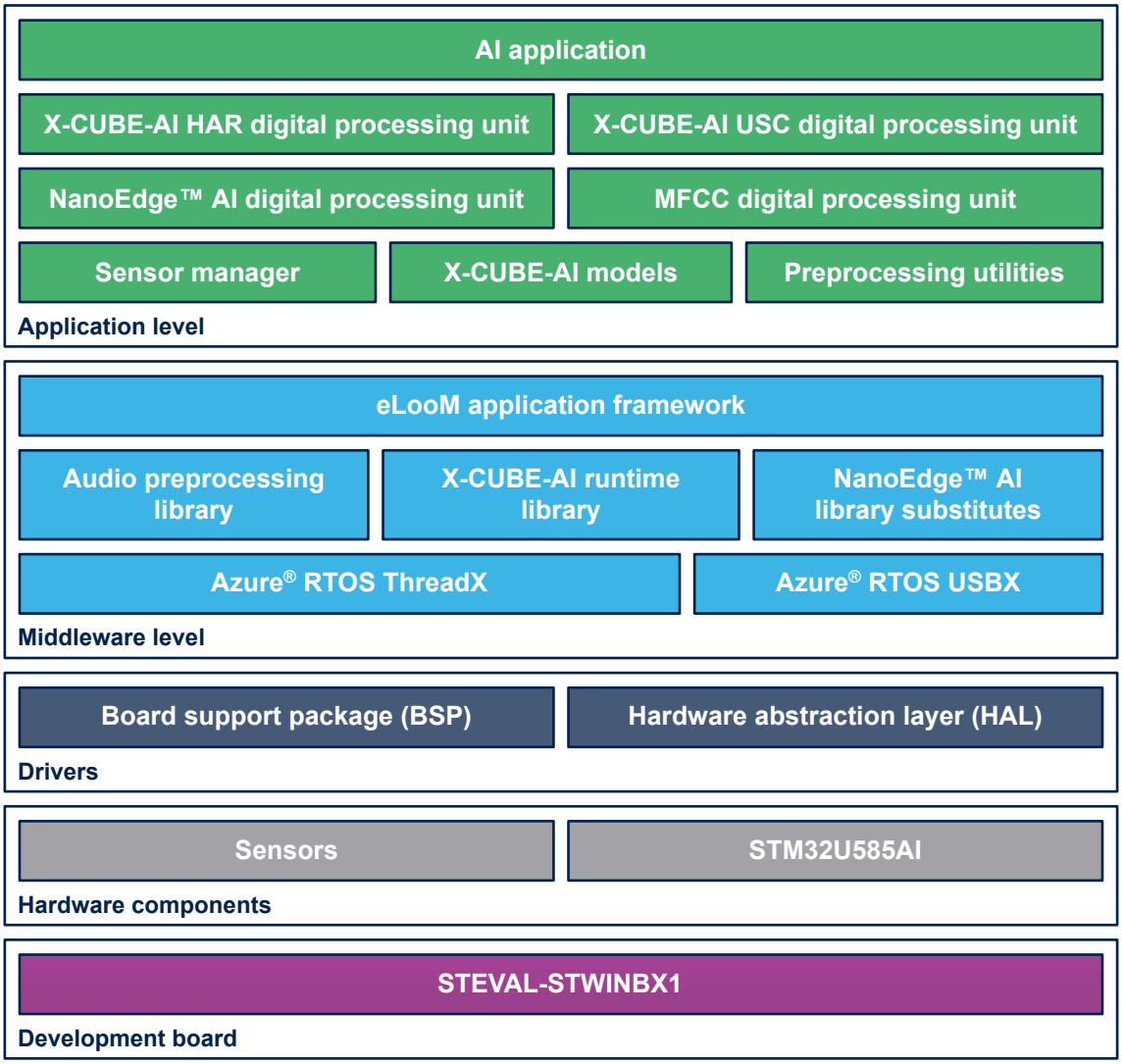
FP-AI-MONITOR2

Data brief

Multi-sensor AI data monitoring framework on wireless industrial node, function pack for STM32Cube



DT71064V1

Product status link
FP-AI-MONITOR2

Features

- Application example of combined anomaly detection based on vibration and anomaly classification based on ultrasound
- Application example of human activity classification based on motion sensors
- Complete firmware to program an STM32U5 sensor node for an AI-based sensor monitoring application on the STEVAL-STWINBX1 SensorTile wireless industrial node
- Runs classical machine learning (ML) and artificial neural network (ANN) models generated by the X-CUBE-AI, an STM32Cube Expansion Package
- Runs machine learning (ML) libraries generated by NanoEdge™ AI Studio (NanoEdgeAIStudio) for AI-based sensing applications. Easy integration by replacing the preintegrated substitute
- Application binary of high-speed datalogger for STEVAL-STWINBX1 data record from any combination of sensors and microphones configured up to the maximum sampling rate on a microSD™ card
- eLooM (embedded Light object-oriented fraMework) enabling efficient development of soft real-time, multitasking, event-driven embedded applications on STM32U5 Series microcontrollers
- Sensor manager eLooM component to configure any board sensors easily, and suitable for production applications
- Digital processing unit (DPU) eLooM component providing a set of processing blocks, which can be chained together, to apply mathematical transformations to the sensors data
- Configurable autonomous mode controlled by user button
- Interactive command-line interface (CLI):
  - Node and sensor configuration
  - Configuration of applications running either an X-CUBE-AI ML or ANN model, or a NanoEdge™ AI Studio (NanoEdgeAIStudio) model with learn-and-detect capability
  - Configuration of applications running concurrently an X-CUBE-AI ANN model, and a NanoEdge™ AI Studio model with learn-and-detect capability
  - Configuration of applications running a NanoEdge™ AI Studio model with classification capability
- Easy portability across STM32 microcontrollers by means of the STM32Cube ecosystem
- Free and user-friendly license terms

