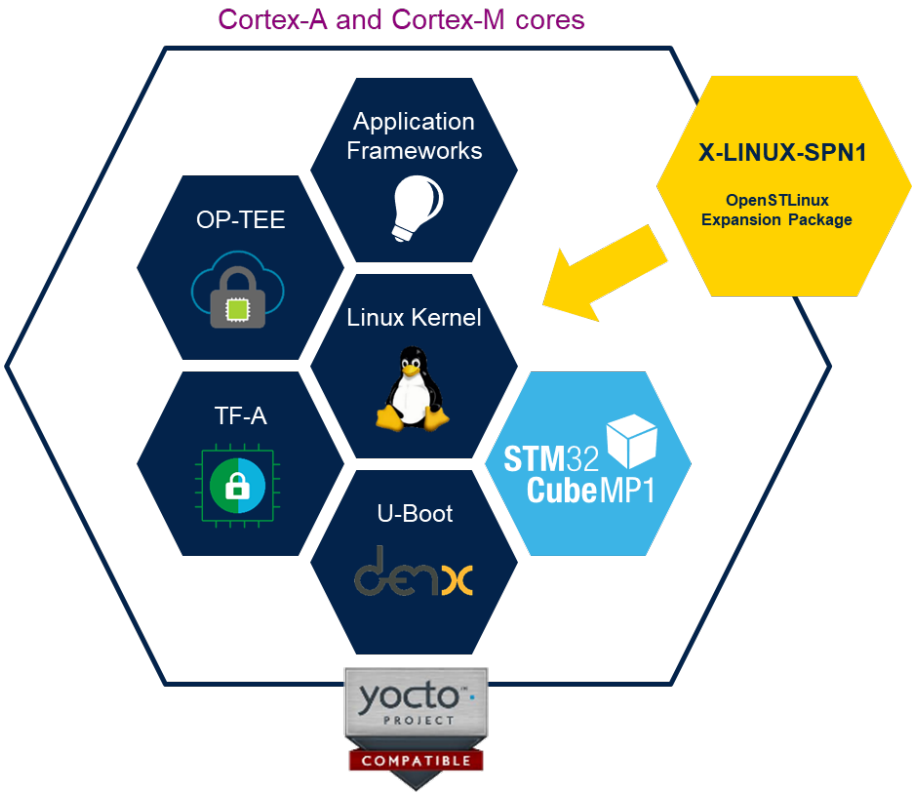
Getting started with X-LINUX-SPN1 software

Introduction

X-LINUX-SPN1 is an OpenSTLinux based software package to demonstrate STSPIN family devices on the STM32MP microprocessor platform. It provides Linux software (drivers, APIs, and applications) to target the expansion boards based on STSPIN family motor drivers. The software can be used as a starting point for developing more complex motor control applications. The included application and drivers run on the Cortex-A core(s) of the MPU.

Figure 1. X-LINUX-SPN1 Package



1 Description

1.1 X-LINUX-SPN1 software features

The X-LINUX-SPN1 expansion software provides drivers and user space applications running on the STM32MP platform to control multiple channels of a motor controller.

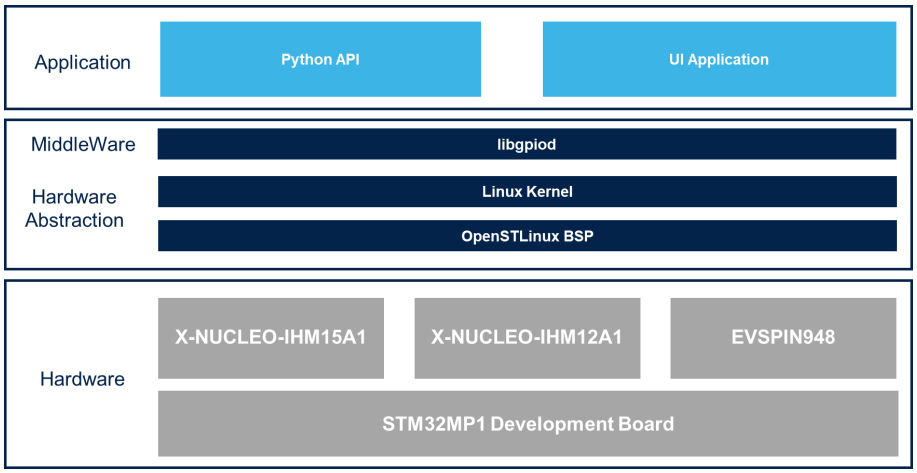
The X-LINUX-SPN1 software package is made up of the following components:

