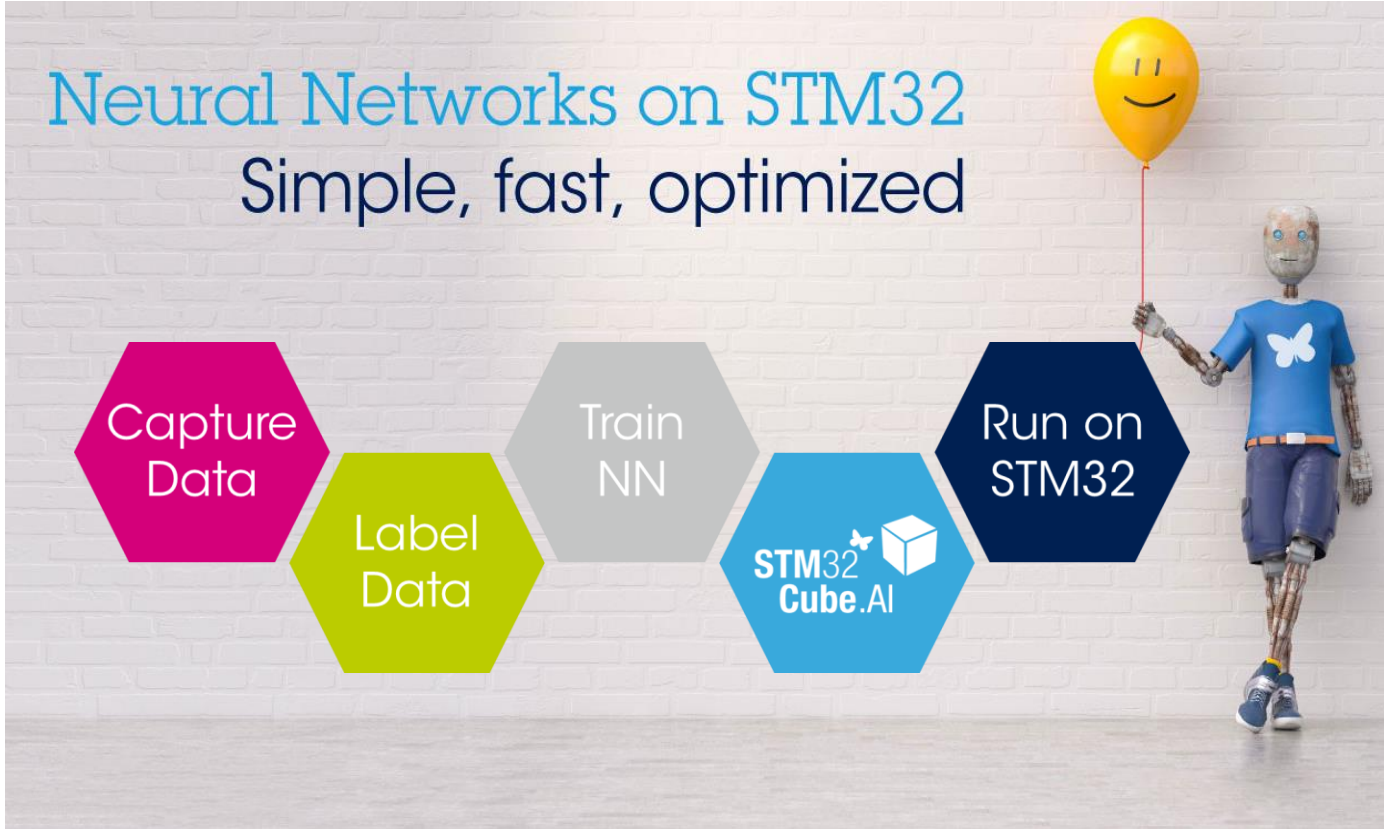


STM32Cube.AI – Neural Networks on STM32



STM32Cube.AI
AI Conversion Tool

STM32 Solutions for AI

Demos available in AI lab



STM32Cube.AI – AI Conversion Tool

STM32CubeMX Extension

2

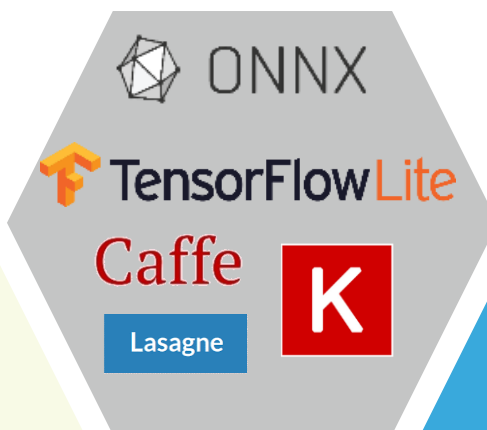
Brings AI To the STM32 MCU Family

Input your framework-dependent, pre-trained Neural Network into the **STM32Cube.AI** conversion tool

Automatic and fast generation of an STM32-optimized library

STM32Cube.AI offers interoperability with state-of-the-art Deep Learning design frameworks

Train NN Model



Process & Analyze new data using trained NN



Convert NN into optimized code for STM32





STM32 Solutions for AI

More Than Just the STM32Cube.AI

3

An extensive toolbox to support easy creation of your AI application

STM32
Cube.AI



AI extension for STM32CubeMX
to **map pre-trained Neural Networks**



 **Software examples** for quick prototyping
Audio, Motion and Vision Function packs
On **ST development hardware**



 STM32 **Community** with dedicated
Neural Networks topic

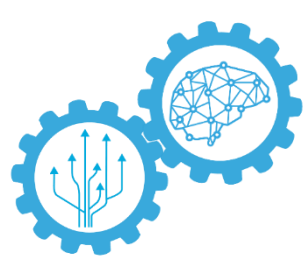


 Trainings, hands on, MOOCs and
partner **videos**



 STM32 AI Partner Program with dedicated
partners providing **Machine or Deep
