



STMicroelectronics SensorTile Tutorial: Introduction to STMicroelectronics Development Environment and DataLog Project Example for Apple Mac Platforms



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1. Introduction

The SensorTile is a new Internet of Things (IoT) system provided by STMicroelectronics integrating state-of-the-art processor, wireless interfaces, and sensor systems. The SensorTile can form the foundation for wearable consumer devices, wearable medical devices, residential IoT systems and vehicle IoT systems.

The SensorTile system provides an exceptionally powerful and well-supported platform for introduction to IoT technology. The SensorTile is remarkably compact as shown in Figure 1.

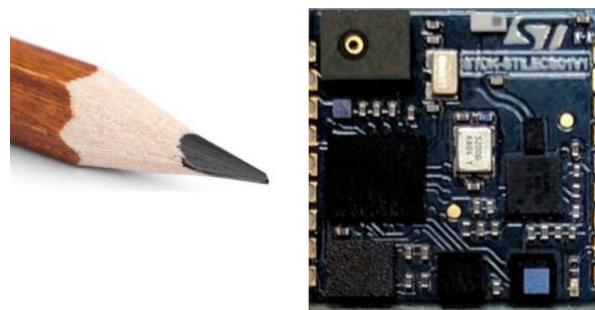


Figure 1. The STMicroelectronics SensorTile Platform with a pencil reference indicating its compact geometry.

The SensorTile includes these components:

- 1) The SensorTile Processor System is an STM32L4 microprocessor based on the ARM Cortex M4 system. This provides introduction to the ARM processor architecture that is deployed on nearly every smartphone on earth.
- 2) The SensorTile Sensors includes:
 - a) The LSM6DSM combining microaccelerometer and microgyroscope.
 - b) The LSM303AGR combining microaccelerometer and magnetometer for compass heading
 - c) The LPS22HB barometric pressure sensor for determination of altitude and atmospheric pressure.
 - d) The MP34DT04 microphone
- 3) The SensorTile also includes a Bluetooth Low Energy (Bluetooth Smart) wireless interface the BlueNRG-MS system.
- 4) The SensorTile also includes non-volatile flash storage that stores the executable code that enables IoT system operation.
- 5) The SensorTile also includes a cradle accessory with additional features including:
 - a) SD Card Flash Storage System
 - b) STC3115 Battery Monitor providing detailed energy monitoring for the SensorTile
 - c) HTS221 Humidity and Temperature environmental sensors



2. Introduction to This Tutorial

This Tutorial introduces the development environment for the SensorTile system.

Development environments are essential to development of software for IoT systems and other products. These provide support to developers for both creation of systems, testing, debugging, and installation of software systems on platforms.

This development environment is referred to as an Integrated Development Environment (IDE). This includes all of the software tools required to create a software distribution for the SensorTile, compile this software system into the processor instruction set using a Build capability, execute this system using a Debug capability, and also create an “image” file that can be installed in the SensorTile non-volatile storage.

This tutorial is intended for users that have Apple Mac platforms, and will guide users through the tasks listed below. Please note that there is a companion Tutorial for users that have personal computers with the Windows operating system.

The Tutorial steps include:

1. Installing an Integrated Development Environment (IDE) on Mac.
2. Obtaining reference design example project software. This will specifically include a sensor Data Logging system.
3. Usage of the IDE to Import, Build, Run, Debug and Flash the SensorTile board to run the example Data Logging project.

For more information regarding the SensorTile board, please open the following link on a web-browser on your Mac.

www.st.com/sensortile

2.1. List of Required Equipment and Materials

- 1) 1x STMicroelectronics SensorTile kit.
- 2) 1x STMicroelectronics Nucleo Board.
- 3) 1x Mac with two USB type-A inputs OR you must have a powered USB hub.
- 4) 1x USB 2.0 A-Male to Micro-B Cable (micro USB cable).
- 5) 1x USB 2.0 A-Male to Mini-B Cable (mini USB cable).
- 6) Network access to the Internet.



3. Integrated Development Environment Installation

This portion of the document will guide users through the System WorkBench Integrated Development Environment (IDE) installation process.

3.1. Prerequisite Steps

1. Open the following link to register an account with the OpenSTM32 community.

<http://www.openstm32.org/tiki-register.php>

2. Update your Mac's operating system (OS) to OS X 10.10 Yosemite or a newer version.
3. Download and Install the latest version of Xcode from the App store. Open the following link on a web-browser on your Mac for more details.

<https://developer.apple.com/xcode/>

4. Accept the license agreement by opening the terminal utility and issuing the following command.

```
$ sudo xcodebuild -license
```

When prompted to enter your password, enter the password used to log into your user account on your Mac.

Press the **[Space]** key to scroll through the license.

Once you reach the end of the license, type **agree** followed by the **[Enter]** key.



3.2. Install System WorkBench (IDE)

1. Open the following link on a web-browser on your Mac to download the System Workbench Installer.

https://drive.google.com/open?id=1Tgtktoqpkq_5b71bX4CAHy1_hwkIde7T

2. Move the installer (*install_sw4stm32_macos_64bits-v2.2.run*) to Desktop.
3. Open your **Terminal** on Mac.
4. Navigate into Desktop directory.

```
$ cd Desktop
```

5. Change the permission of the installer file.

```
$ chmod 755 install_sw4stm32_macos_64bits-v2.2.run
```

6. Disable the gate keeper restriction on your Mac.

```
$ sudo spctl --master-disable
```

7. Install System WorkBench.

```
$ ./install_sw4stm32_macos_64bits-v2.2.run
```

Then, you should see the installation information in terminal like Figure 2.

```
[mbp-194:Desktop cliccuser$ ./install_sw4stm32_macos_64bits-v2.2.run
Checking integrity... (could take a while, -m to bypass)
Extracting JRE... done
Logging initialized at level 'INFO'
Commandline arguments:
Detected platform: mac_osx,version=10.12.6,arch=x86,symbolicName=null,javaVersion=1.8.0_131
```

Figure 2: System WorkBench Installation information in terminal.

8. Wait for a few seconds, you will see a GUI installation interface popup as Figure 3.

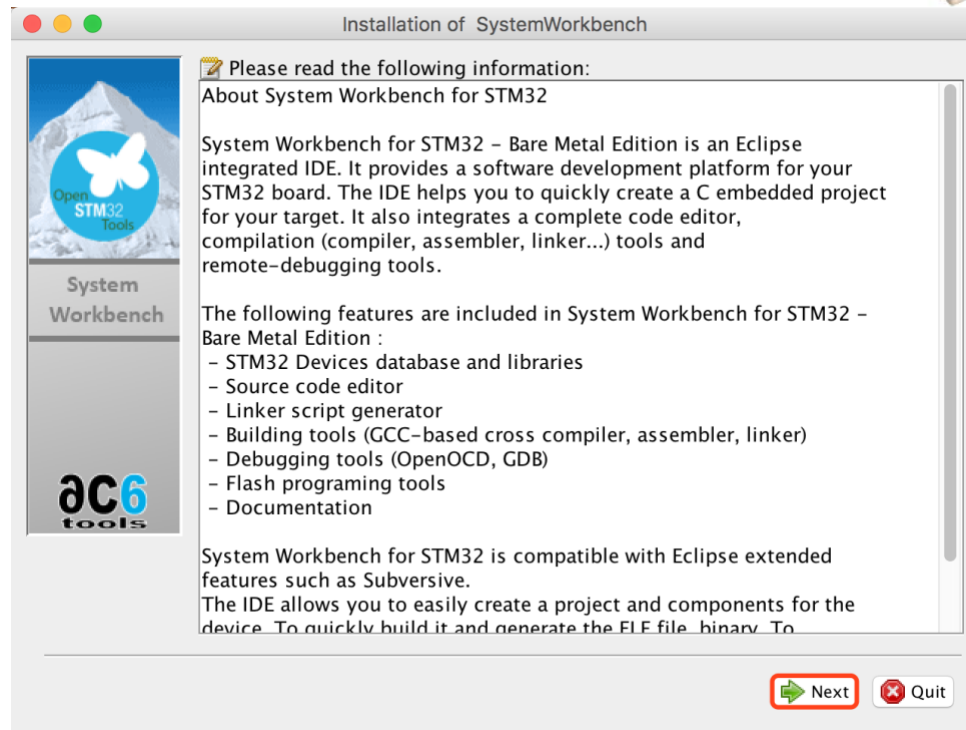


Figure 3: GUI installation interface of System WorkBench

9. Click on Next to continue. Accept all the license agreement and click next to continue as Figure 4.

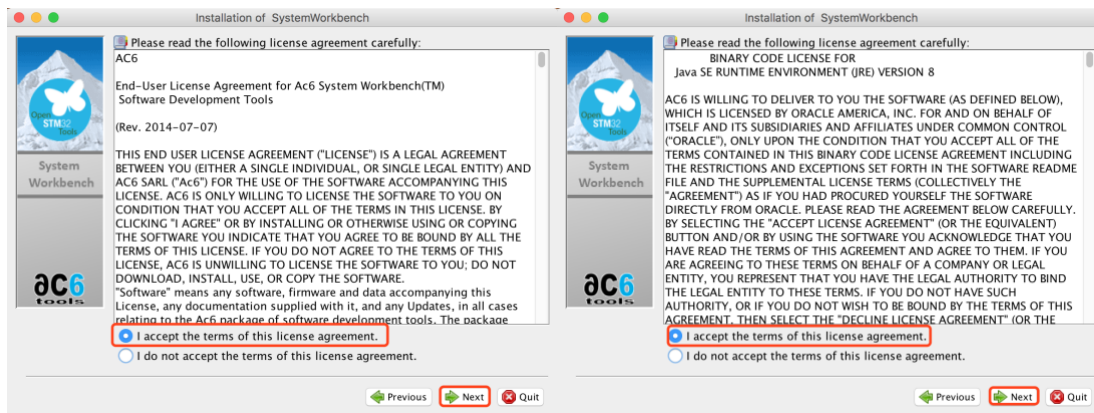


Figure 4: Agree the license agreement for System WorkBench.

