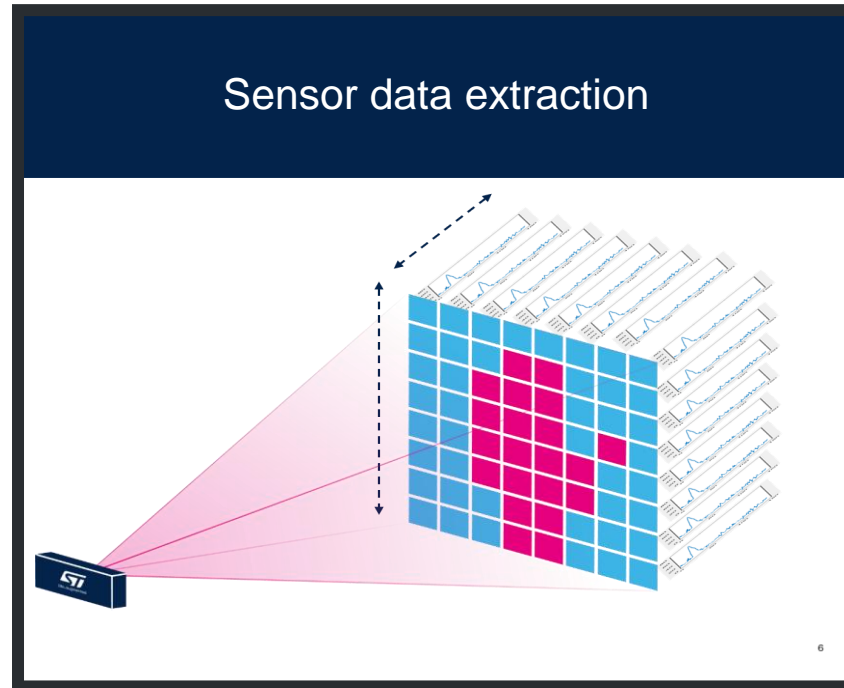


# Gesture recognition software principle

## Natural human interaction enabler



# Step 1: Data extraction via ToF sensor



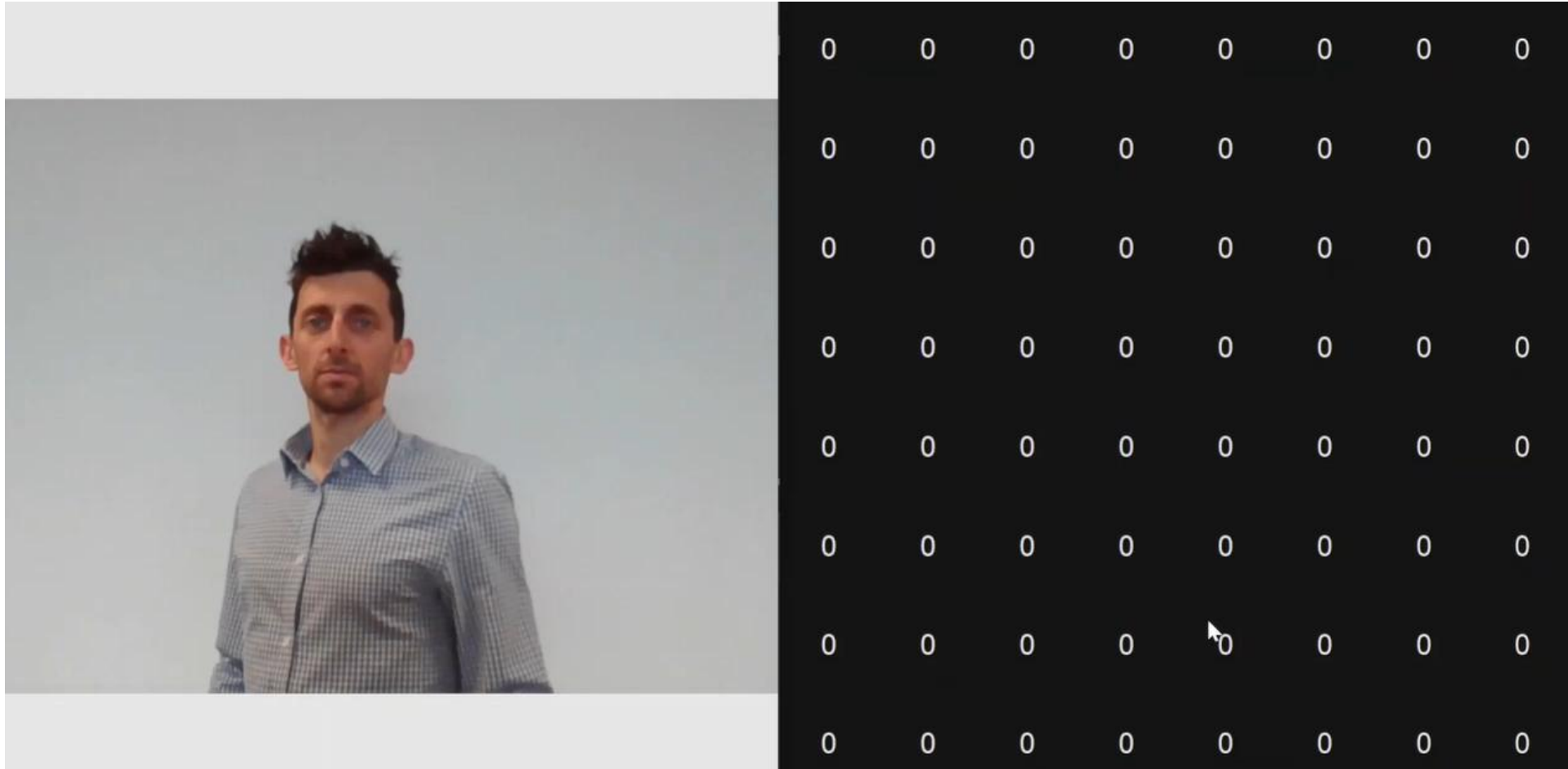
## Using multizone Time-of-Flight sensor data:

