Artificial intelligence and machine learning with STM32 microcontrollers and ST sensors

Fan anomaly detection

Material detection with STM32 and ToF

People detection and counting

Sensor Tile Wireless Industrial Node

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Fan anomaly detection

Learn and monitor assets behavior at the edge with a cost and power efficient solution

NANOEDGE AI STUDIO

- **Unsupervised Learning** on the device for a more flexible solution
- Add intelligence to your existing solutions with NanoEdge AI Studio unique ability to limit the models' footprints
- **Predictive maintenance** can now be a feature of all your STM32 solutions

Advanced models on STM3

Model input resolution	256 points * 3 axis
RAM	3kB
Flash	13kB

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NanoEdge™ AI STUDIO is the only solution designed with embedded learning capabilities

We re-wrote, from the algebra, ML and signal processing algorithms so that they LEARN and INFER inside a microcontroller

- Designed for embedded developers
- Ultra memory efficient Flash and RAM
- Unsupervised Learning in the device
- Superior security
- Small footprint, any STM32 microcontroller
- Close to 100% accuracy and confidence

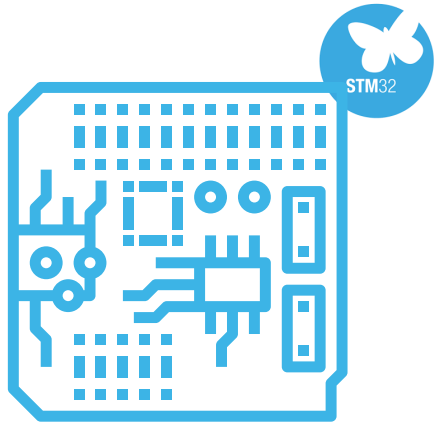
NanoEdge AI Studio bring Machine Learning to the edge

1 **Create the library ONCE**

Standalone PC (Win/Linux) solution

Create and embed a self learning engine

2 **Use the library MANY times**



Model is self-trained « at the Edge »

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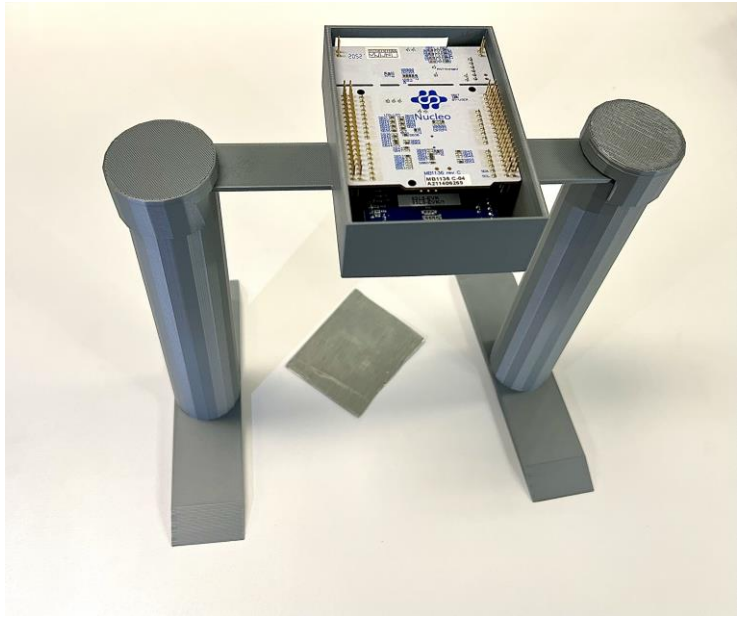
Material detection with STM32 and ToF

Detect materials with a cost and power efficient solution

NANOEDGE AI STUDIO

- Classify materials to enable your system to accurately understand its environment
- Add intelligence to your **Time-of-Flight** solutions: Sort materials, count objects and add environmental exploration capabilities



Advanced models on STM32 with VL53L5

Model input resolution	64 points
RAM	1kB
Flash	1.5kB

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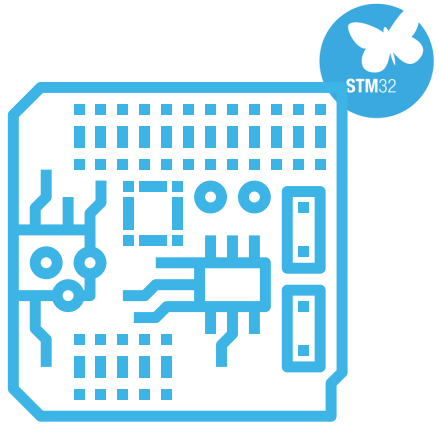

Model is self-trained « at the Edge »

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People detection and counting

Monitor building usage with cost and power efficient solution

- Detect multiple people to enable your system to count **accurately**
- Add intelligence to your **smart building** : monitor factory, meeting room or showroom people flows
- **Monitor physical distances** between multiple people

STM32 Cube.AI

Advanced models on STM32H7

Model input resolution	240x240 RGB pixels
Model complexity	96M MACC
Inference time	371 ms @ 400 MHz
Max rate	2.7 FPS
Flash	230 KB
RAM	233 KB
MCU power consumption (SMPS)	80 mA