10. Use its **default** installation directory and click next to continue. See Figure 5.

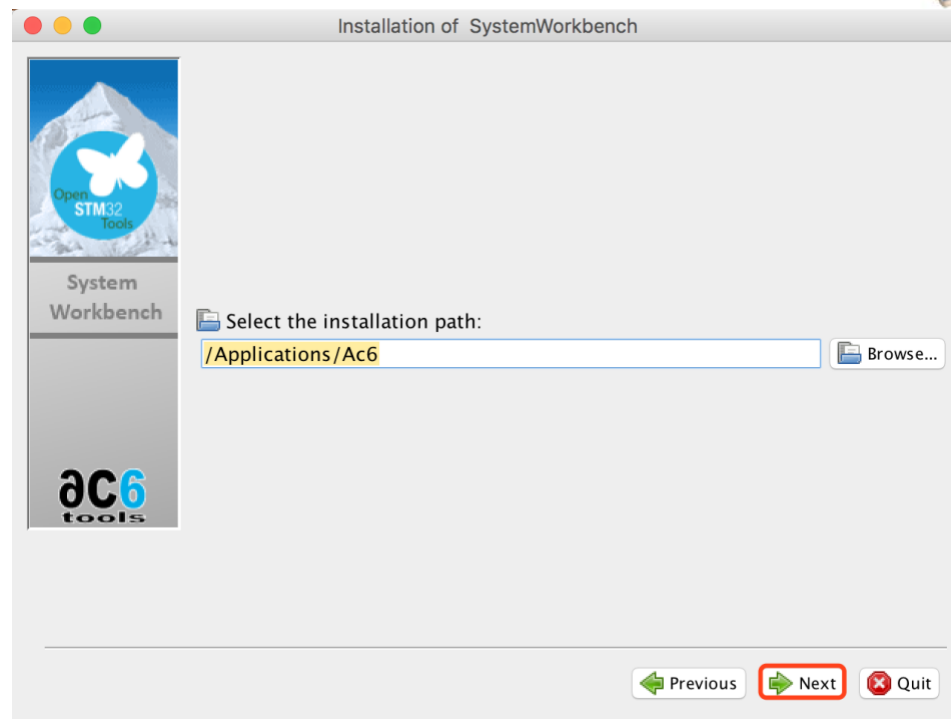


Figure 5: Use default installation directory

11. Click OK in the pop-up window. See Figure 6.

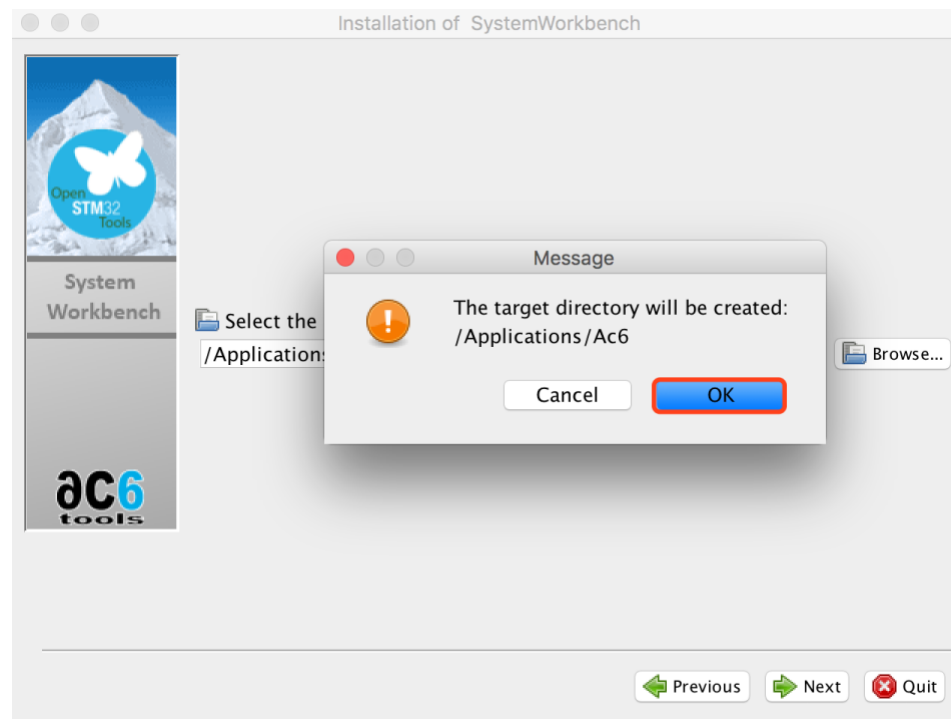


Figure 6: Create the installation directory



12. Make sure that all installation options have been checked and click next to continue. See Figure 7.

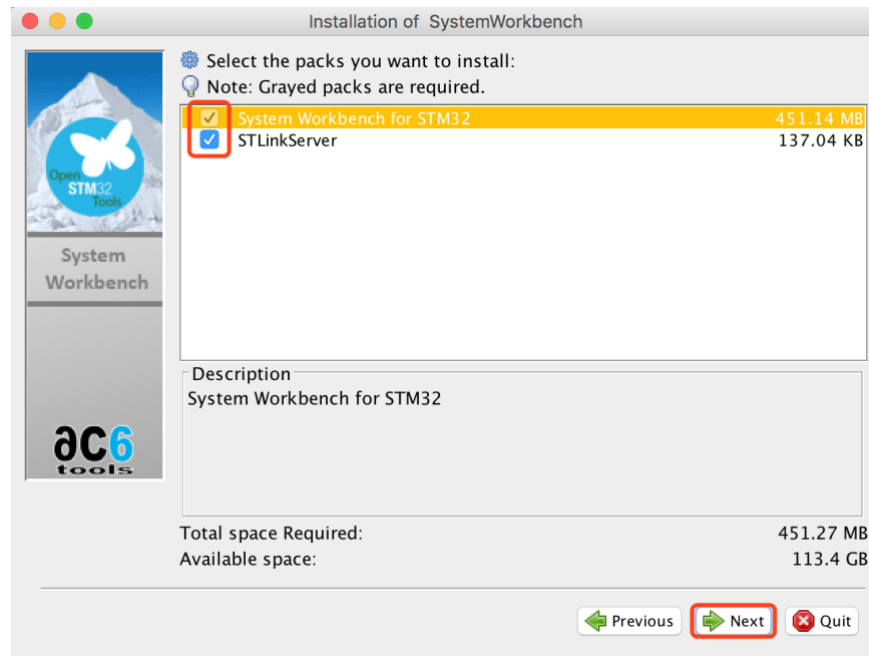


Figure 7: Install everything in the package

13. Wait until the installation has been finished. See Figure 8. **IF THE INSTALLATION IS STUCK at 2/2, CHECK YOUR TERMINAL AND ENTER YOUR MAC PASSWORD IF IT REQUIRES.**