- Distances for each zones
- Signal (quantity of photons)





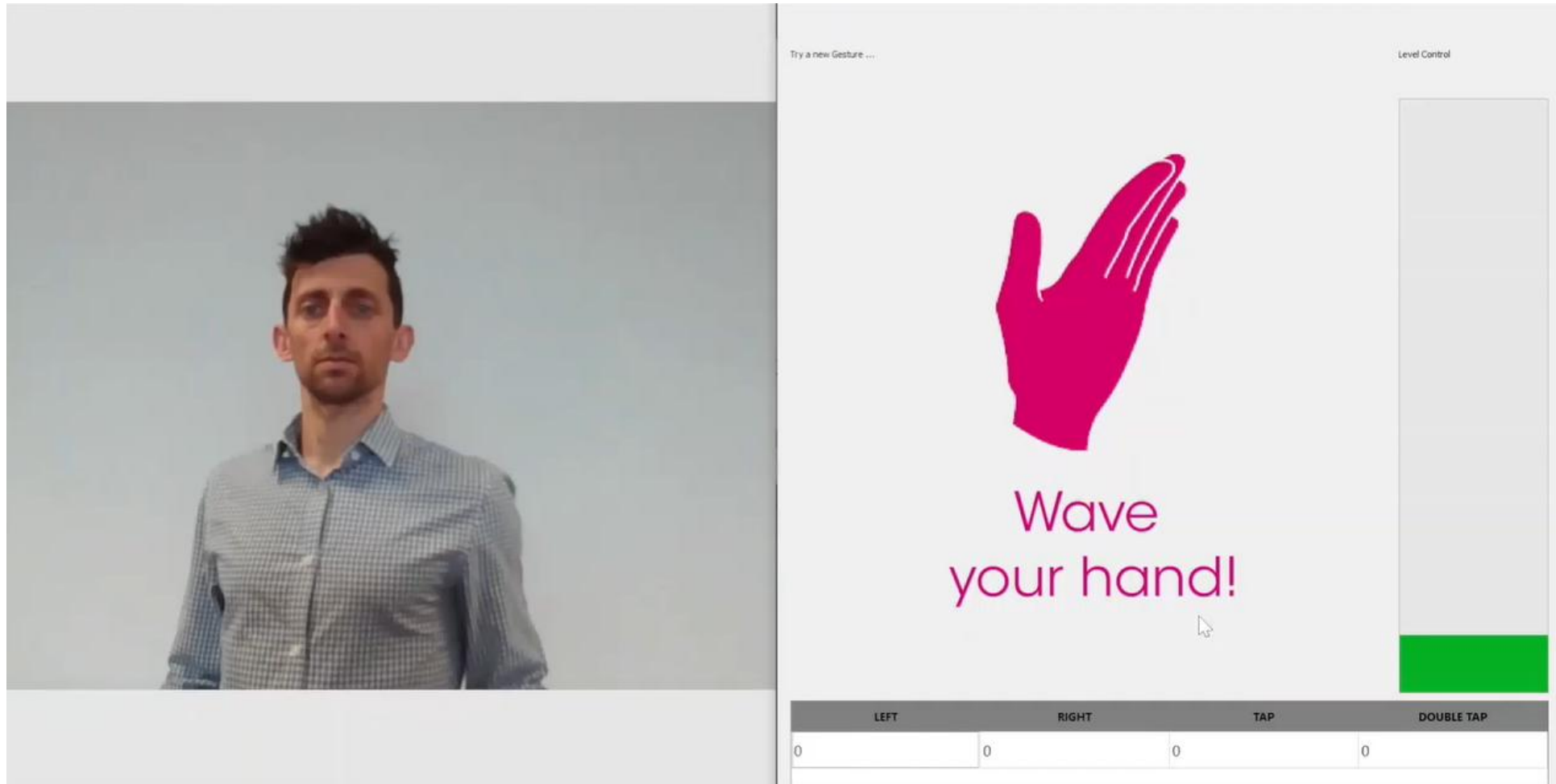
## Step 2: Hand tracking



