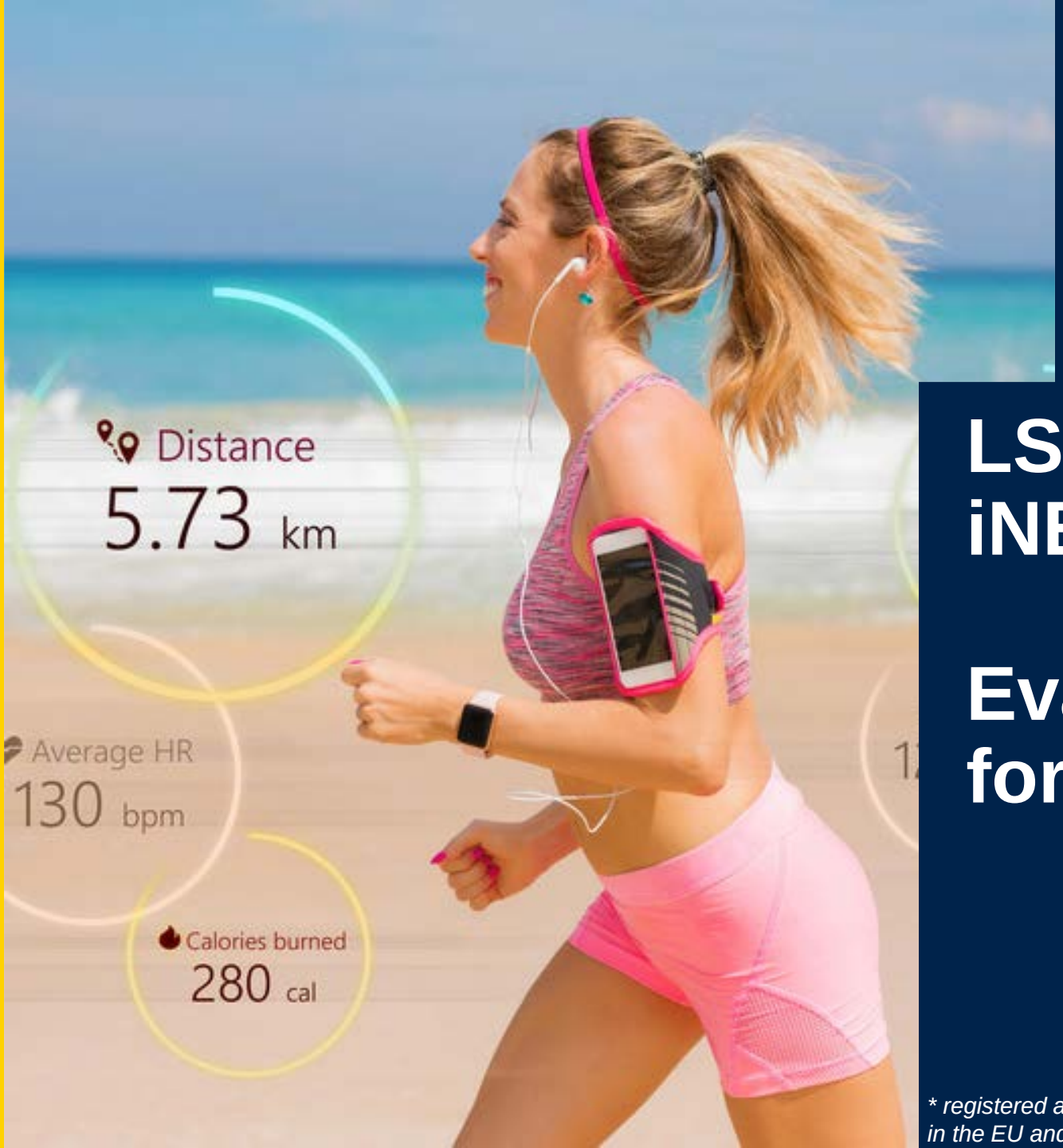

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LSM6DSOX
iNEMO* inertial module

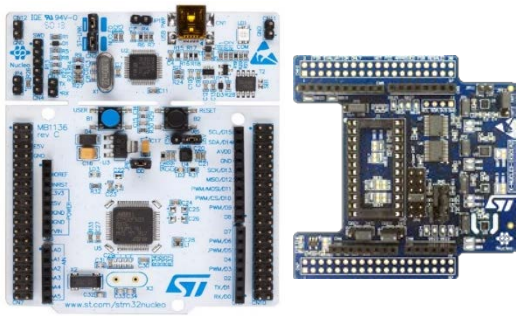
Evaluation tools and GUI for Machine Learning

iNEMO

LSM6DSOX quick prototype

Two solutions to capture and process data

STM32 Nucleo with Expansion board tool & Unicleo GUI



STM32 NUCLEO* with EXPANSION
X-NUCLEO-IKS01A13

DIL24 adapter board
LSM6DSOX STEVAL-MKI197V1

Software packages:
- UNICLEO GUI with X-CUBE-MEMS1
- AlgoBuilder
- Unico-GUI for MLC development