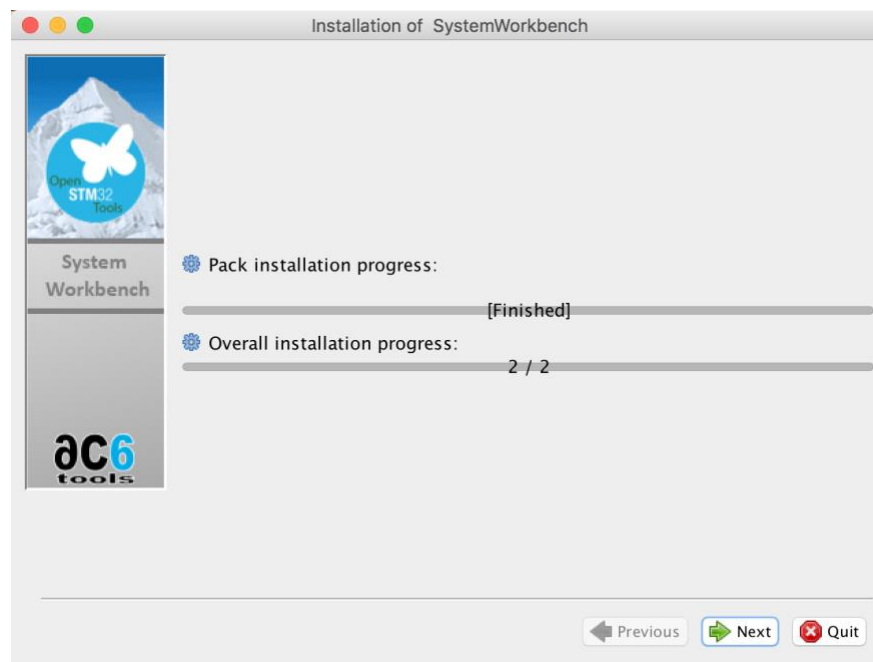


Figure 8: Installation has been finished



14. Open your *Finder* and find the *System WorkBench* according to Figure 9 (*Applications->Ac6 -> SystemWorkBench*).

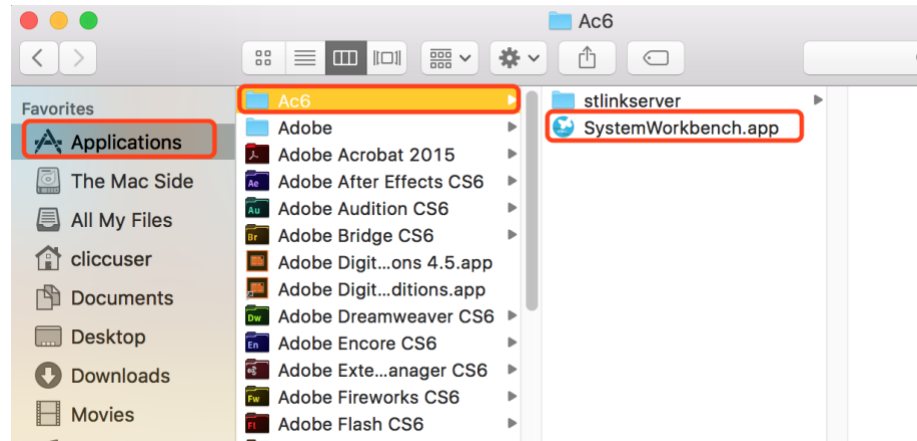


Figure 9: System WorkBench application location

15. Make sure your computer is connected to internet and double-click *SystemWorkbench.app*. Use the default workspace directory and wait for the final step of installation as Figure 10.

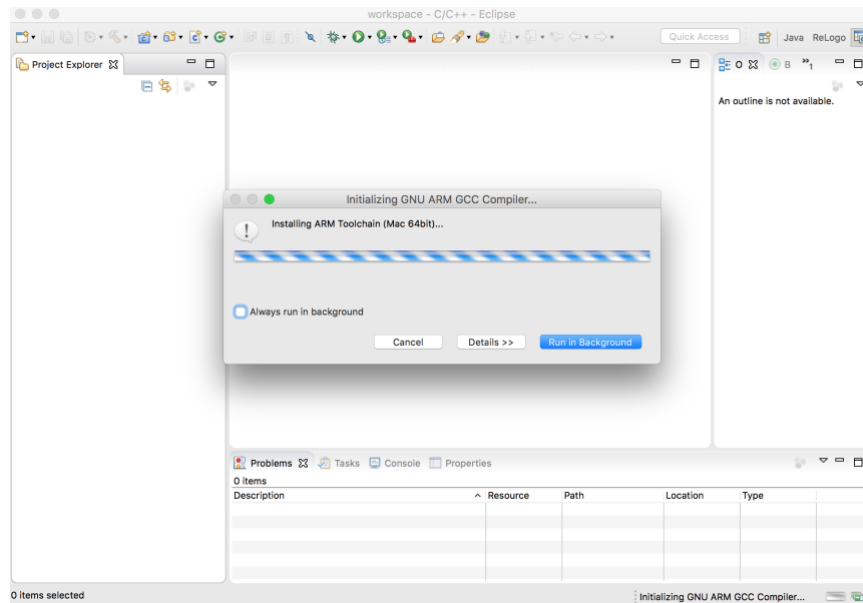


Figure 10: Last step of System Workbench (IDE) installation

16. After step 15, you System Workbench (IDE) is ready to go. System Workbench is an Eclipse with proper configuration and compiler tools.



4. ST-Link Utilities for STM32

This section will guide users through the process of downloading and installing a flash tool.

1. Open a terminal on your Mac. To do this, open spotlight search by clicking the magnifying glass in the top right-hand corner of your Mac toolbar (see Figure), and search for "Terminal". Double click the result highlighted in the red box in Figure .



Figure 11: Opening Spotlight search on Mac.

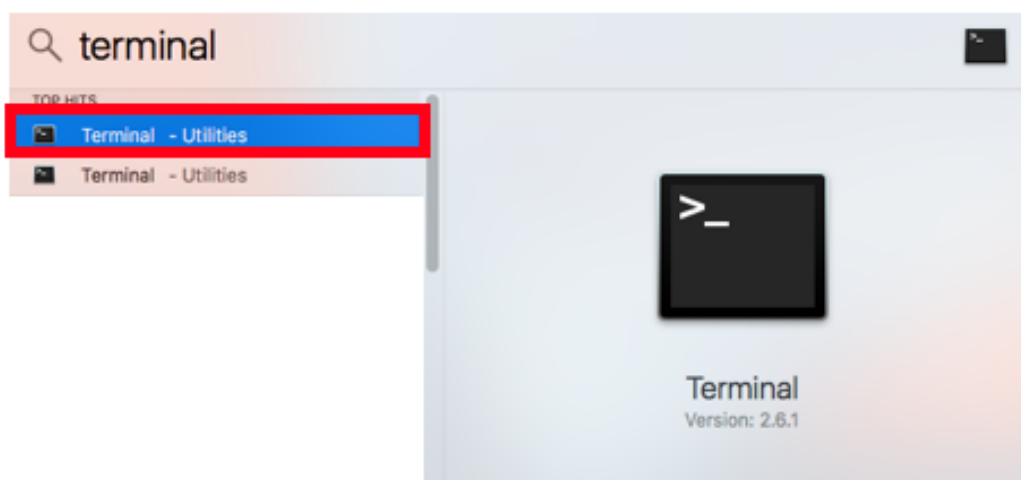


Figure 12: How to open the "Terminal" application on a Mac.

2. Follow the instructions online at <https://brew.sh/> to install Homebrew (a package manager). Alternatively, issue the command shown below in the terminal session from step 1. Follow the onscreen prompts.

```
$ /usr/bin/ruby -e "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/master/install)"
```

Note that the above command appears as one line.



```
wifi-131-179-27-42:~ the_prawns$ /usr/bin/ruby -e "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/master/install)"
==> This script will install:
/usr/local/bin/brew
/usr/local/share/doc/homebrew
/usr/local/share/man/man1/brew.1
/usr/local/share/zsh/site-functions/_brew
/usr/local/etc/bash_completion.d/brew
/usr/local/Homebrew
Press RETURN to continue or any other key to abort
```

Figure 13: Installing Homebrew.

3. Issue the following command in the terminal session from step 1.

\$ brew install stlink
4. To check for successful installation, type **st** into the terminal session from step 1 **without pressing [Enter]**.
5. While the prompt displays **st**, Press **[Tab]** twice and the terminal session will list some programs through the auto-complete feature. If the terminal session displays the following items (highlighted in the red box in Figure), the installation completed successfully.

```
wifi-131-179-27-144:~ the_prawns$ st
st-flash      stdhosts      stty
st-info        stream        stty.pl
st-util        stringdups    stty5.16.pl
startx         stringdups32  stty5.18.pl
stat           strings
stdethers      strip
```

Figure 14: Three st tools should appear when using the autocomplete feature.



5. Example Data Logging Project

5.1. Download STSW-STLKT01 v1.2.0

Follow the instructions below to download an existing data-logging project for the SensorTile.

First, please note that this Tutorial supported Version 1.2.0 of the SensorTile Firmware, STSW-STLKT01

Instructions to download firmware from STMicroelectronics website.

1. Open the following link on a web-browser on your Mac.

http://www.st.com/content/st_com/en/premium-content/sensortile-curriculum-stsw-stlkt01_zip.html

2. Scroll to the bottom of the page, and click “Get Software” for the entry **STSW-STLKT01**.

GET SOFTWARE

Part Number	Software Version	Marketing Status	Supplier	Order from ST
STSW-STLKT01	1.2.0	Active	ST	Get Software

Figure 15: This figure depicts what to click in order to acquire the example project files.

3. When the license agreement appears (Figure), read through it.



After reading the agreement, click “Accept” at the top of the page.

License Agreement

ACCEPT

IMPORTANT-READ CAREFULLY: This Production Limited License Agreement (“PLLA”) for ST materials is made between you on behalf of yourself or on behalf of any entity by which you are employed or engaged (collectively referred to in this PLLA as “You” or “Licensee”) and STMicroelectronics International NV, a company incorporated under the laws of the Netherlands acting for the purpose of this PLLA through its Swiss branch located at 39, Chemin du Champ des Filles, 1228 Plan-les-Ouates, Geneva, Switzerland (hereinafter “ST”). Affiliates shall mean any corporation, partnership, or other entity that, directly or indirectly, owns, is owned by, or is under common ownership with ST, for so long as such ownership exists. For the purposes of the foregoing, “own”, “owned,” or “ownership” shall mean ownership of more than fifty percent (50%) of the stock or other equity interests entitled to vote for the election of directors or an equivalent governing body.