*using the ST Gesture\_EVK*

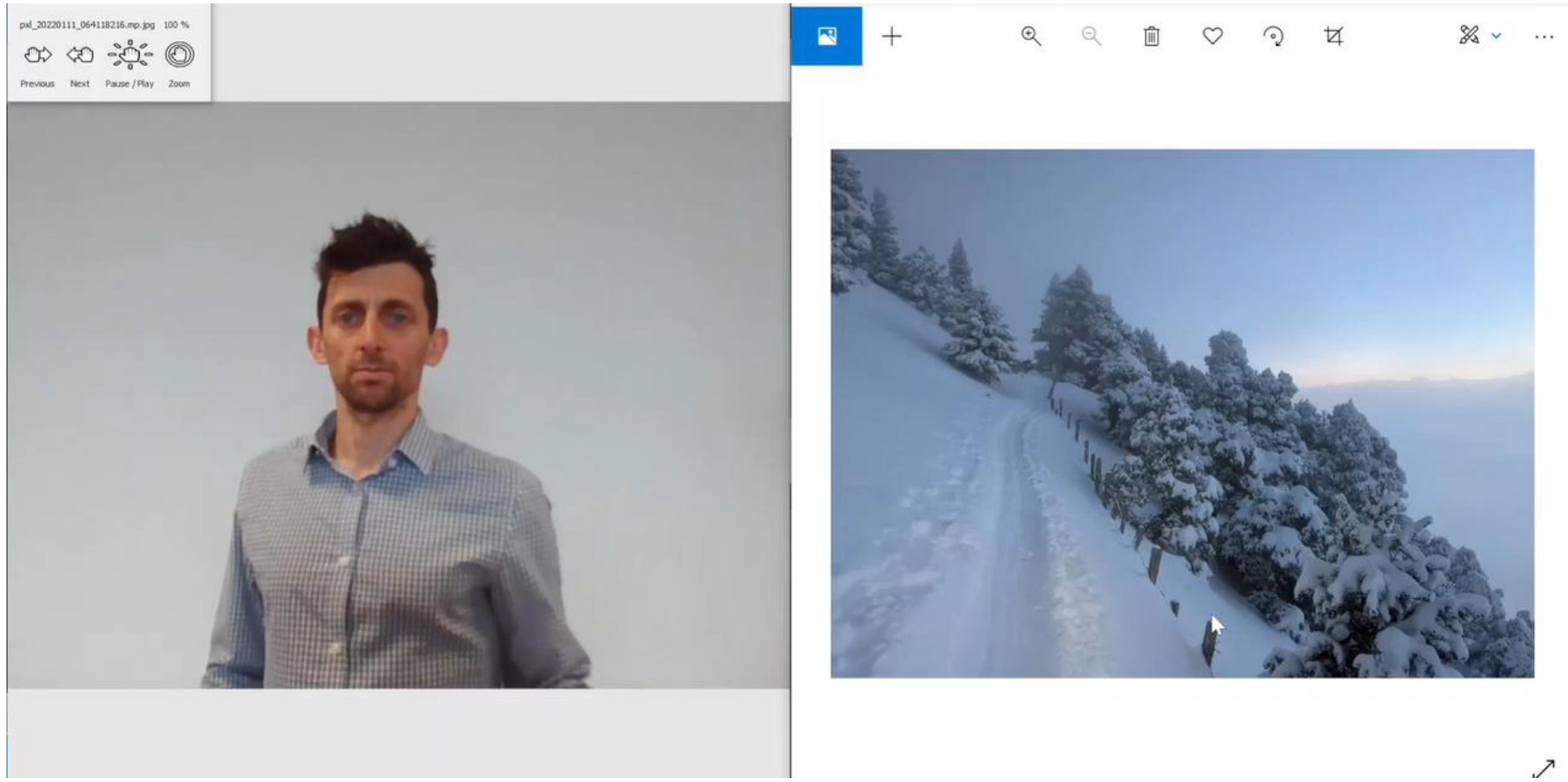


# Step 3: Gesture recognition



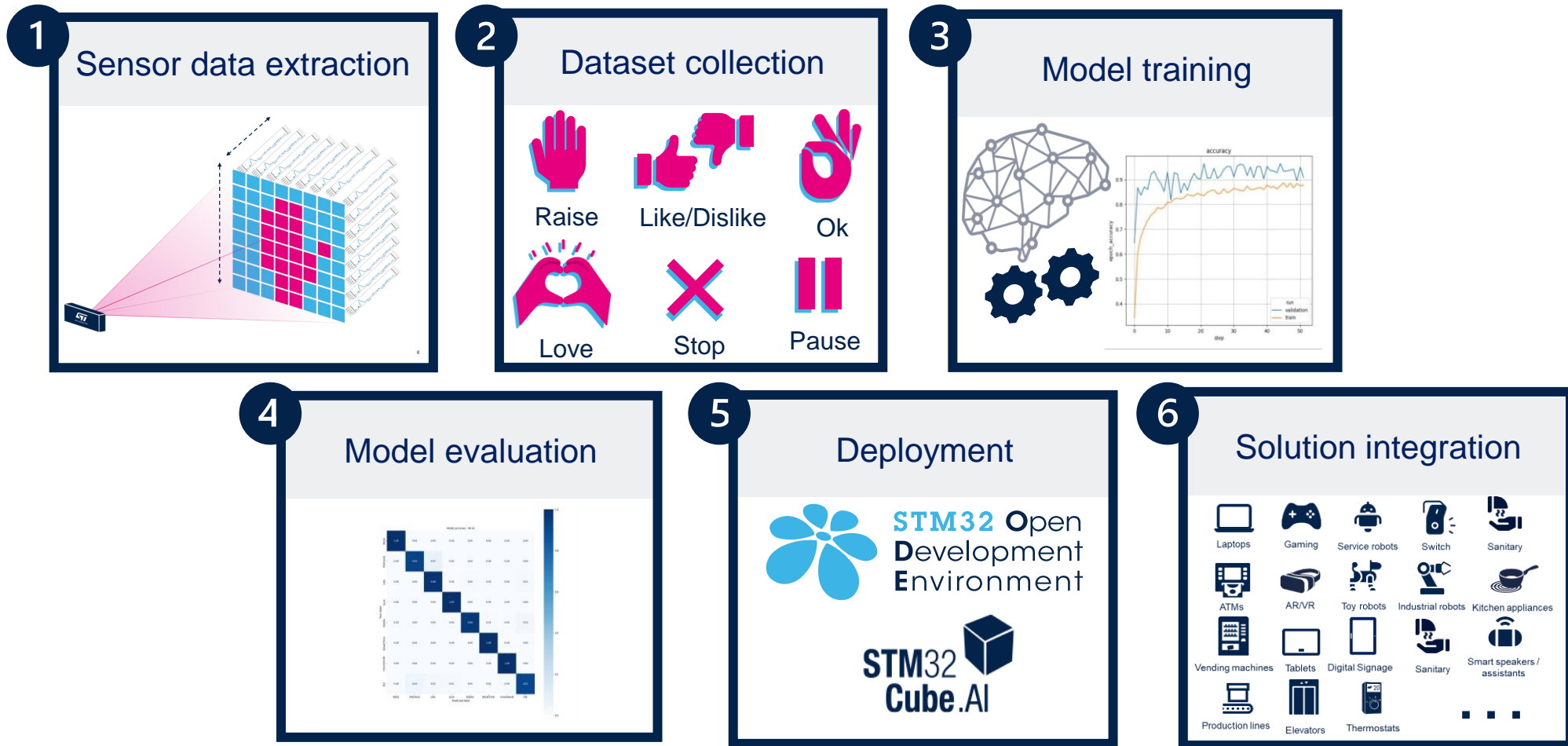