Learning engineering services**





Contextual Activity Recognition

4

Distributed intelligence between ST Smart Sensor MLCore and audio-scene classification CNN on STM32

Use cases:

- Adapt behavior based on user environment: outdoor, indoor or in-vehicle
- Environment is detected based on local audio acquisition by microphone
- Low power consumption allows usage by variety of products



Wearable Smartwatch enables BLE when user is driving and turns off WI-FI when not indoors

Sport watch turns GPS on during outdoor activities



Demo overview

- Ultra-low power with always-on Human Activity Recognition on LSM6DSOX, based on 3-axis accelerometer data
- Low-power sound-analysis Neural Network on STM32L4 is triggered by activity recognition
- Recognize 3 environments (outdoor, indoor or in-vehicle) in 5 activity contexts (stationary, walking, running, biking, driving)

SensorTile.Box



Machine Learning Core



STM32 Cube.AI



on





Facial Expression Recognition

5

Live face-expression recognition from a camera video stream

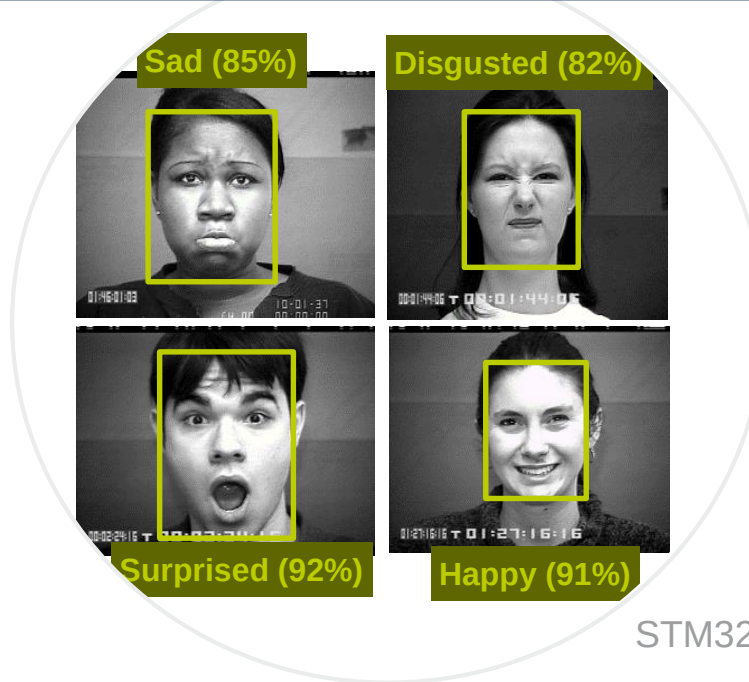
Use cases

- Build interactive experience in toys
- Optimize advertising experience based on customer emotional response
- Only requires a low-resolution camera