1. Python APIs
2. GTK-based UI application

1.2 X-LINUX-SPN1 architecture

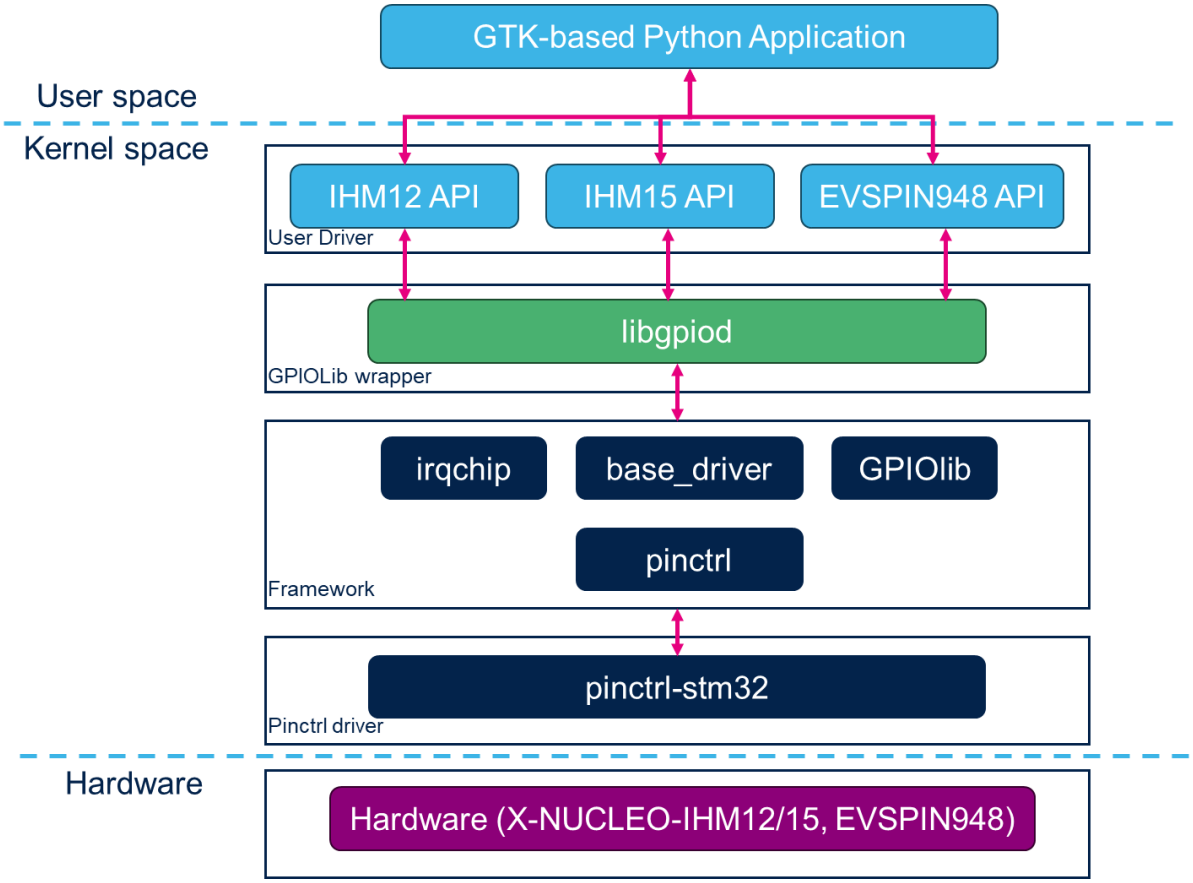
The software uses `libgpiod` to control the motor drivers via GPIOs.