# Step 4: Application control

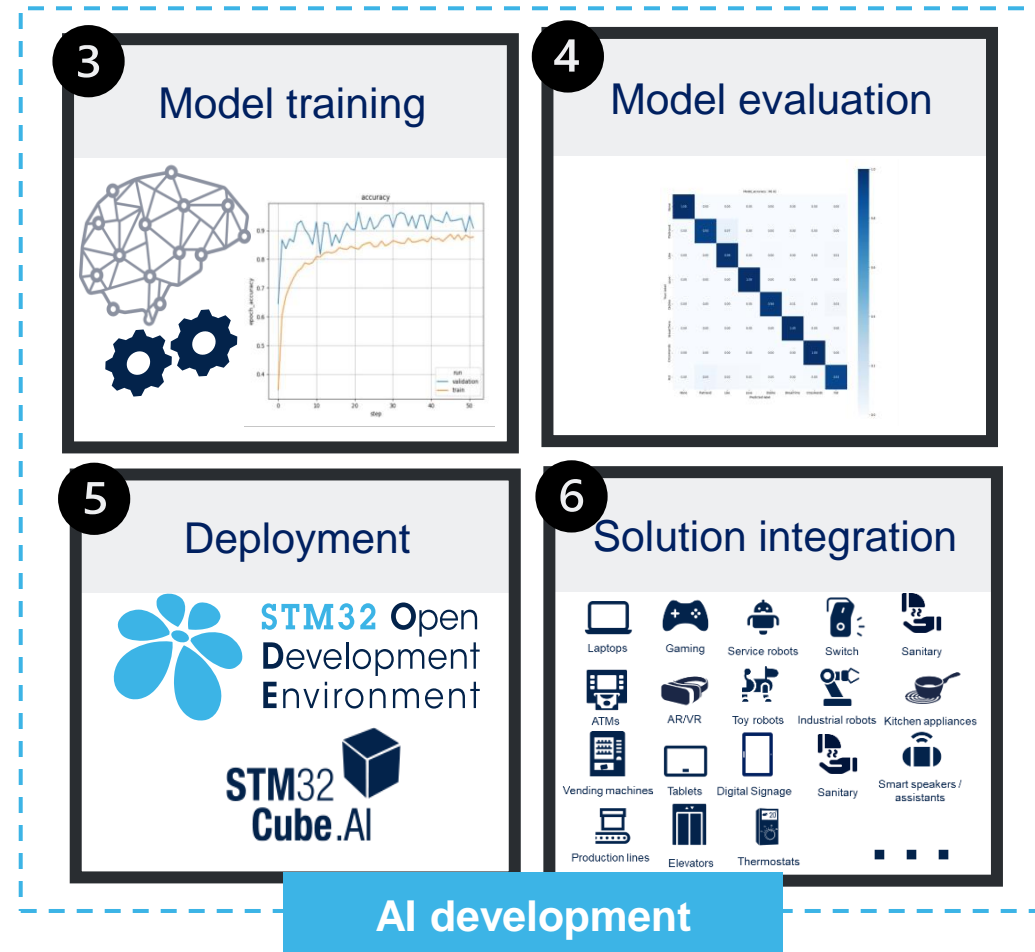
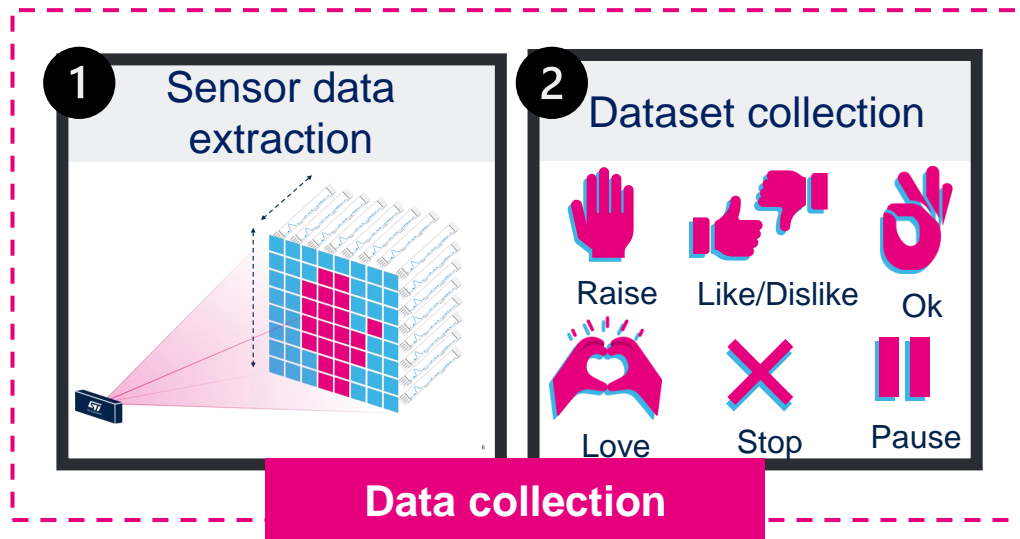