Description

The FP-AI-MONITOR2 function pack helps to jump-start the edge AI implementation and development for sensor-monitoring-based applications powered by X-CUBE-AI or NanoEdge™ AI Studio . It covers the entire design of the machine learning development workflow from the data set acquisition to the integration on a physical node. The examples provided allow the user to create, in a matter of minutes, a proof of concept for a predictive maintenance solution with anomaly detection and classification based on both vibration and ultrasound, but also on activity recognition. These examples can be fine-tuned to fit the user's dedicated use cases by retraining the models with the user's data set.

X-CUBE-AI extends the STM32CubeMX capabilities with the automatic conversion of pretrained a neural network and the integration of the generated optimized library into the user's project. The support vector classifier used for human activity recognition (HAR) example is generated by X-CUBE-AI.

NanoEdge™ AI Studio (NanoEdgeAIStudio) automates the creation of autonomous machine learning libraries with the possibility of running training and inference directly on the target. For instance, condition-based monitoring applications using vibration and motion data can be created easily by recompiling the function pack with NanoEdge™ AI anomaly detection libraries.

FP-AI-MONITOR2 runs the learning session and the inference in real time on the STM32U585AI ultra-low-power microcontroller of the STEVAL-STWINBX1 SensorTile wireless industrial node, taking physical sensor data as input.

FP-AI-MONITOR2 implements a wired interactive CLI to configure the node, and manage the learn and detect phases. For simple operation in the field, a standalone battery-operated mode allows basic controls through the user button, without using the console.

1 General information

The FP-AI-MONITOR2 function pack runs on the STM32U5 microcontrollers based on the Arm® Cortex®-M33 processor.

Note: Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

1.1 Ordering information

FP-AI-MONITOR2 is available to download from the *www.st.com* website as described in Table 1. Retrieve more information on STM32CubeMX, X-CUBE-AI, and NanoEdge™ AI Studio (NanoEdgeAIStudio) on *www.st.com*.

Table 1. FP-AI-MONITOR2 ordering information

Order code	Target board	Target STM32	Detailed information
FP-AI-MONITOR2	STEVAL-STWINBX1	STM32U585AI	• Getting started (wiki) • User manual (wiki)

1.2 What is STM32Cube?

STM32Cube is an STMicroelectronics original initiative to improve designer productivity significantly by reducing development effort, time, and cost. STM32Cube covers the whole STM32 portfolio.

STM32Cube includes:

- A set of user-friendly software development tools to cover project development from conception to realization, among which are:
  - STM32CubeMX, a graphical software configuration tool that allows the automatic generation of C initialization code using graphical wizards
  - STM32CubeIDE, an all-in-one development tool with peripheral configuration, code generation, code compilation, and debug features
  - STM32CubeCLT, an all-in-one command-line development toolset with code compilation, board programming, and debug features
  - STM32CubeProgrammer (STM32CubeProg), a programming tool available in graphical and command-line versions
  - STM32CubeMonitor (STM32CubeMonitor, STM32CubeMonPwr, STM32CubeMonRF, STM32CubeMonUCPD), powerful monitoring tools to fine-tune the behavior and performance of STM32 applications in real time
- STM32Cube MCU and MPU Packages, comprehensive embedded-software platforms specific to each microcontroller and microprocessor series (such as STM32CubeU5 for the STM32U5 Series), which include:
  - STM32Cube hardware abstraction layer (HAL), ensuring maximized portability across the STM32 portfolio
  - STM32Cube low-layer APIs, ensuring the best performance and footprints with a high degree of user control over hardware
  - A consistent set of middleware components such as ThreadX, FileX / LevelX, NetX Duo, USBX, USB-PD, touch library, network library, mbed-crypto, TFM, and OpenBL
  - All embedded software utilities with full sets of peripheral and applicative examples
- STM32Cube Expansion Packages, which contain embedded software components that complement the functionalities of the STM32Cube MCU and MPU Packages with:
  - Middleware extensions and applicative layers
  - Examples running on some specific STMicroelectronics development boards

2 License

FP-AI-MONITOR2 is delivered under the SLA0048 software license agreement and its Additional License Terms.

Revision history

Table 2. **Document revision history**

Date	Revision	Changes
1-Feb-2023	1	Initial release.

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