Figure 2. System components



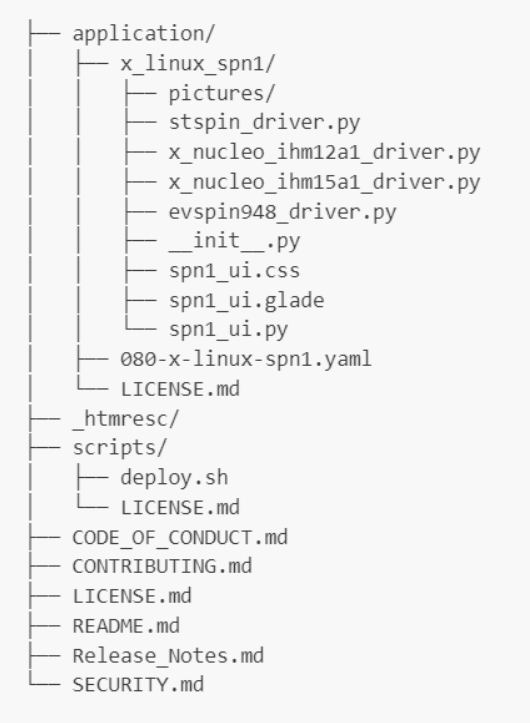
The provided GTK application is built on top of the Python APIs and provides a ready-to-use interface. Application developers can, however, write their own applications using the Python APIs provided with this package.

Figure 3. X-LINUX-SPN1 architecture



1.3 X-LINUX-SPN1 package structure

Figure 4. X-LINUX-SPN1 Folder Structure



The contents of the package are described below.

- "application":
  - "x_linux_spn1": This folder contains sources for the API and UI App
    - "pictures": All the picture and icon resources required by the UI App are present in this folder.
    - stspin_driver.py: Base class for the motor driver.
    - x_nucleo_ihm12a1_driver.py, x_nucleo_ihm15a1_driver.py, evspin948_driver.py: Implement the API used to control the respective motor drivers.
    - "spn1_ui.py": Contains GTK-based UI application source code.
    - "spn1_ui.glade": This file is generated by "Glade" tool and contains widgets configuration used in UI App.
    - "spn1_ui.css": Contains visual styles used by the widgets in UI App.
  - "080-x-linux-spn1.yaml": This file adds a menu entry to the default demo application that comes with the STM32MP1 evaluation/discovery boards
  - "deploy.sh": This is the deployment script used to deploy files from the host computer to the MPU board. It copies the files to the correct location in the MPU filesystem, such that the demo launcher recognizes and loads the new application at startup.

2 Hardware setup

The current package provides software support for the following boards

- X-NUCLEO-IHM15A1 board based on the STSPIN840 driver. The STSPIN840 is an affordable and easy-to-use solution for the implementation of compact motor driving applications such as thermal printers, robotics, and toys. It also supports parallel operation, where it acts as a single brush DC driver with double the current capability. The current limiters and complete set of protection features make it suitable for reliable applications.
- X-NUCLEO-IHM12A1 board based on the STSPIN240 driver. The STSPIN240 can control two brushed DC motors at the same time. It comes in a very small 4x4 QFN package and a low resistance power stage. It can also work in parallel mode as a single full-bridge driver with higher current capability. It has two PWM current controllers that can be set by the user. It has a low power mode and several protections for the power stage. It is suitable for demanding industrial applications.
- EVSPIN948 board is based on STSPIN948. STSPIN948 is a 4.5A dual full-bridge driver for brushed DC motors or bipolar stepper motors. The power stage is designed with high dynamic performance, allowing to achieve high frequency PWM control with precise duty-cycle. Each full-bridge is totally independent with a current limiter with adjustable threshold and OFF-time with slow or mixed decay selection. Two amplifiers with fixed amplification factor are available for current sensing (using an external shunt resistor). The adjustable slew-rate guarantees the best trade-off between performances and EMI. Versatile power stage offers several ways of operation for a high level of flexibility. The device offers a complete set of protection features including overcurrent, overtemperature, and low bus voltage detection.

Subsequent versions of the package will add support for more motor drivers.