using the ST Gesture\_EVK

## Well known AI flow applied on hand posture recognition



## A comprehensive ST AI framework based on 2 tools

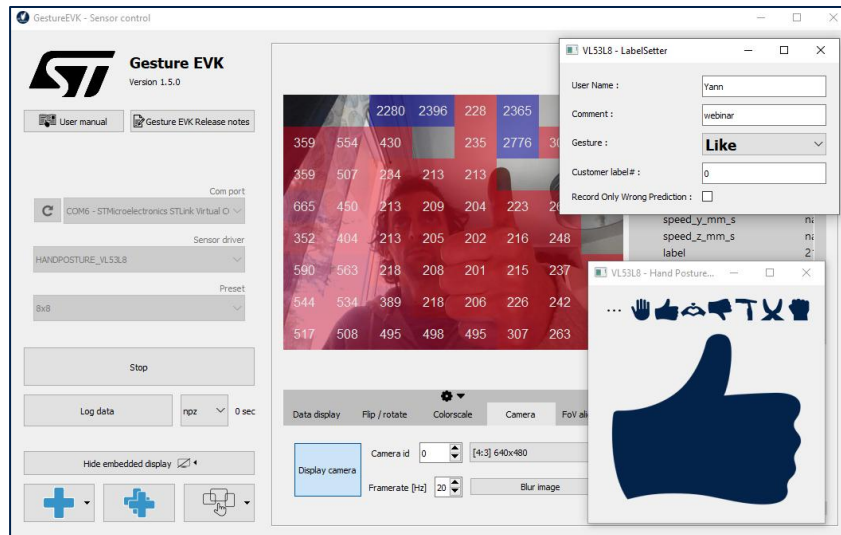




# Hand posture AI framework

A comprehensive ST AI framework based on 2 tools

## 1 + 2 Gesture EVK GUI



Data collection

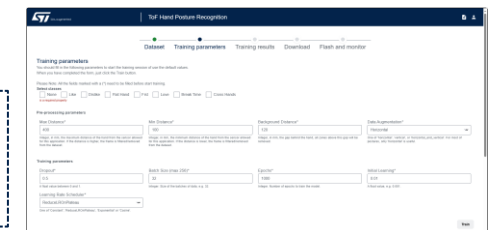
## 3 + 4 + 5 + 6 ST model zoo and web app



GitHub

- AI Python scripts
- ST public dataset
- Model topologies

Hand posture Web app  
User interface



AI development







## Create your own hand posture solution in less than 10 minutes

The application



1

Collect data

2

Organize the dataset

3

Train the model

4

Evaluate the model

5

Deploy the solution

6

Test your application

7

Enhance your model



## Create your own hand posture solution in less than 10 minutes

The application



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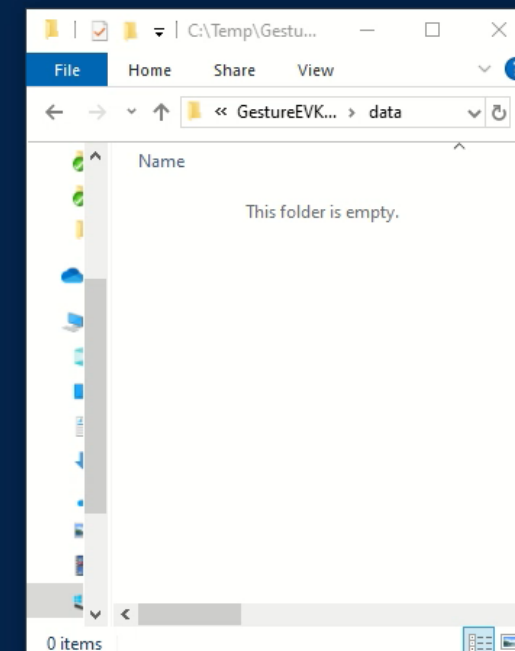
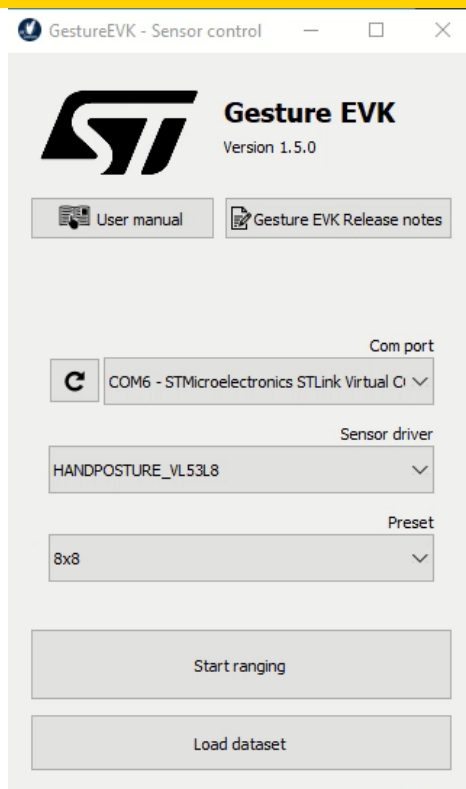
Enhance your model