The ST materials licensed under this PLLA shall mean the software made available by ST and/or its Affiliates upon agreeing to this PLLA, including any associated Documentation (collectively the “Licensed Materials”). Documentation shall mean and include any comments, annotations, instructions, manuals, and other materials, whether in printed or electronic form, including without limitation installation manuals, user’s guides, and programmer guides, related to any software made available under this PLLA. The Licensed Materials include any software updates, and supplements that ST and/or its Affiliates may provide You or make available to You after the date You obtain the

Figure 16: License agreement that appears once you click “Get Software”.

4. Either register an account, or enter your name and email address when prompted by the popup depicted in Figure .



Then, click “Download” at the bottom of the popup screen.

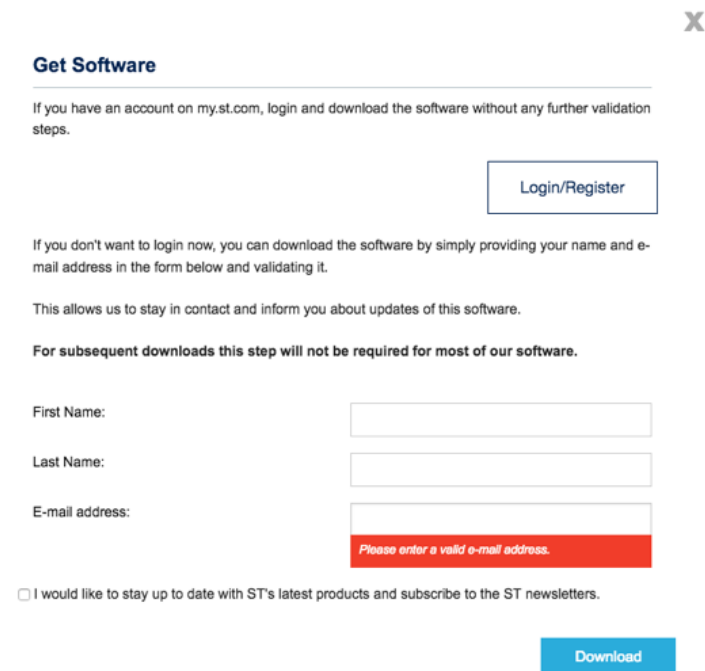


Figure 17: Dialog box that collects developer information prior to enabling acquisition of example project files.

- The popup box should resemble the Figure below if all steps have proceeded successfully.

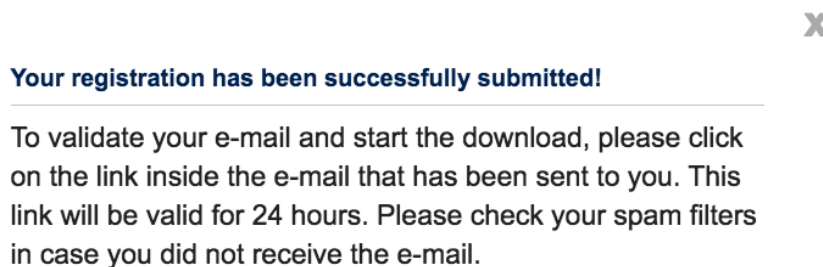


Figure 18: This is a successful registration notification box.

- Check your email **inbox** and **spam** folders for the email. Follow the link that you were sent to download the example code. The email should resemble Figure .

Note: this link will not function if your web-browser is in “Incognito” or “Private” mode.

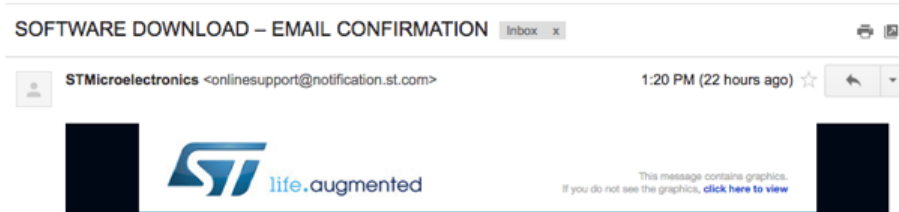


Figure 19: Email from STMicroelectronics containing weblink to enable access to download example project.

7. Extract the contents of the archive. The default output folder name should be **v1.2.0**. For consistency with this tutorial, please extract the archive into the Downloads directory.

The full path of the directory should resemble “/Users/<username>/Downloads/v1.2.0”.

Name	^	Date Modified	Size
▶ folder _htmresc		Dec 6, 2016, 5:59 PM	--
▶ folder binary		Dec 6, 2016, 5:59 PM	--
▶ folder Documentation		Dec 6, 2016, 5:59 PM	--
▶ folder Drivers		Dec 6, 2016, 5:59 PM	--
▶ folder Middlewares		Dec 6, 2016, 5:59 PM	--
package.xml		Dec 6, 2016, 6:07 PM	205 bytes
▶ folder Projects		Dec 6, 2016, 5:59 PM	--
Release_Notes.html		Dec 6, 2016, 5:59 PM	41 KB
▶ folder Utilities		Dec 6, 2016, 5:59 PM	--

Primary > Users > the_prawns > Downloads > v1.2.0

Figure 20: Contents of folder "v1.2.0".



5.2.Import

Follow the instructions below in order to import the example project into the System WorkBench IDE. Note: while we call this System WorkBench, it will be listed as “Eclipse” in your applications.

1. Open the System WorkBench application.
2. Use the default workspace directory, and click “Ok”. See Figure 21.

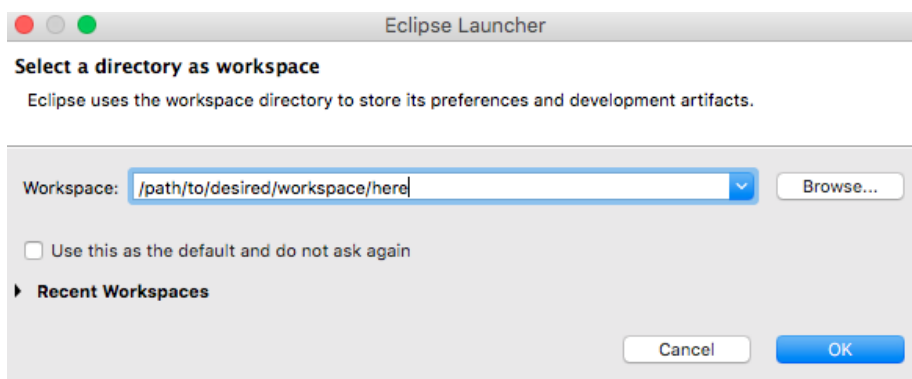


Figure 21: Selecting your workspace directory. It is recommended that you use the default location. It will resemble the form “/Users/<username_here>/Documents/workspace”.

3. If you see a welcome screen, close it by clicking the “x” in the top left corner. See Figure .



Figure 22: Closing the welcome splash page.

4. Once you are on the main screen of System WorkBench, click “File > Import ...” to begin importing the project. See Figure .

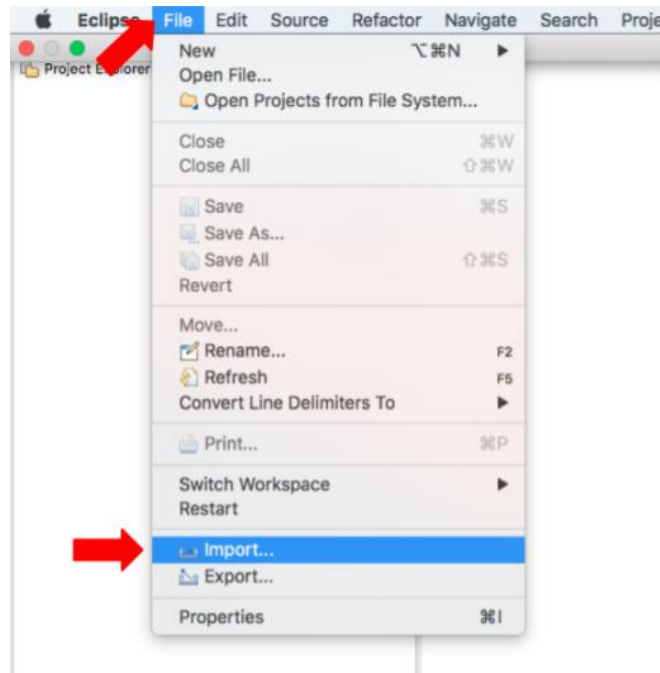


Figure 23: Importing an existing project into the workspace.

5. When the new window popup appears, click double click the entry “General”. See Figure .
6. Double click the “Existing Projects into Workspace” option that appears under “General”. See Figure .

