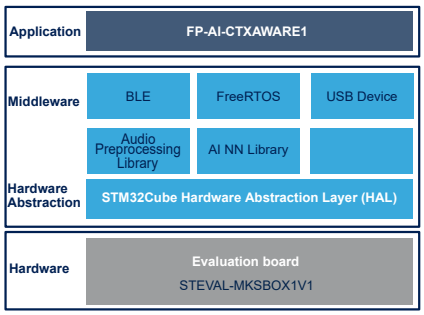
FP-AI-CTXAWARE1

Data brief

STM32Cube function pack for ultra-low power context awareness with distributed artificial intelligence (AI): acoustic analysis with NN on MCU and motion analysis with ML on IMU



STM32 Open Development Environment

Features

- Complete firmware to develop a context awareness node with BLE connectivity, digital microphone, environmental and motion sensors, performing real-time monitoring of sensors and audio data
- Machine Learning Core (MLC) featuring real-time human activity recognition (HAR) generated thanks to Unico-GUI and running on LSM6DSOX
- Middleware library generated thanks to STM32CubeMX extension called X-CUBE-AI, featuring example implementation of neural networks for acoustic scene classification (ASC) application
- Multi-network support: concurrent execution of the MLC for HAR and the neural network for ASC
- Ultra-low power implementation based on the use of an RTOS
- Compatible with STBLESensor application for Android/iOS, to perform sensor data reading, audio and motion algorithm feature demo in standalone or combined views, and firmware update over the air (full FOTA)
- Sample implementation available for STEVAL-MKSBOX1V1 evaluation board
- Easy portability across different MCU families, thanks to STM32Cube
- Free, user-friendly license terms

Product summary	
STM32Cube function pack for ultra-low power context awareness with distributed artificial intelligence (AI): acoustic analysis with NN on MCU and motion analysis with ML on IMU	FP-AI-CTXAWARE1
Neural network library extension for STM32CubeMX tool	X-CUBE-AI
iNEMO inertial module with Machine Learning Core	LSM6DSOX
Tool to facilitate the programming of sensors for an intuitive Machine Learning experience	Unico-GUI
Multi-sensor kit with portable sensor box and smart sensor app	STEVAL-MKSBOX1V1
BLE sensor application for Android and iOS	STBLESensor
Applications	Sensing Wearable

Description

FP-AI-CTXAWARE1 is an STM32Cube function pack featuring examples that let you connect your context awareness node to a smartphone via BLE and use a suitable Android™ or iOS™ application, like the STBLESensor app, to configure the device.

The package enables advanced applications such as human activity recognition (HAR) or acoustic scene classification (ASC), on the basis of outputs generated by the LSM6DSOX machine learning core (MLC) for HAR and the neural networks (NN) for ASC running on the STM32L4R9ZIJ6 MCU. The machine learning for HAR is a decision tree logic algorithm generated by Unico-GUI. The NN are implemented by a multi-network library supporting both floating and fixed point arithmetic, generated by the X-CUBE-AI extension for STM32CubeMX tool. The NN provided in this package are just examples of what can be achieved by combining the output of X-CUBE-AI with connectivity and sensing components from ST.

This package, together with the suggested combination of STM32 and ST sensors, can be used to develop specific wearable AI applications, where ultra-low power consumption is a key requirement, thanks to distributed deep edge AI approach.

The software runs on the STM32 microcontroller and includes all the necessary drivers for the STEVAL-MKSBOX1V1 evaluation board.

1 Detailed description

1.1 What can you do with STM32Cube function packs?

STM32Cube function packs leverage the modularity and interoperability of STM32 Nucleo and X-NUCLEO boards together with STM32Cube and X-CUBE software to create function examples for some of the most common use cases of different application technologies.

These software function packs are designed to exploit the underlying STM32 ODE hardware and software components as much as possible to best satisfy the requirements of final user applications.

Moreover, function packs may include additional libraries and frameworks that are not present in the original X-CUBE packages, thus enabling new functionalities allowing real and usable system for developers.

1.2 What is STM32Cube?

STM32Cube is a combination of a full set of PC software tools and embedded software blocks running on STM32 microcontrollers and microprocessors:

- STM32CubeMX configuration tool for any STM32 device; it generates initialization C code for Cortex-M cores and the Linux device tree source for Cortex-A cores
- STM32CubeIDE integrated development environment based on open-source solutions like Eclipse or the GNU C/C++ toolchain, including compilation reporting features and advanced debug features
- STM32CubeProgrammer programming tool that provides an easy-to-use and efficient environment for reading, writing and verifying devices and external memories via a wide variety of available communication media (JTAG, SWD, UART, USB DFU, I2C, SPI, CAN, etc.)
- STM32CubeMonitor family of tools (STM32CubeMonRF, STM32CubeMonUCPD, STM32CubeMonPwr) to help developers customize their applications in real-time
- STM32Cube MCU and MPU packages specific to each STM32 series with drivers (HAL, low-layer, etc.), middleware, and lots of example code used in a wide variety of real-world use cases
- STM32Cube expansion packages for application-oriented solutions

1.3 How does this function pack complement STM32Cube?

This software is based on the STM32CubeHAL. It extends STM32Cube by providing a board support package (BSP) for the BLE, sensor and microphone expansion boards and middleware components for communication with other BLE devices.

The package contains several libraries implementing various neural network models.

It also provides an AI data logging and annotation utility and some sample applications to demonstrate, on a smartphone using the STBLESensor app, the use cases related to human activity recognition and acoustic scene classification.

Revision history

Table 1. **Document revision history**

Date	Revision	Changes
06-May-2021	1	Initial release.