Assert customer interest at point of sale, like vending machines

Improve toy's reaction based on user's expression



Demo overview

- Detection of multiple faces with labeled bounding box displayed in real time
- Recognize 7 expressions: angry, disgusted, scared, happy, neutral, sad, surprised
- Processing time: 4.8 FPS for 1 face, 3.4 FPS for 2 faces

STM32H747 Discovery + VG5661

STM32
Cube.AI



Neural Network on





Face Identification

6

Multiple faces detection and identification with bounding box displayed in real time from a live video feed

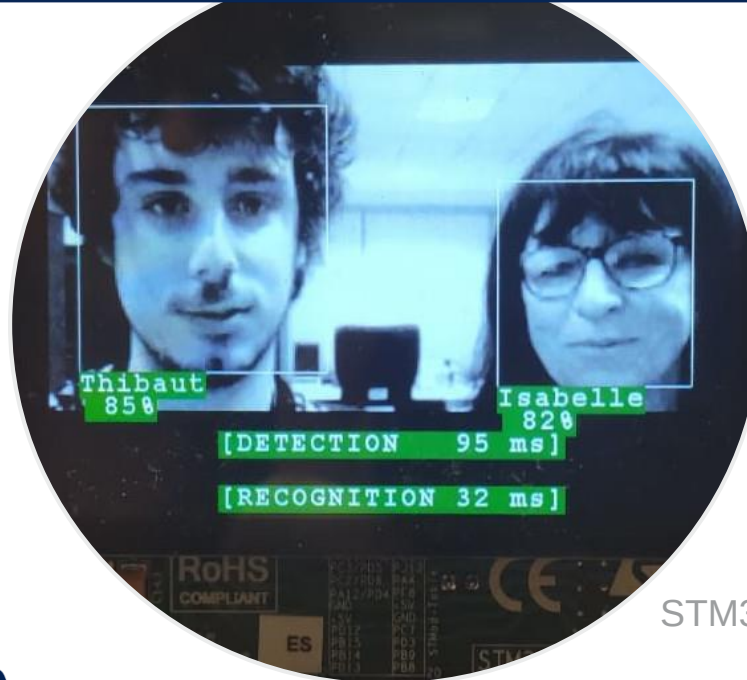
Use cases

- Build customized experience in appliances, toys or smart controls
- User onboarding is done in total privacy on associated application
- Requires only a low-resolution camera



Adjust coffee strength for each family member

Doorbell sound personalized using security-camera feed



STM32H747 Discovery + DIS-CAM

Demo overview

- Enrollment of new faces (as many as 8) via a PC
- Neural Network: CNN up to 8 classes plus one for unknown face
- Processing time: 9 FPS for 1 face, 5.5 FPS for 3 faces

STM32
Cube.AI



Neural Network on





Image Classification on STM32MP1 MPU

7

Advanced classification of images among 1000 different categories using TensorFlow Lite on STM32MP1

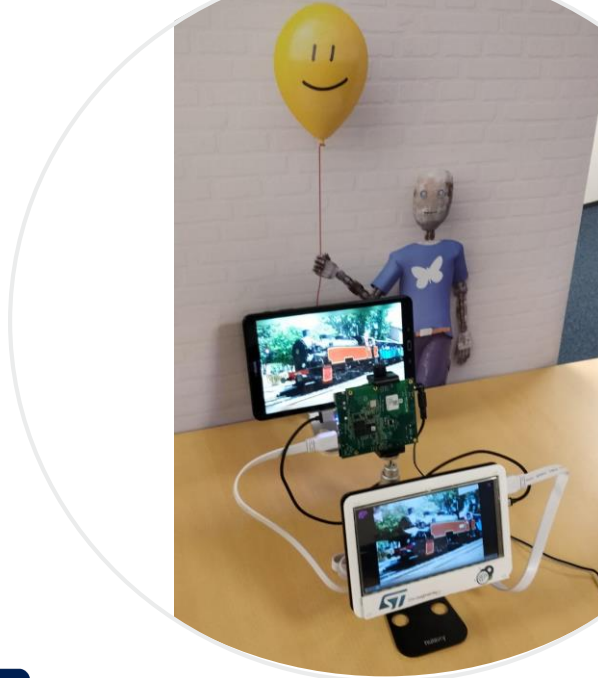
Use cases

- Classify objects from a catalog of 1000 objects
- Classification is done in real time for fast interaction with user
- Requires only a low resolution camera