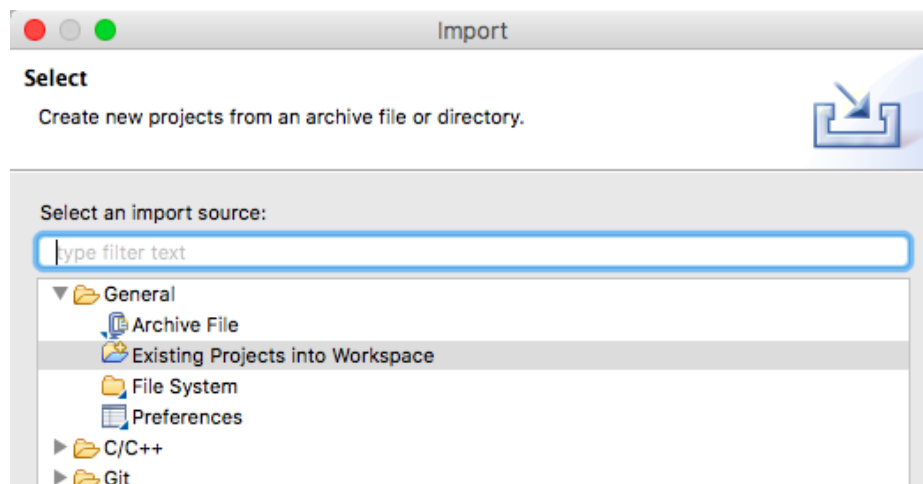


Figure 24: Instructions on the "Select" dialog box.



7. **DO NOT CLICK FINISH UNTIL YOU COMPLETELY READ THROUGH STEP 8.**

There are three projects in the v1.2.0 folder. If you import more than one project at a time, compilation will fail. This is because the three projects are dependent on other files in the folder.

On the new popup window, enter the path to the folder **v1.2.0** in the text field “Select root directory”. **DO NOT CLICK FINISH.**

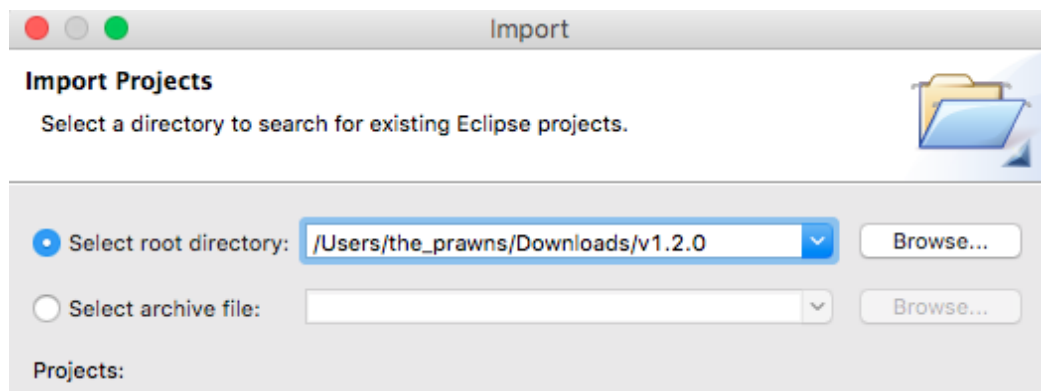


Figure 25: Selecting the folder where the existing project was extracted.

8. The projects box should be populated with 3 projects.
 - 8.1. AudioLoop (DE-SELECT THIS).
 - 8.2. BLE_SampleApp (DE-SELECT THIS).
 - 8.3. DataLog (Keep this selected).

Uncheck the boxes next to AudioLoop and BLE_SampleApp.



Figure 26: Only selecting one project from the existing files to import into the workspace.

If you have selected more than one project and clicked “Finish”, you will need to open your workspace directory on the Finder application on your Mac and manually delete all of the files.



```
'SensorTile/Applications/AudioLoop/SW4STM32/STM32L4xx-SensorTile)
'SensorTile/Applications/BLE_SampleApp/SW4STM32/STM32L4xx-SensorTile)
'SensorTile/Applications/DataLog/SW4STM32/STM32L4xx-SensorTile)
```

Figure 27: Close-up image of text from Figure.

Click “Finish” with **only one project** selected.

9. Your screen should resemble the screenshot depicted below.

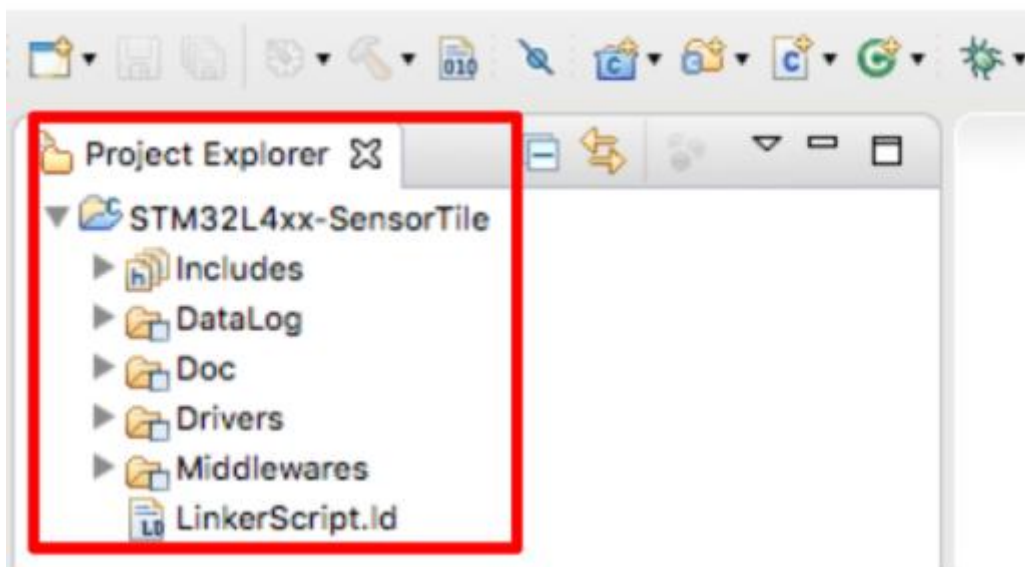


Figure 28: Contents of "Project Explorer" after successfully importing the example project files.



5.3.Build

This portion of the document will guide users through the process of compiling the C-source code into a binary file that can be loaded onto the SensorTile board.

1. Select STM32L4xx-SensorTile -> DataLog in Project Explorer. Then, click Project -> Build Project (see the Figure below).

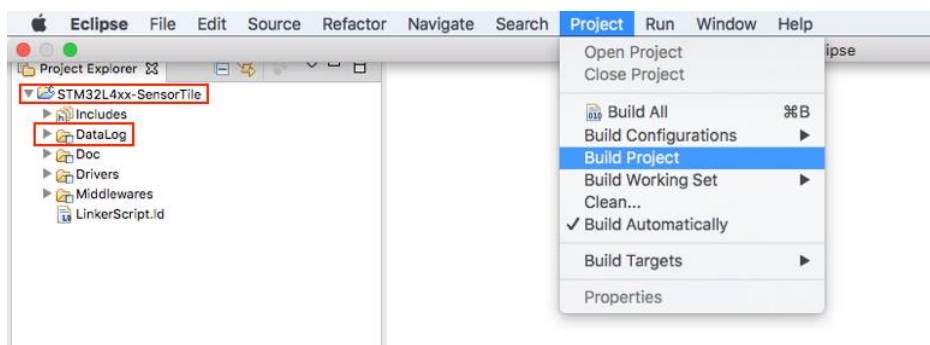


Figure 29: Compiling the source code for the example project.

2. If step 1 completed successfully, a folder named “Release” should appear and contain a **.bin** file. See the Figure below.

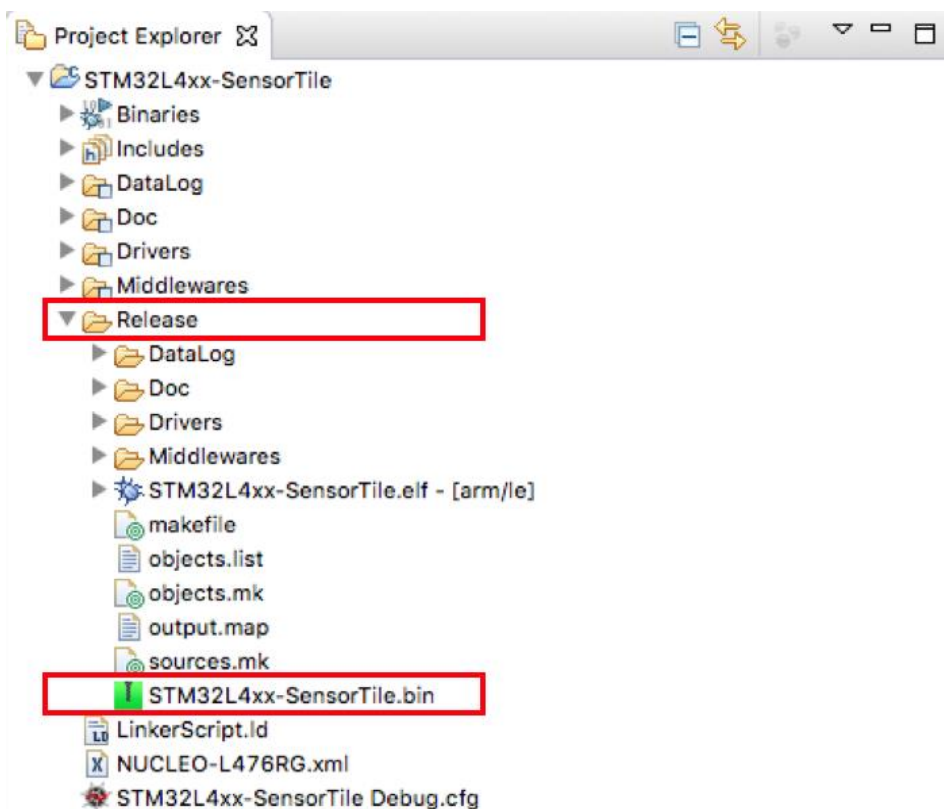


Figure 30: Project directory contents after successful compilation of project source code.