# Create your hand posture solution

1 2 3 4 5 6 7

Collect data

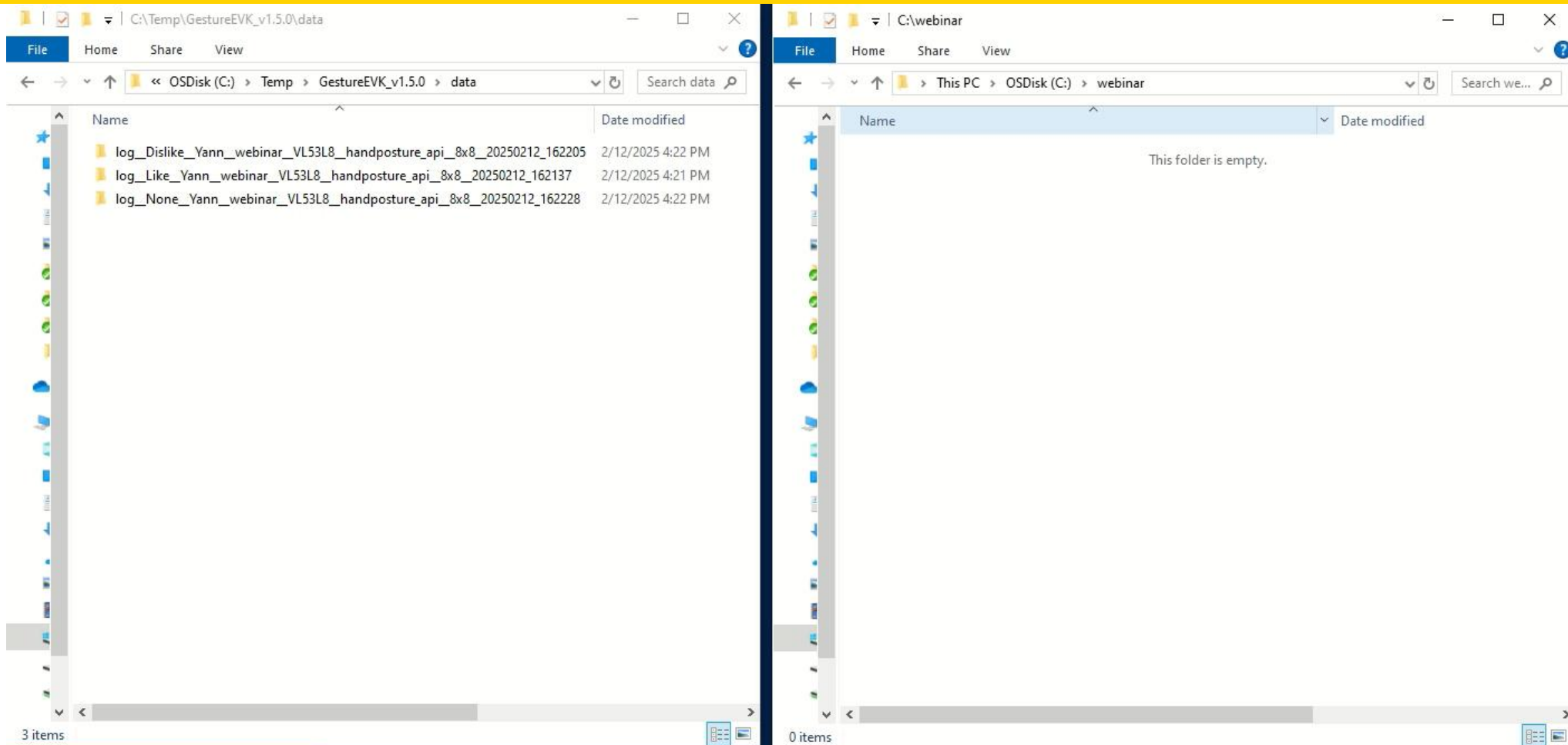




# Create your hand posture solution

1 2 3 4 5 6 7

## Organize the dataset

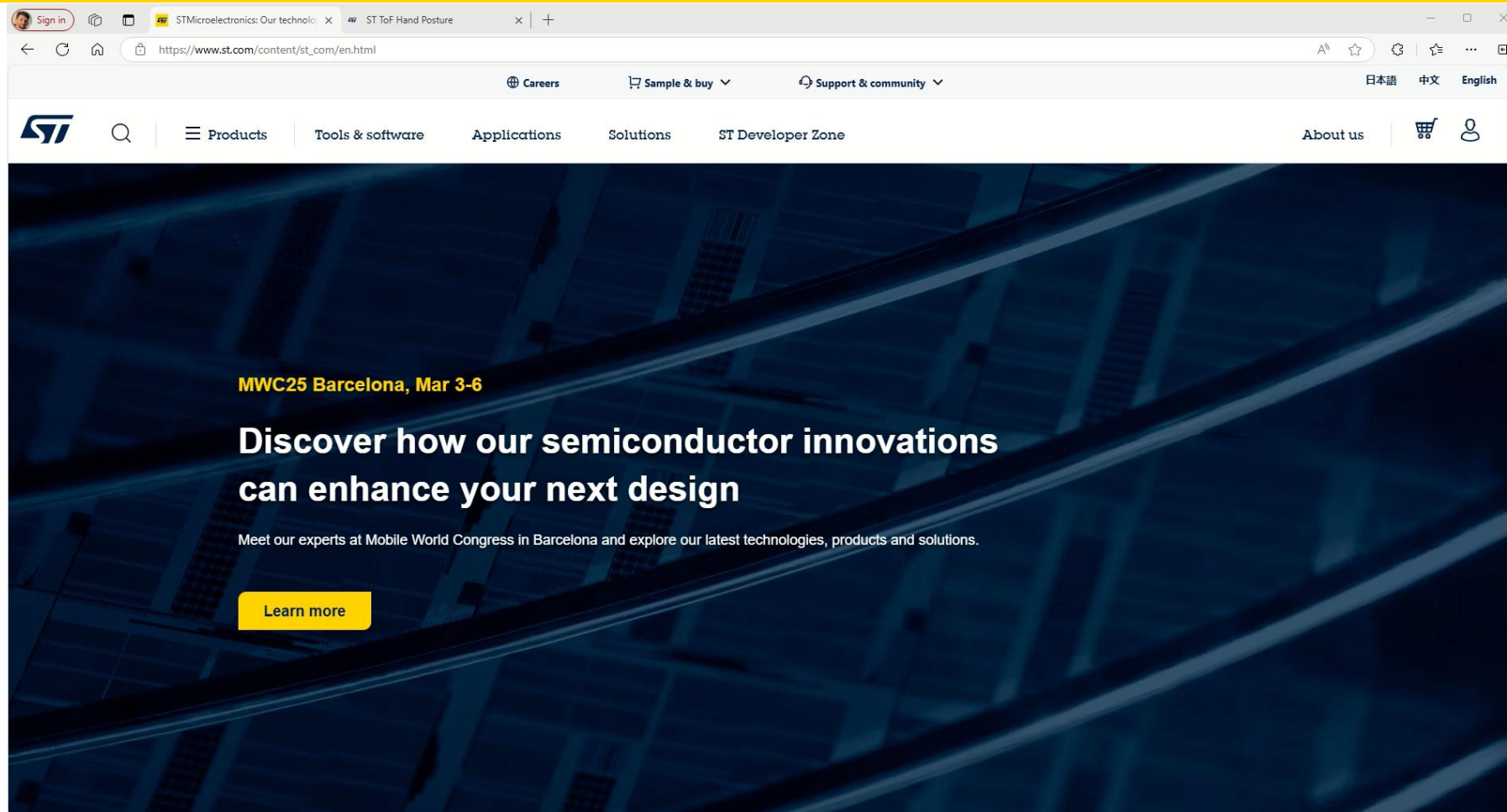




# Create your hand posture solution



## Train the model

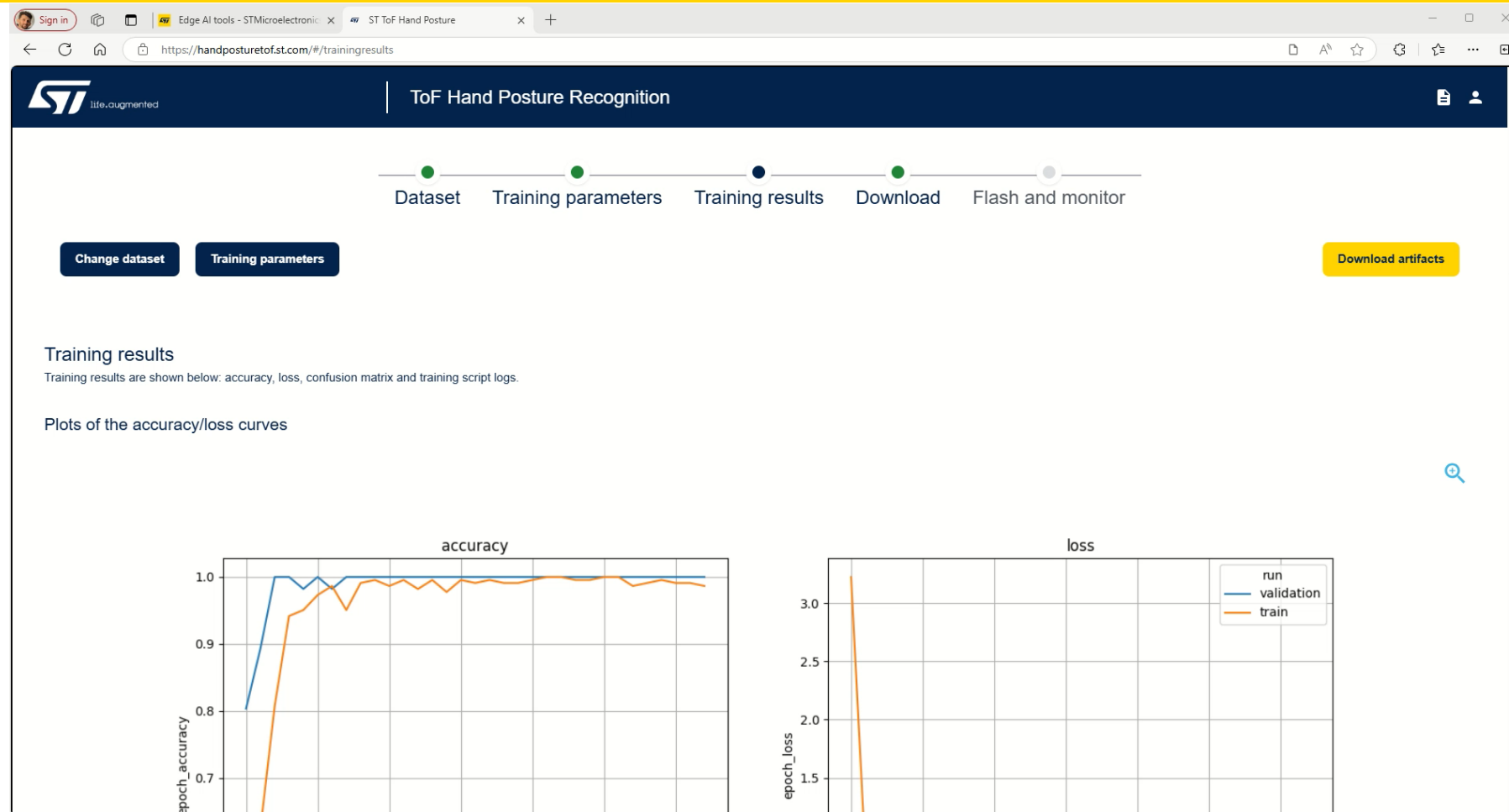




# Create your hand posture solution



## Evaluate the model





# Create your hand posture solution

- 1
- 2
- 3
- 4
- 5
- 6
- 7

## Deploy the solution

Sign in

Edge AI tools - STMicroelectronics x ST ToF Hand Posture

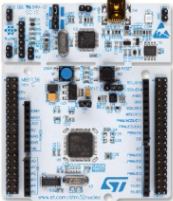
https://handposturetof.st.com/#/trainingresults

None Like Predicted label Dislike

Using 223 files for training.  
Using 56 files for validation.  
Model: "Augmented\_model"

**NETRON**  
[Show Graph](#)

<b>CUBE.AI VERSION</b> 8.1.0	<b>OPTIMIZATION</b> balanced	<b>ALLOCATE INPUTS</b> true	<b>ALLOCATE OUTPUTS</b> true		
<b>MODEL FORMAT</b> float	<b>INPUT</b> float 1x128	<b>OUTPUT</b> float 1x3	<b>WEIGHTS SIZE</b> 10.1 KB	<b>ACTIVATION SIZE</b> 1.6 KB	<b>MACC</b> 8280



**Nucleo F401RE**  
Arm Cortex-M4 with FPU | 84MHz

Internal SRAM: 96 KB  
Internal flash: 512 KB

Measured Inference time  
**1.499 ms**

[Change dataset](#) [Training parameters](#) [Download artifacts](#)



# Create your hand posture solution



## Test your application

The screenshot shows a web browser window with the URL <https://handposturetof.st.com/#/download>. The page title is "ToF Hand Posture Recognition". A progress bar at the top indicates the current step is "Download", with previous steps "Dataset", "Training parameters", and "Training results" completed. A "Flash and monitor" button is visible on the right.