Detect low supply in fridge or freezer

Detect type of food placed in oven or microwave



Demo overview

- TensorFlow Lite integrated via C++ runtime implementation on STM32MP1 dual-core A7
- MobileNet v1: 1000 classes
- CPU load balanced on the 2 cores
- Processing time: 8 FPS

Arrow Avenger96
DCMI Camera@30fps
Display

STM32
Cube.AI



Neural Network on



STM32 MP1

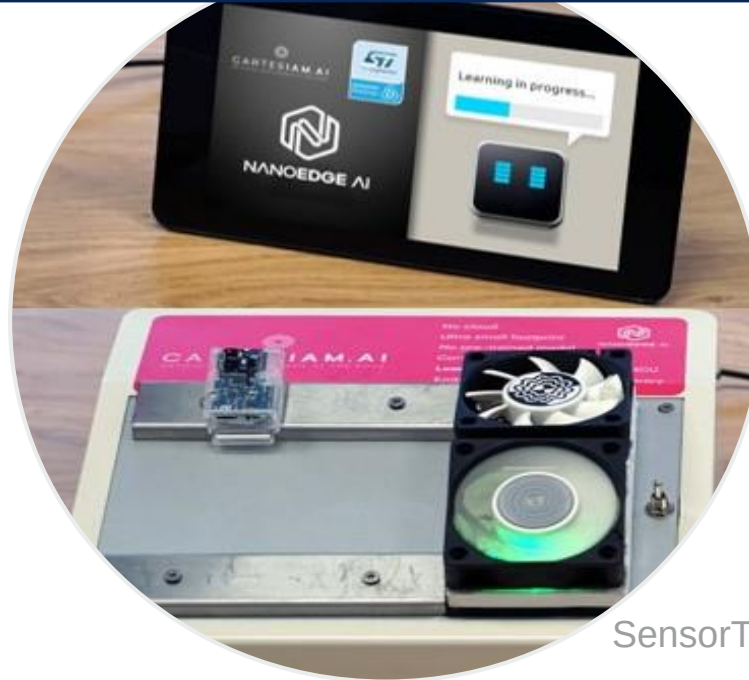
Use cases

- Detect anomalies in complex system based on accelerometer sensor
- Learn normal state during onsite initialization phase
- No training on abnormal state is required, on-chip anomaly detection is done in real-time



Real time detection of clogging on servers

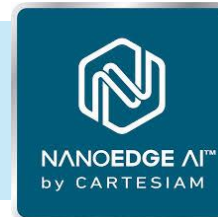
Real time detection of shocks, misalignment or motor unbalance on industrial appliances



SensorTile

Demo overview

- NanoEdge AI™ Studio by **Cartesiam** easily creates custom machine learning library able to learn and infer in STM32 microcontrollers
- No dataset, no data scientist, no pre-trained Neural Network is required
- Vibration analysis in a multi-source non-stationary environment



Learns and detects on



Predictive Maintenance

Condition monitoring of fleet of industrial fans

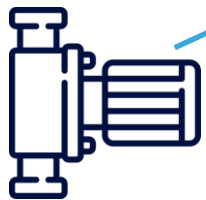
Use cases

- Detect anomalies (unbalance, tilt) in industrial fans based on vibration monitoring
- Report predicted condition to Exosite Murano IoT platform via Wireless connectivity and monitor on dashboard



Demo overview

- ExoInsight™ by Exosense infers predictions in real time on STM32 microcontrollers
- Monitors fleet conditions on dashboard and review probability of unbalance and tilt per device



Real time detection of anomalies in industrial pumps

Real time detection of anomalies in industrial motors



STM32
Cube.AI



Neural Network on