5.4. SensorTile Hardware Platform

This section describes how to configure the hardware. Be very careful in this section, if the wire connections are not configured correctly, the boards could be permanently damaged. Do not proceed with the tutorial until an instructor has verified that your board is correctly configured.

1. Remove the Nucleo - L476RG board from its packaging.
2. Remove the CN2 Jumpers. (Remove both of them). See Figure .

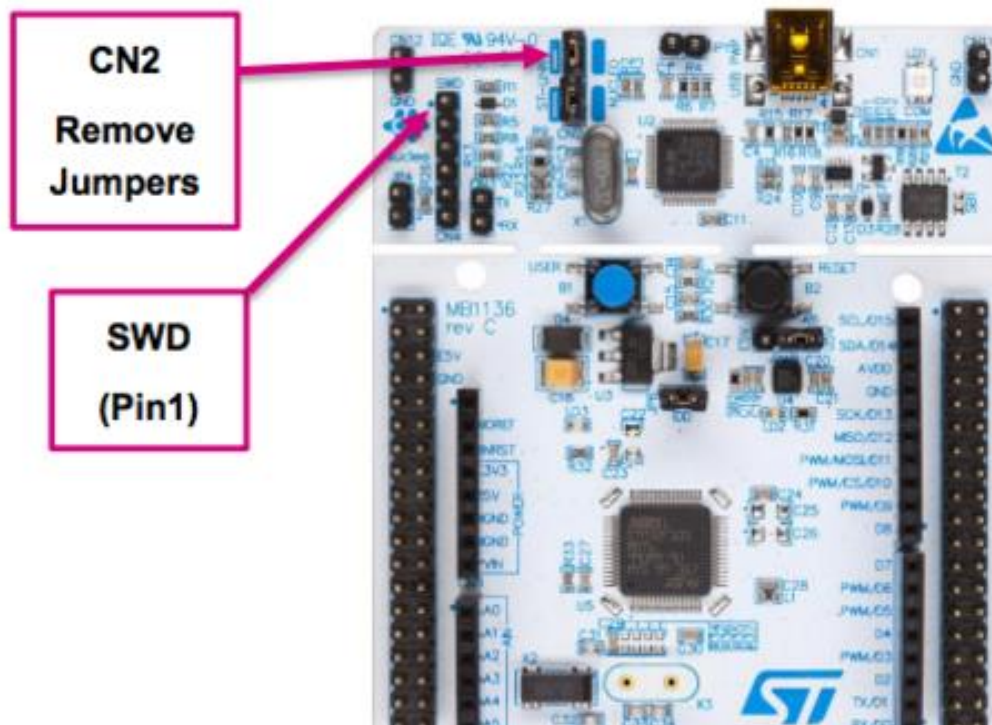


Figure 31: Removing the CN2 Jumpers from the Nucleo-L476RG board.

3. Place the SensorTile on the larger evaluation board. Ensure the orientation of the SensorTile matches Figure .



Figure 32: Ensure the orientation of the SensorTile on the larger evaluation board matches this figure. There should be a green protrusion with a little metallic hole right next to the ST logo.

4. Connect the boards by attaching an SWD connector from the Nucleo board to the SensorTile board. Be **very** careful in this step. Please examine the figures in the next page. Do not proceed with this tutorial until you have verified with an instructor that the hardware is correctly configured.



Figure 33: First figure depicting correct hardware configuration. Ensure that the SWD cable is oriented such that the pins marked “SWD” are connected via the same wire.

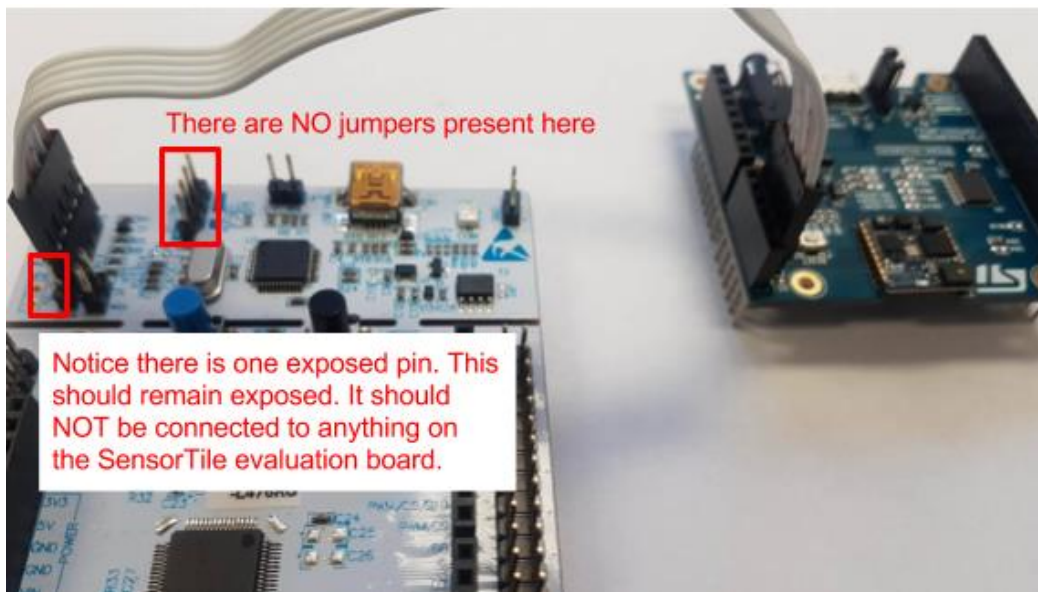


Figure 34: Second figure depicting correct hardware configuration.



5.5.Debug

This section will guide users through the process of running the **DataLog** application in debug mode on the SensorTile board.

1. Attach a mini-USB cable from the **Nucleo** to your Mac. Attach a micro-USB cable from the **SensorTile** to your Mac. See Figure .

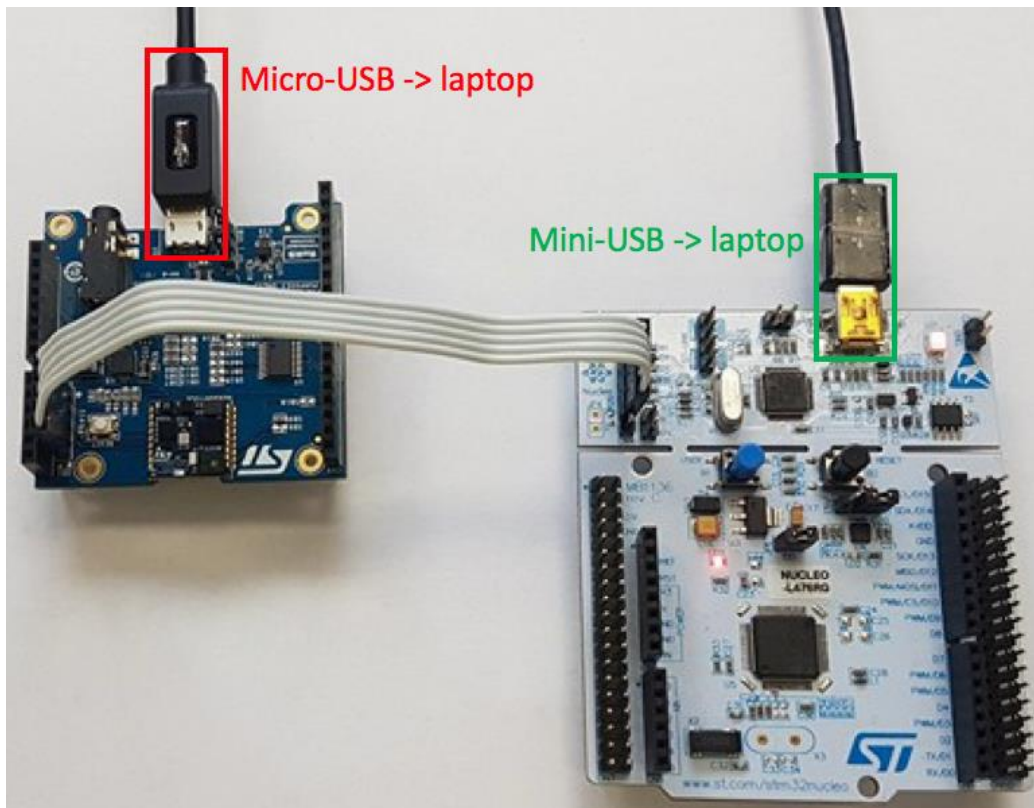


Figure 35: Establish a USB-wireline connection between each board and your Mac.