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Easily implement Neural Networks on STM32

Train Neural Network using any major AI frameworks

And more

Convert NN into optimized code

STM32 Cube.AI

Select most appropriate MCU
Review computation and memory consumption per layer

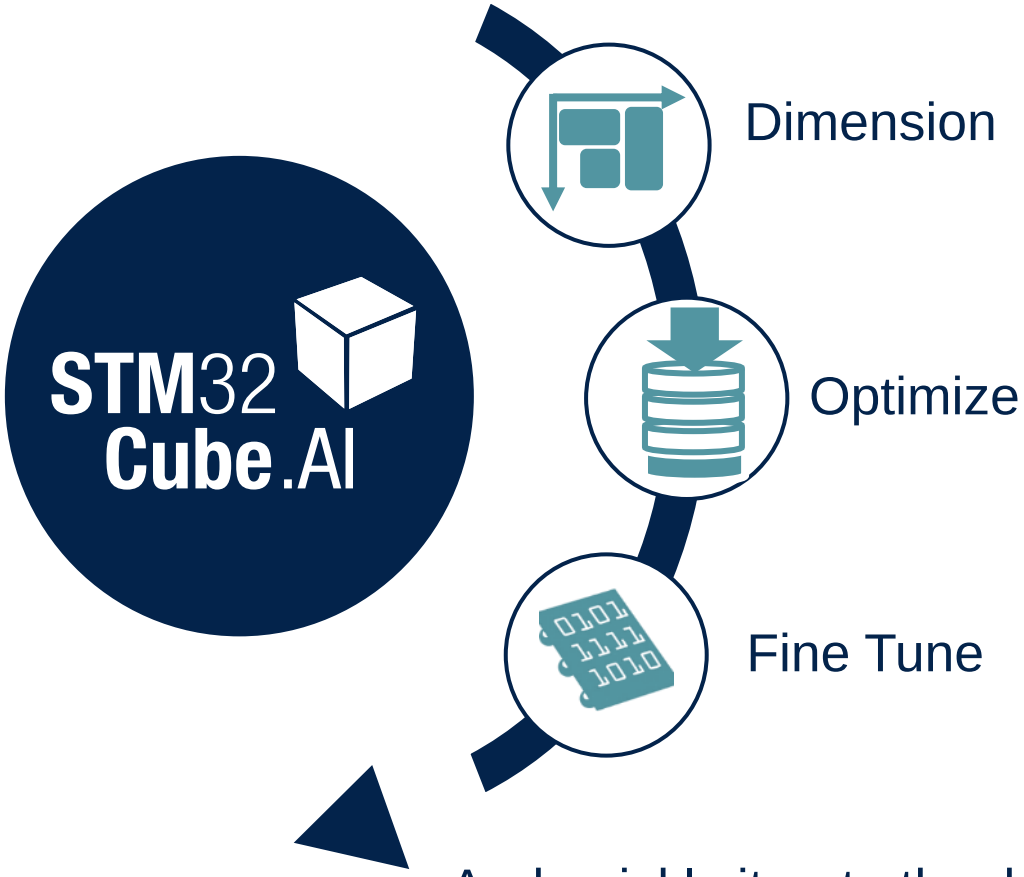
Run on optimized runtime

run-time

Validate code directly on target
Get accuracy and inference time
Optimize memory usage

STM32Cube.AI main features

STM32Cube.AI is available both as graphical and command line interface



- ✓ Quickly assess model footprint requirements
- ✓ Select and configure MCU in STM32CubeMX
- ✓ Review model layers in STM32Cube.AI

- ✓ Generate C-code for pre-trained model
- ✓ Support quantized models to reduce RAM, flash and latency with minimal loss of accuracy
- ✓ Use light run-time libraries
- ✓ Optimize for performance

- ✓ Optimize memory allocation
- ✓ Fine control of weight mapping
- ✓ Split between internal and external memory
- ✓ Update model without full FW update

And quickly iterate thanks to on-target validation

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MORE INFO

Sensor Tile Wireless Industrial Node
STEVAL-STWINKT1B

STEVAL-STWINWFV1

Available Software

FP-IND-PREDMNT1

FP-CLD-AZURE1

FP-SNS-HSDATALOG1

Mobile App

ST BLE Sensor

Cloud App

DSH-PREDMNT

Industrial Motion Sensors

High-performance 6-axis IMU, embedding Machine Learning Core
ISM330DHCX

Ultra-wide bandwidth, low noise 3-axis digital vibration sensor
IIS3DWB

Ultra-low power, high performance 3-axis accelerometer
IIS2DH

Magnetometer
IIS2MDC

Environmental Sensors

Altimeter / Pressure sensor
LPS22HH

Accurate temperature sensor
STTS751

Humidity sensor
HTS221

Analog wide-band microphone
IMP23ABSU

Industrial Digital microphone
IMP34DT05

Processing

STM32L4 low-power MCU
STM32L4R9ZIJ6

Connectivity

Bluetooth Low Energy
BlueNRG-M2

RS485 Transceiver

Connectivity Expansion

Wi-Fi, LTE,
Industrial Ethernet

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