Figure 5. X-NUCLEO-IHM15A1

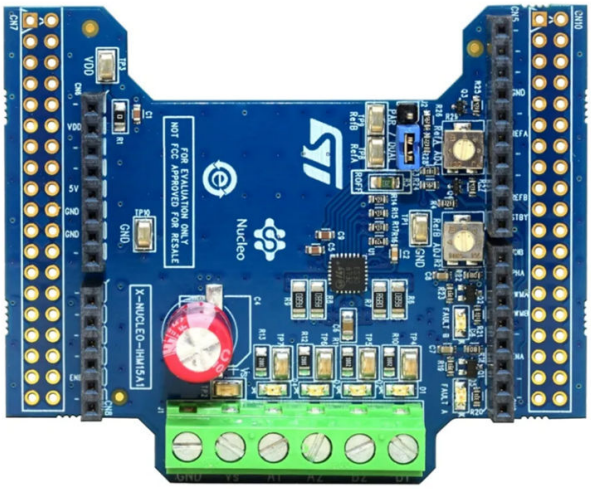


Figure 6. **X-NUCLEO-IHM12A1**

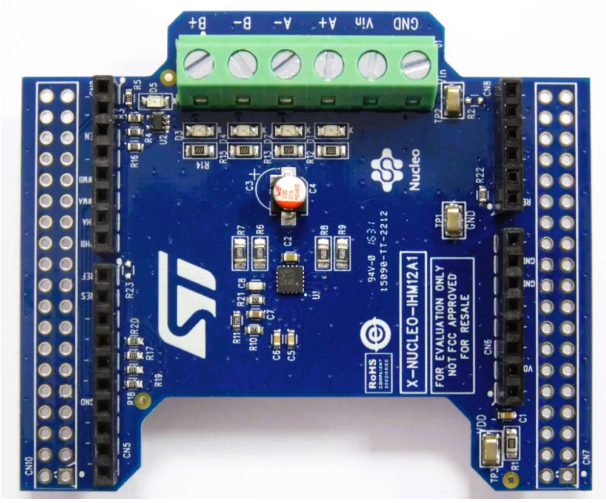
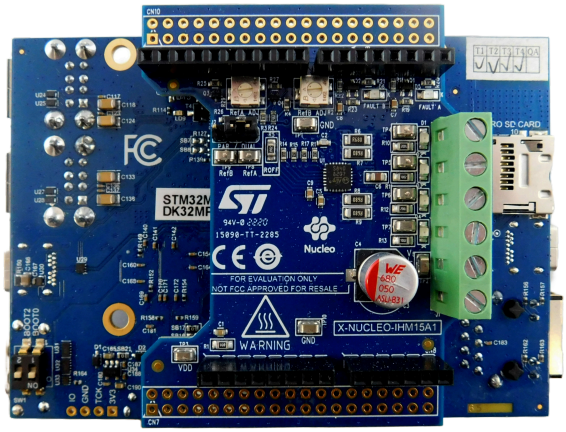


Figure 7. **EVSPIN948 Board**

The board plugs into the Arduino connectors available on the back of STM32MP157F-DK2 discovery boards, as shown below.

Figure 8. **X-NUCLEO-IHM15A1 mounted on STM32MP157F-DK2**



3 Software setup

The section describes the software setup that is required for building, flashing, deploying, and running the application.

3.1 Recommended PC prerequisites

A Linux® PC running under Ubuntu® 20.04 or 22.04 must be used. The developer can follow the below link.
https://wiki.st.com/stm32mpu/wiki/PC_prerequisites

Follow the instructions on the ST wiki page Image flashing to prepare a bootable SD card with the starter package. Alternatively, a Windows/Mac computer can also be used, in which case, the following tools will be useful:

- STM32CubeProgrammer to flash the OpenSTLinux started package image onto the SD card
- TeraTerm or PuTTY to access the console interface via USB
- winscp to copy the application to the MPU board

The following conventions are used when referring to the code instructions.

```
#Comments: Comment describing steps
PC>$ : Development or Host PC/machine command prompt. Text after $ is a command
Board>$ : STM32MP1 command prompt. Text after $ is a command
```

3.2 STMPU Software prerequisites

Python package "gpiod" is a prerequisite for the X-LINUX-SPN1 software and must be installed onto the STM32MP1 board.

```
#Install gpiod
Board>$ apt-get install python3-gpiod
```

3.3 Deploying the files to the MPU board

It is required to transfer the built binaries, Python scripts, and application resources to the STM32MP board from the development PC.