SensorTile.box

SensorTile.box
STEVAL-MKSBOX1V1

STBLESensor

Software packages:
- STBLESensor mobile app
- UNICLEO GUI
- AlgoBuilder
- UNICO GUI for MLC development

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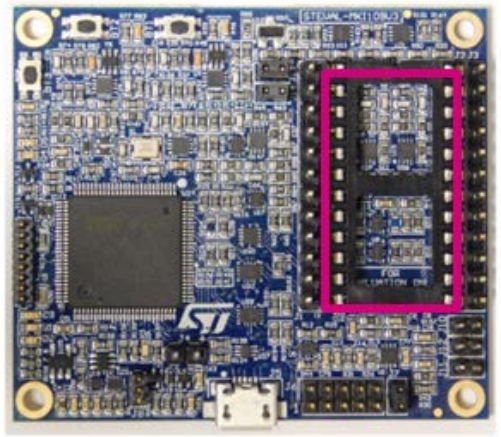
* Refer to product specification: NUCLEO-F401RE, NUCLEO-L152RE, NUCLEO-L476RG, NUCLEO-L073RZ

LSM6DSOX performance evaluation

Form Factor Tool & GUI to capture and process data

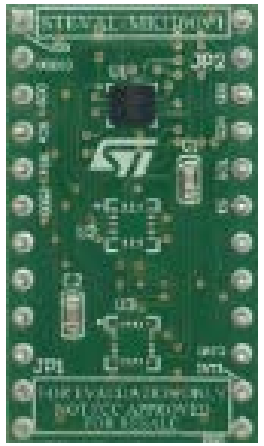
Professional MEMS motherboard	Evaluation board (adapter)



Professional MEMS motherboard
STEVAL-MKI109V3

Software package:
UNICO-GUI

Linux		**STSW-MKI109L**
Mac OS X	→	**STSW-MKI109M**
Windows		**STSW-MKI109W**



DIL24 adapter board
STEVAL-MKI197V1

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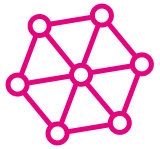
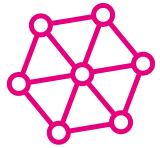
LSM6DSOX – SensorTile.box

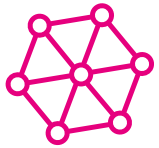
	Capture data	Label data	Build decision tree	Embed decision tree	Process new data
WHAT	 Accelerometer Gyroscope External sensors	 Filters Features	Classification Results	 DT implementation	 Real-time test
HOW – HW	**SensorTile.box** • STEVAL-MKSBOX1V1	-------	-------	-------	**SensorTile.box** • STEVAL-MKSBOX1V1
HOW – SW	**No USB cable:** • STBLESensor **With USB cable:** • FP-SNS-STBOX1 • Unicleo GUI **(for advanced level)** • AlgoBuilder	**Unico GUI** * *External tools for building decision tree: Weka, RapidMiner, MATLAB, Python			**No USB cable:** • STBLESensor **With USB cable**: • FP-SNS-STBOX1 • Unicleo GUI **(for advanced level)** • AlgoBuilder

LSM6DSOX - STM32 Nucleo with expansion board

	Capture data	Label data	Build decision tree	Embed decision tree	Process new data
WHAT	 Accelerometer Gyroscope External sensors	 Filters Features	 Classification Results	 DT implementation	 Real time test
HOW – HW	**STM32 Nucleo board*** **Expansion board:** • X-NUCLEO-IKS01A3 **Adapter (DIL24)** • STEVAL-MKI197V1	-------	-------	-------	**STM32 Nucleo board*** **Expansion board:** • X-NUCLEO-IKS01A3 **Adapter (DIL24)** • STEVAL-MKI197V1
HOW – SW	**Unicleo GUI** • X-CUBE-MEMS1 **(for advanced level)** • AlgoBuilder • X-CUBE-ALGOBUIDL	**Unico GUI** ** ** External tools for building decision tree: Weka, RapidMiner, MATLAB, Python			**Unicleo GUI** • X-CUBE-MEMS1 **(for advanced level)** • AlgoBuilder • X-CUBE-ALGOBUIDL

* NUCLEO-F401RE, NUCLEO-L152RE,
NUCLEO-L476RG, NUCLEO-L073RZ
With STM32CubeMX to generate SW support

LSM6DSOX - Professional MEMS tool motherboard

	Capture data	Label data	Build decision tree	Embed decision tree	Process new data
WHAT	 Accelerometer Gyroscope External sensors	 Filters Features	Classification Results	 DT implementation	 Real-time test
HOW – HW	**Professional MEMS tool motherboard** • STEVAL-MKI109V3 **Adapter (DIL24)** • STEVAL-MKI197V1	-------	-------	-------	**Professional MEMS tool motherboard** • STEVAL-MKI109V3 **Adapter (DIL24)** • STEVAL-MKI197V1
HOW – SW	**Unico GUI** *				