2. Select the project folder, “STM32L4xx-SensorTile”, in Project Explorer. Then, click “Run -> Debug As -> AC6 STM32 C/C++ Application”. See Figure in the next page.

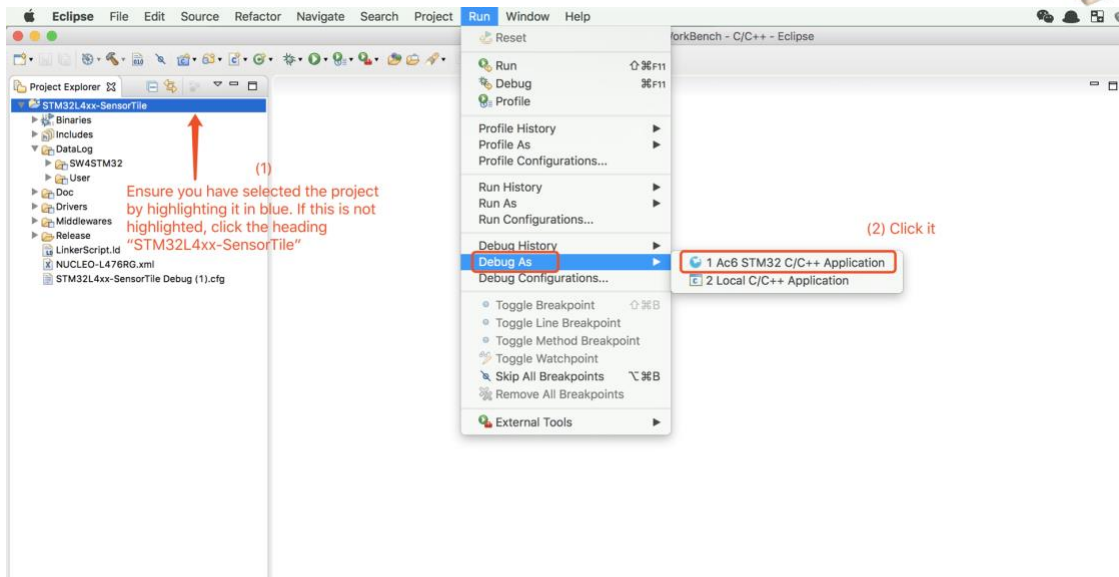


Figure 36: Launching the DataLog program in debug mode.

3. A dialog box may appear. Click “Yes” on this dialog box.

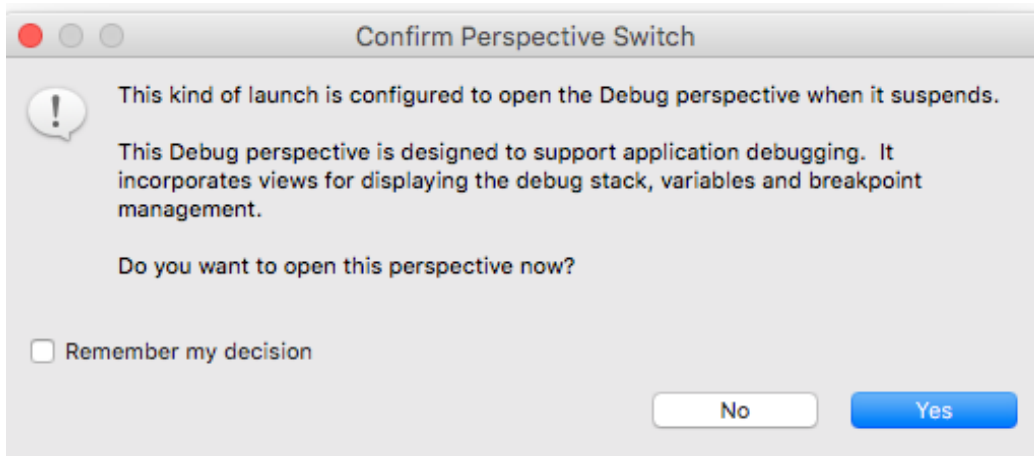


Figure 5: Click "Yes" on this dialog box.

4. A debugging interface should appear.

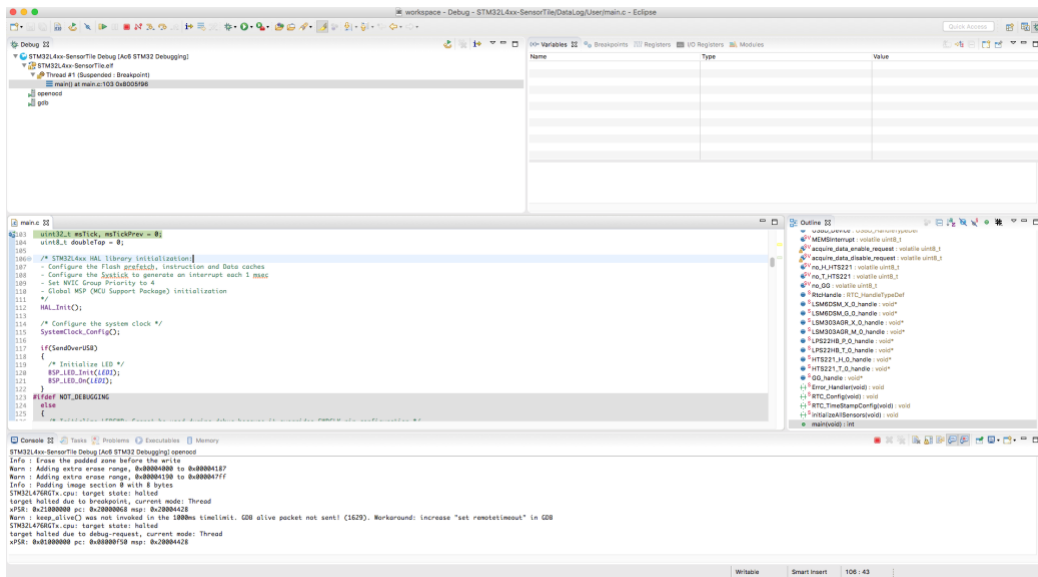


Figure 38: Debugging interface.

If you wish to switch back to the C/C++ view, click the top right corner button labeled “C/C++”. See the Figure below.

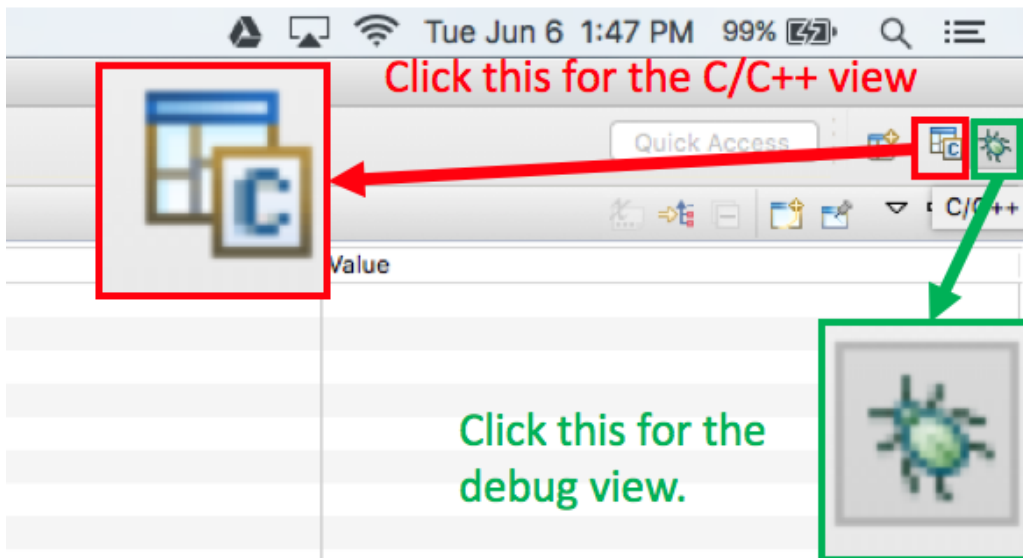


Figure 39: To enter the “C/C++” view, click the button highlighted in the red box. To enter the “debug mode” view, click the button highlighted in the green box.

5. Examine your SensorTile device. Notice how none of the LED’s are activated.
6. Press the “green arrow with the yellow bar on its left” button that indicates “Resume” when you mouse over it. See Figure .

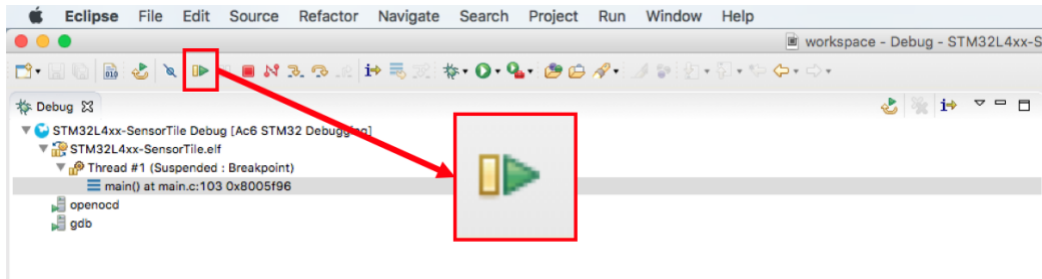


Figure 40: Starting the application in debug mode.