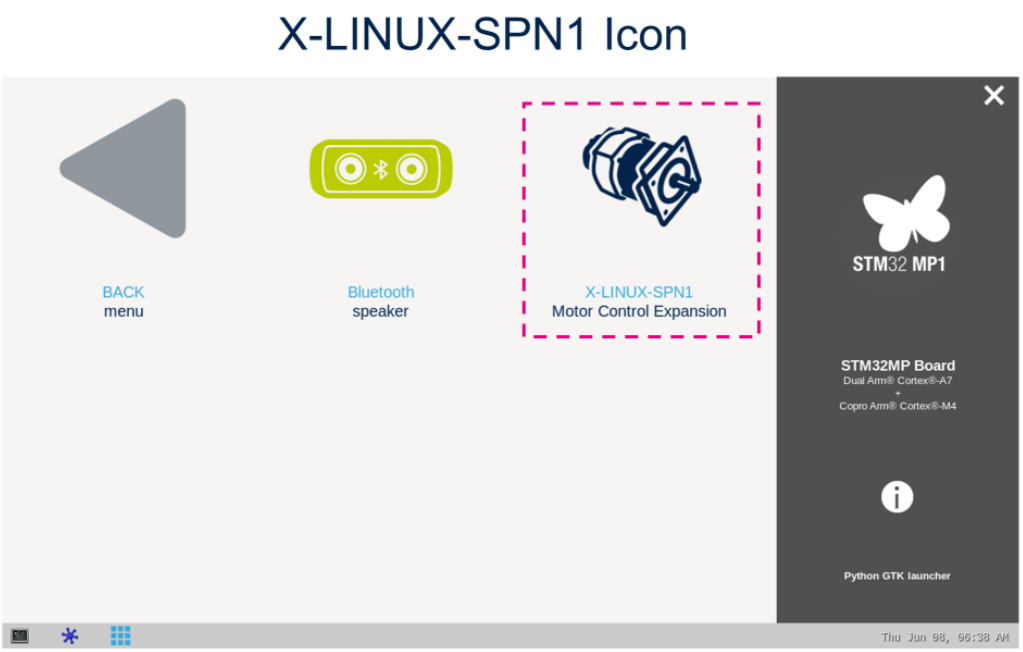
The resources can be transferred via any of the following methods:

- Using a network connection
  - Refer to How to Transfer a File Over a Network to connect the MPU board to a network, you may connect it to a wired network via the Ethernet jack on the MPU board
  - Alternatively, to connect to a WLAN, refer to How to Setup a WLAN Connection
- Using a serial protocol (like zmodem from Teraterm or kermit)
  - For Linux hosts, refer to How to transfer a file over a serial console
  - For Windows hosts, refer to How to transfer files to Discovery kit using Tera Term

To evaluate the X-LINUX-SPN1 package quickly, developers may copy the contents of the "application" folder contained in the package to /usr/local/demo/application folder on the STM32MP board using any of the above methods. To facilitate this task, the deployment script in the "application" folder of X-LINUX-SPN1 package may be used (only if using a network connection).

After the files have been copied to the MPU board, reboot the board. After reboot, the demo menu will have an option added for X-LINUX-SPN1

