

# STM32Cube.AI: AI productivity boosted on STM32 MCU

Danilo Pau <sup>1</sup>, Matthieu Durnerin <sup>2</sup>, Viviana D'Alto <sup>1</sup>, Miguel Castro <sup>2</sup>

<sup>1</sup> System Research and Applications, STMicroelectronics, Italy

<sup>2</sup> Microcontroller Group, STMicroelectronics, France

## 1. Problem

Artificial Intelligence (AI) has attracted the interest of the embedded processing industry with chip sales forecast to reach \$91 Billion by 2025, a CAGR of 45.4%<sup>1</sup>. However, huge productivity gaps exist today between AI scientists and embedded firmware developers. These scientists generally have no knowledge of MCU programming, since they run AI in environments with virtually unlimited memory and computing resources. No interoperability exists between deep learning python frameworks and the Integrated Development Environments (IDE) used for microcontrollers. Without automated solutions, developers of MCU-based embedded solutions need to generate repetitive, error prone handcrafted C-code for Artificial Neural Network (ANN) implementation, wasting time and resources.

## 2. Technical Approach and its Novelty

STMicroelectronics has developed a novel AI ecosystem to enable a broad range of developers to map and run pre-trained ANNs on MCUs in its broad STM32 Arm® Cortex®-based 32-bit microcontroller portfolio. A tool called STM32Cube.AI<sup>2</sup> was created, as an AI-enabling extension pack of the widely used STM32CubeMX configuration and code generation tool. The

STM32Cube.AI has the following features, which are fundamental to boost developer productivity:

1) interoperability with popular deep learning training tools; 2) compatibility with many IDEs and compilers; 3) sensors and RTOS agnosticism; 4) ability to run multiple ANNs on a single STM32 MCU; 5) support to exploit the ultra-low-power features of STM32 MCUs.

The STM32Cube.AI comes together with ready-to-use software function packs that include example code for human activity recognition and audio scene classification. These code examples are immediately usable with the ST Sensor Tile reference board and the ST BLE Sensor mobile app, which allows easy data collection and labelling.

## 3. Results

STMicroelectronics released the STM32Cube.AI to all developers on January 3<sup>rd</sup> 2019. Recent demonstration included:

- 1) Hands-on examples of the main features of STM32Cube.AI on Nucleo-F746 board;
- 2) FP-AI-SENSING1 including Audio Scene Classification and Human Activity Recognition on SensorTile development kit and associated BLE Sensor smartphone application;
- 3) AI-enabled handwriting character recognition on the new ultra-low power STM32L5 discovery board with security and smartwatch-type screen;
- 4) Fixed Point Single Object Image (trained for 18 food classes recognition) classification on STM32H7 Discovery kit with STM32F4DIS-CAM camera module. This is preview of new STM32Cube.AI features to be introduced later in 2019.

---

<sup>1</sup> <https://mailchi.mp/d27f54c3c48e/7wck6096q1?e=2caee09883>

<sup>2</sup> <https://www.st.com/stm32cubeai>