**Download**  
Download model, application binary file or C source project

**Download .bin**  
This is the binary file to flash on the NUCLEO capable of recognizing the gestures you performed during the training phase.  
[Download](#)

**Download model**  
This is the model file, results of the training phase executed on the dataset selected at the first step.  
[Download](#)

**Download firmware app**  
This is the STM32 Cube IDE firmware project.  
[Download](#)

Footer links: About STMicroelectronics, Connect with Us, Browse, [Contact us](#)







# Create your hand posture solution

1 2 3 4 5 6 **7**

Enhance your model

The screenshot displays the 'ToF Hand Posture Recognition' web application. A progress bar at the top indicates the current step is 'Flash and monitor', with previous steps 'Dataset', 'Training parameters', 'Training results', and 'Download' completed. The main content area is divided into two panels. The 'Control panel' on the left shows the 'Device connection status' as 'OPEN' and includes 'Disconnect' and 'Terminal' buttons. The 'Inference results' panel on the right features a refresh icon, the text 'None 0.00%', and a terminal window displaying the following output:

```
Hand Posture = #0 (None)
Class #0 (None) : 0.000000
Class #1 (Like) : 0.000000
Class #2 (Dislike) : 0.000000
```

A status bar at the bottom right indicates 'Device is streaming data...'.