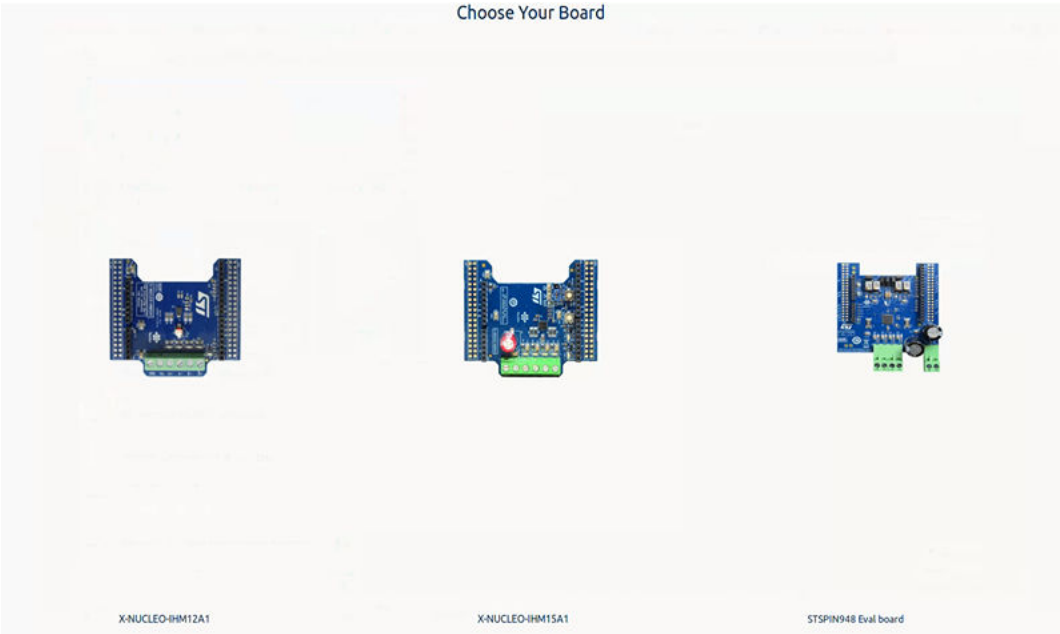
Figure 9. **X-LINUX-SPN1 menu icon**



3.4 Using the GTK Application

On opening the application, the user is presented with the option to select the motor driver board to be used. The interface is depicted below.

Figure 10. **Board selection**



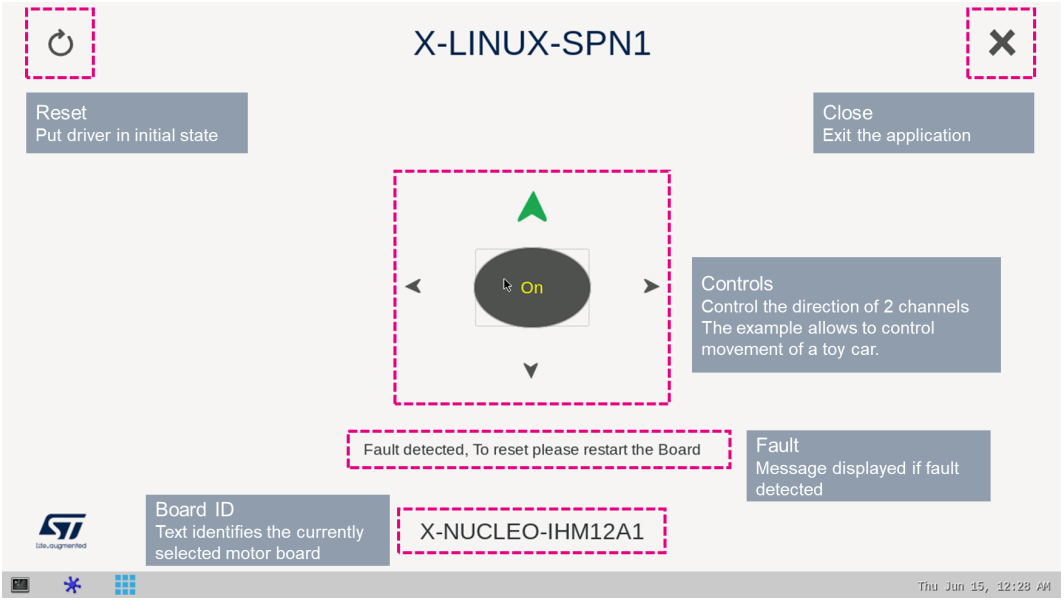
4 Using the GTK application

The application interface contains a start/stop button and four direction buttons. The application is designed for two channels that control the left and right side motors:

- On tapping the On/Off button, both motors start moving in the forward direction
- On clicking the back button, both motors start moving in the reverse direction
- On tapping the left and right buttons, both motors move in opposite directions to turn left or right as per the user action.

The interface is depicted below.

Figure 11. Application interface



Revision history

Table 1. **Document revision history**

Date	Version	Changes
04-Dec-2023	1	Initial release.
01-Aug-2024	2	Updated Figure 2. System components, Figure 3. X-LINUX-SPN1 architecture, Section 1.3 X-LINUX-SPN1 package structure, Section 3.2 STMPU Software prerequisites, Section 2 Hardware setup and Figure 10. Board selection.

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