FP-AI-PREDMNT2
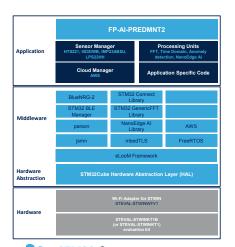
STM32Cube function pack for STEVAL-STWINKT1B evaluation kit plus STEVAL-STWINWFV1 Wi-Fi adapter board for predictive maintenance application based on artificial intelligence (AI)

Features

- Complete firmware to develop a sensor node for predictive maintenance applications, featuring analog microphone, environmental and motion sensors, and performing real-time monitoring of parameters and equipment status via Wi-Fi connectivity
- Compatible with NanoEdge™ AI Studio solution, to enable AI-based solution
- Generic FFT library middleware to enable frequency domain analysis for any kind of sensor through Fast Fourier Transform (with programmable size, overlapping and windowing)
- Motion TD library middleware for vibration analysis in time domain (speed RMS and acceleration peak)
- Configurable alarm and warning thresholds for key parameters
- Compatible with STBLESensor application for Android/iOS, to perform Wi-Fi configuration and secure certificate provisioning
- Compatible with DSH-PREDMNT web-based predictive maintenance dashboard for monitoring sensor data and device status
- Easy portability across different MCU families, thanks to STM32Cube
- Firmware modular example based on eLooM (embedded Light object-oriented fraMework for STM32) to enable code re-usability at application level
- Free, user-friendly license terms

Description

FP-AI-PREDMNT2 is an STM32Cube function pack that programs the STWIN as an IoT Edge node, connected to the cloud, able to acquire sensor data, process them and send the results to the DSH-PREDMNT cloud dashboard. It includes dedicated algorithms for advanced time and frequency domain signal processing and analysis of 3D digital accelerometers with flat bandwidth up to 6 kHz.

The function pack helps to jump-start the implementation and development of condition monitoring applications designed with the NanoEdge™ AI Studio solution, thus easily enabling an AI-based predictive maintenance solution (the NanoEdge™ AI library generation is out of the scope of this function pack and must be generated using NanoEdge™ AI Studio).

The package includes pressure, relative humidity and temperature sensor monitoring, as well as audio algorithms to check acoustic emission (AE), up to 20 kHz, and ultrasound emission analysis up to 80 kHz.

Using the STBLESensor app you can set up Wi-Fi credentials and exchange cloud certificates to enable the connection to the dedicated DSH-PREDMNT web-based dashboard. The dashboard allows monitoring and logging the algorithm output, sensor data and equipment status.

The FP-AI-PREDMNT2, together with the suggested combination of STM32 and ST devices, can be used to develop specific industrial predictive maintenance applications for early detection of warning signs of potential failure.

The software runs on the STM32 microcontroller and includes all the necessary drivers for the STEVAL-STWINKT1B evaluation kit.

Product summary	
STM32Cube function pack for STEVAL-STWINKT1B evaluation kit plus STEVAL-STWINWFV1 Wi-Fi adapter board for predictive maintenance application based on artificial intelligence (AI)	FP-AI-PREDMNT2
STWIN SensorTile Wireless Industrial Node development kit and reference design for industrial IoT applications	STEVAL-STWINKT1B
Wi-Fi adapter board for STWIN	STEVAL-STWINWFV1
Cloud based web application for condition monitoring and predictive maintenance	DSH-PREDMNT

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Product summary	
BLE sensor application for Android and iOS	STBLESensor
Applications	Condition Monitoring/ Predictive Maintenance

FP-AI-PREDMNT2 firmware is based on application-level modules (Sensor Manager, Digital Processing Units, etc.) that you can reuse and easily extend to build a customized application.

These application modules adopt state-of-the-art design patterns and natively support low-power modes. To enable this solution, the function pack has been built on top of eLooM, an embedded Light object-oriented fraMework for STM32 applications specifically designed for embedded low-power applications powered by STM32.

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 support for the STEVAL-STWINKT1B evaluation kit to develop specific industrial predictive maintenance applications for early detection of warning signs of potential failure.

The package contains two reusable software modules at application level: Sensor Manager and Digital Processing Units (DPU).

The Sensor Manager firmware module retrieves sensor data and sets the sensor parameters. It is implemented as an acquisition engine that:

- orchestrates multiple task accesses to sensor bus;
- defines interfaces to avoid implementation dependencies;
- dispatches events to notify when a certain amount of data is available;

DPU firmware module provides a set of processing blocks, which can be chained together, to apply mathematical transformations to the sensor data.

Available processing modules include:

- FFT
- time domain inertial analysis
- anomaly detection
- NanoEdge AI

Further details are available in the "Documentation" folder of the function pack and in the "Doc" folder of each firmware module.

Revision history

Table 1. Document revision history

Date	Revision	Changes
21-Sep-2021	1	Initial release.
27-Jun-2022	2	Updated cover page image, features, and description.

IMPORTANT NOTICE – READ CAREFULLY