# Quick visit to the ST GitHub model zoo

## ST Modelzoo

The screenshot shows the GitHub repository page for `STMicroelectronics/stm32ai-modelzoo-services`. The repository is public and has 20 stars and 2 forks. The main branch is `main` with 1 branch and 1 tag. The repository contains a file tree with the following structure:

File/Folder	Description	Last Update
<code>application_code</code>	Release AI-ModelZoo-3.0.0:	2 months ago
<code>audio_event_detection</code>	Fix broken links in README files and code typo.	2 months ago
<code>common</code>	Updates :	last month
<code>hand_posture</code>	Fix broken links in README files and code typo.	2 months ago
<code>human_activity_recognition</code>	Fix broken links in README files and code typo.	2 months ago
<code>image_classification</code>	Fix broken links in README files and code typo.	2 months ago
<code>instance_segmentation</code>	Updates :	last month
<code>object_detection</code>	Updates :	last month
<code>pose_estimation</code>	Updates :	last month
<code>semantic_segmentation</code>	Fix broken links in README files and code typo.	2 months ago
<code>speech_enhancement</code>	Fix broken links in README files and code typo.	2 months ago
<code>tutorials</code>	Release AI-ModelZoo-3.0.0:	2 months ago
<code>CODE_OF_CONDUCT.md</code>	Release AI-ModelZoo-3.0.0:	2 months ago
<code>CONTRIBUTING.md</code>	Release AI-ModelZoo-3.0.0:	2 months ago
<code>LICENSE.md</code>	Release AI-ModelZoo-3.0.0:	2 months ago
<code>README.md</code>	Fix broken links in README files and code typo.	2 months ago

The right sidebar shows the repository's metadata and links to the README, license, and code of conduct. The `Releases` section shows the latest release, `Release AI-ModelZoo-3.0.0`, dated Dec 10, 2024.



**What is available today?**



# Get started with your development

## Where to find all the resources

**Hardware**  
ToF, X-NUCLEO, STM32

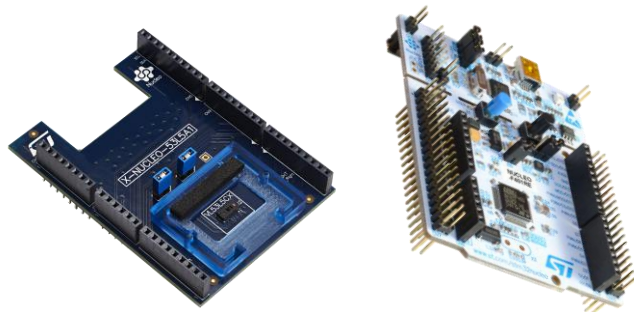


**Software links**



**Evaluate our solution**

**STSW-IMG035**  
GUI Gesture EVK

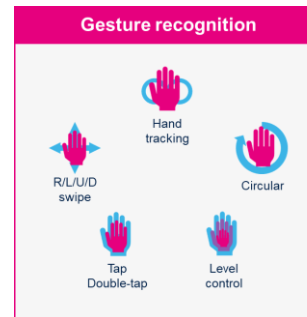


VL53L7CX

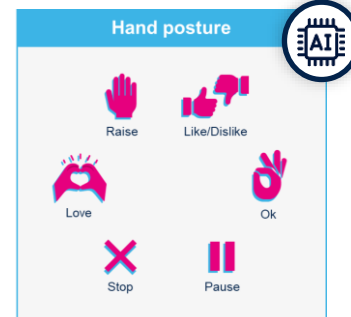
[Link](#)

VL53L8CX

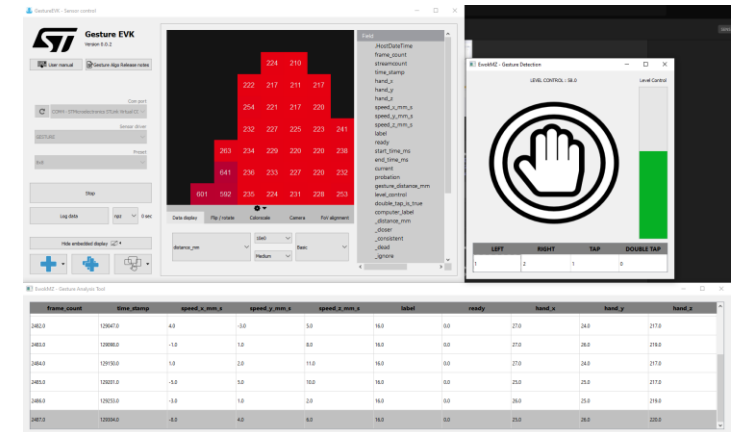
[Link](#)



[Link](#)



[Link](#)



# Conclusion



# ST Gesture & hand posture recognition summary

## Market leader in ToF with key benefits



**1st**



### VL53L7CX

- 90° wide FoV
- Up to 350 cm ranging



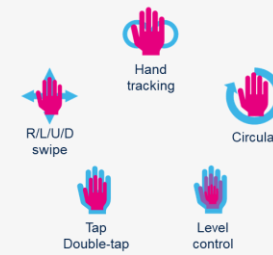
### VL53L8CX

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

- 100% privacy (no camera, no image)
- Easy integration due to all-in-one module
- Low cost
- Robust

## Two unique software solutions

### Gesture recognition



### Hand posture



## Unlimited markets & applications

### Innovation



### Hygienic



### Safety



### Entertainment



## Evolving roadmap

### Current

VL53L7CX  
VL53L8CX



### Future

3DToF: VL53L9CX

# Our technology starts with You



Find out more at [www.st.com](http://www.st.com)

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