*External tools for building decision tree:
Weka, RapidMiner, MATLAB, Python

ST sensor tools
Dataset generation & label

Capture data

1

a) **Sensortile.box**

STBLESensor or **AlgoBuilder**

b) **STM32 Nucleo board with expansion**

Unicleo-GUI (USB cable) or **AlgoBuilder**

c) **Professional MEMS tool motherboard**

Unico-GUI (USB cable)

Logs generation in .csv files

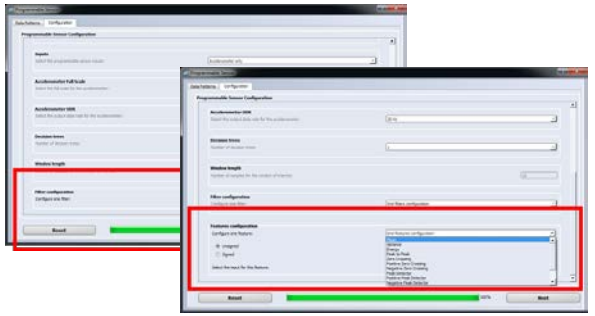
Label data

2

Unico-GUI → **MLC development tool**

STEPS

1. Import .csv files in Unico
2. Assign label (class) to the files
3. When all files are imported, start MLC configuration: sensors setup (ODR, FS, etc), windows length, filters and features
4. Generation of .arff file



from Logs in .csv files to .arff file generation

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ST sensor tools
Decision tree creation process – build & embed

Build decision tree

Unico-GUI

→ ST MLC development tool

3

From .arff file to Decision Tree generation in .txt file
(only for Weka/RapidMiner copy the content in .txt file)

Embed decision tree

Unico-GUI

→ MLC development tool

4

STEPS:

1. Import .txt file in Unico
2. Assign values to the classes
3. Meta-classifier configuration (if needed)
4. Generation of .ucf/.h file

From . txt file to .ucf/.h file generation

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ST sensor tools
Real-time test with trained decision tree

Process new data

5

Unicleo-GUI

- Test the Decision Tree on STM32 Nucleo board with expansion using USB cable

Unico-GUI

- Test the Decision Tree on Professional MEMS board using USB cable

AlgoBuilder

- PC application for advanced development level

STBLESensor

- Mobile app using BLE

Import .ucf file to configure the device

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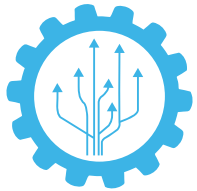
AlgoBuilder GUI – PC application

- AlgoBuilder is a graphical design tool to build and use algorithms
- AlgoBuilder GUI uses the outputs from MLC and FSM to allow you to build more complex projects
- An existing MLC / FSM configuration (.ucf file) can be implemented

Explore MLC examples and resources

- Decision tree examples are available online at the dedicated GitHub project for Machine Learning Core



https://github.com/STMicroelectronics/STMems_Machine_Learning_Core

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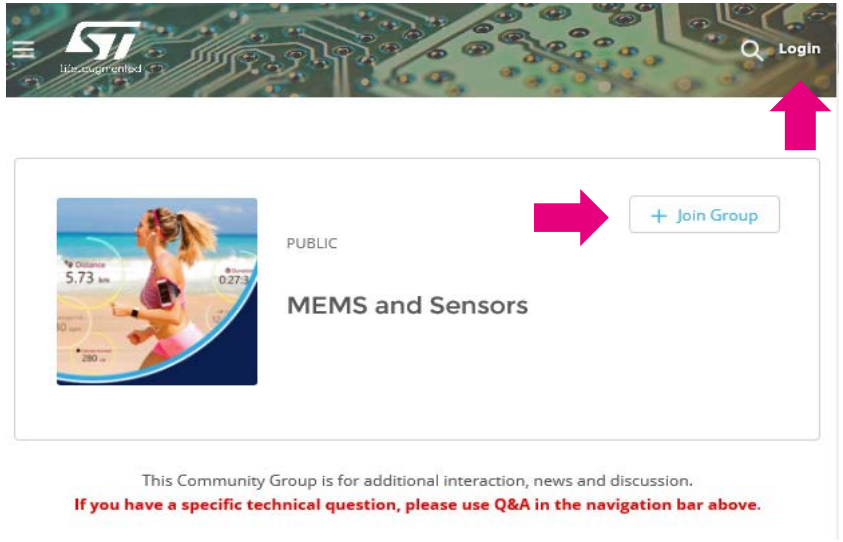
MEMS Machine Learning & AI @ ST Community!
Ask questions, collaborate and share insights!

ST Community

Join our **MEMS and Sensor** community and participate in **Q&As**

Our experts are there to help you!



Login & Join

MEMS and sensors
General Q&A section

For questions related to implementing AI in sensors,
visit the Q&A section on MEMS Machine Learning & AI

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Thank you

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