7. Examine your SensorTile device. Notice how the orange LED is rapidly blinking.
8. Open a terminal and issue the command shown in Figure .

```
$ ls /dev/cu.usb*
```

```
wifi-131-179-27-42:~ the_prawns$ ls /dev/cu.usb*  
/dev/cu.usbmodem142131 /dev/cu.usbmodem142143  
wifi-131-179-27-42:~ the_prawns$
```

Figure 41: Inspecting the devices connected via USB.

Notice how there are two devices listed.

The device ending in “3” is the Nucleo board.

The device ending in “1” is the SensorTile.

9. **If you receive an error in this step, please proceed to step 10.**

Inspect the data the SensorTile is sending over serial wireline USB connection by issuing the command shown in Figure . Make sure this command is edited to suit the name of the device as it appears in your terminal session. The output should resemble Figure .

```
$ screen /dev/cu.usbmodem<SENSORTILE_ID> 9600
```

```
wifi-131-179-27-42:~ the_prawns$ ls /dev/cu.usb*  
/dev/cu.usbmodem142131 /dev/cu.usbmodem142143  
wifi-131-179-27-42:~ the_prawns$ screen /dev/cu.usbmodem142131 9600
```

Figure 42: Examining the output from the SensorTile.



```

Timestamp: 00:00:24.94
ACC_X: 23, ACC_Y: -42, ACC_Z: 1014
GYR_X: 210, GYR_Y: -2030, GYR_Z: 350
MAG_X: -45, MAG_Y: -153, MAG_Z: -252
PRESS: 998.25

Timestamp: 00:00:25.04
ACC_X: 25, ACC_Y: -45, ACC_Z: 1013
GYR_X: 140, GYR_Y: -2030, GYR_Z: 350
MAG_X: -33, MAG_Y: -148, MAG_Z: -255
PRESS: 998.23

Timestamp: 00:00:25.14
ACC_X: 24, ACC_Y: -44, ACC_Z: 1014
GYR_X: 210, GYR_Y: -1960, GYR_Z: 350
MAG_X: -43, MAG_Y: -156, MAG_Z: -246
PRESS: 998.25

```

Figure 43: Data being captured by the SensorTile.

10. If you receive the error shown in Figure , pause the program by clicking the two parallel yellow bars next to the run button (see Figure), unplug the SensorTile board from the Mac, wait 10 seconds, and reconnect it. Once the cable is reconnected, repeat steps 6-9.

```
Cannot open line '/dev/cu.usbmodem142131' for R/W: Resource busy
```

Figure 44: Common error message when examining data from the SensorTile using "screen".



Figure 45: Pause button to temporarily halt execution of code on the SensorTile board.



5.6.Flash

This section will guide users through the process of uploading a compiled binary file onto the SensorTile for execution. Once the program is uploaded to the board, it will run every time the SensorTile is supplied with power. The SensorTile will no longer need to be connected to the Nucleo board, nor will users have to interface with System WorkBench (the IDE).

1. Terminate and remove all existing applications on the SensorTile board as shown in Figure .

Note: Ensure to remove ALL existing applications. Figure only contains one application. If there are more, delete all of them.

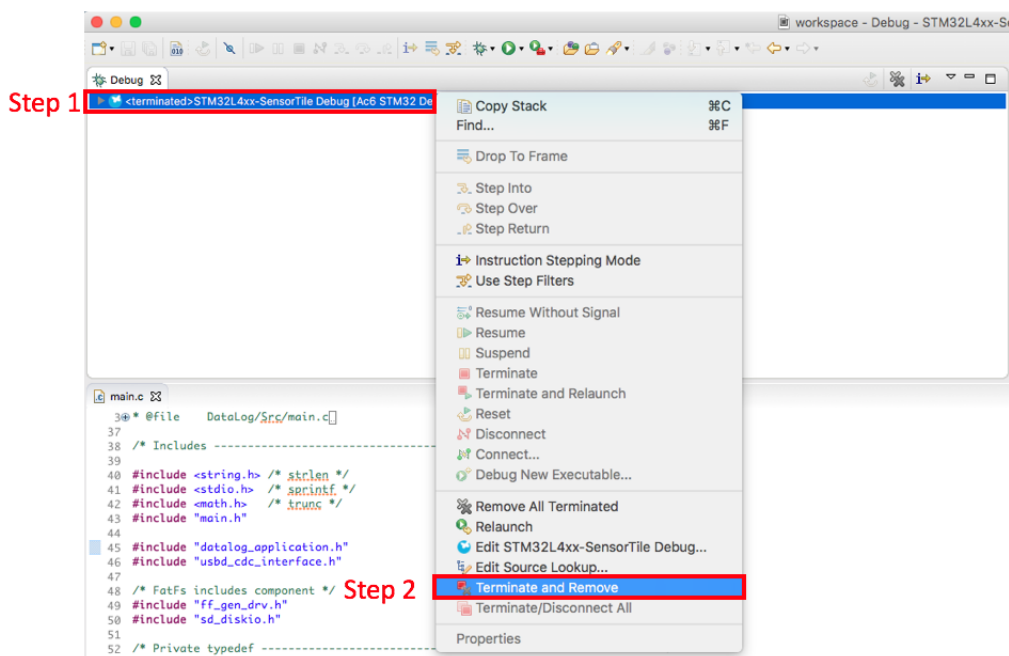


Figure 46: Terminating and removing existing applications on the SensorTile board.

2. Open a terminal session, and navigate to the **v1.2.0** directory.

```
wifi-131-179-27-42:~ the_prawns$ cd /Users/the_prawns/Downloads/v1.2.0/
wifi-131-179-27-42:v1.2.0 the_prawns$
```

Figure 47: Navigating to the v1.2.0 directory.

3. Issue the command shown below and depicted in Figure .

```
$ cd Projects/SensorTile/Applications/DataLog/SW4STM32/STM32L4xx-SensorTile/Release
```



```
wifi-131-179-27-42:v1.2.0 the_prawns$ cd Projects/SensorTile/Applications/DataLog/SW4STM32/STM32L4xx-SensorTile/Release
wifi-131-179-27-42:Release the_prawns$ ls
DataLog          STM32L4xx-SensorTile.bin    objects.mk
Doc              STM32L4xx-SensorTile.elf    output.map
Drivers          makefile                    sources.mk
Middlewares      objects.list
wifi-131-179-27-42:Release the_prawns$
```

Figure 48: Navigating to the directory containing the binary file compiled earlier in this tutorial.

4. Ensure that the directory contains the same files as seen in Figure .
5. Issue the command shown below and depicted in Figure .

```
$ st-flash write STM32L4xx-SensorTile.bin 0x8004000
```

```
wifi-131-179-27-42:Release the_prawns$ st-flash write STM32L4xx-SensorTile.bin 0x8004000
st-flash 1.3.1
2017-06-06T15:21:03 INFO src/common.c: Loading device parameters....
2017-06-06T15:21:04 INFO src/common.c: Device connected is: L4 device, id 0x10076415
2017-06-06T15:21:04 INFO src/common.c: SRAM size: 0x18000 bytes (96 KiB), Flash: 0x100000 bytes (1024 KiB) in pages of 2048 bytes
2017-06-06T15:21:04 INFO src/common.c: Attempting to write 116456 (0x1c6e8) bytes to stm32 address: 134234112 (0x8004000)
Flash page at addr: 0x08020000 erasedEraseFlash - Page:0x40 Size:0x800
2017-06-06T15:21:05 INFO src/common.c: Finished erasing 57 pages of 2048 (0x800) bytes
2017-06-06T15:21:05 INFO src/common.c: Starting Flash write for F2/F4/L4
2017-06-06T15:21:05 INFO src/flash_loader.c: Successfully loaded flash loader in sram
size: 32768
size: 32768
size: 32768
size: 18152
2017-06-06T15:21:08 INFO src/common.c: Starting verification of write complete
2017-06-06T15:21:09 INFO src/common.c: Flash written and verified! jolly good!
```

Figure 49: 'st-flash' command and resulting output to terminal.

6. Navigate back to the **v1.2.0** directory as seen in step 2.
7. Issue the command below and depicted in Figure . Ensure the contents match Figure .

```
$ cd Utilities/BootLoader/STM32L476RG
```

```
wifi-131-179-27-42:STM32L476RG the_prawns$ cd /Users/the_prawns/Downloads/v1.2.0/
wifi-131-179-27-42:v1.2.0 the_prawns$ cd Utilities/BootLoader/STM32L476RG
wifi-131-179-27-42:STM32L476RG the_prawns$ ls
BootLoaderL4.bin
wifi-131-179-27-42:STM32L476RG the_prawns$
```

Figure 50: Navigating to ".../v1.2.0/Utilities/BootLoader/STM32L476RG". Contents of said directory.

8. Issue the command below and depicted in Figure .

```
$ st-flash write BootLoaderL4.bin 0x8000000
```




```
wifi-131-179-27-42:STM32L476RG the_prawns$ st-flash write BootLoaderL4.bin 0x8000000
st-flash 1.3.1
2017-06-06T15:28:44 INFO src/common.c: Loading device parameters...
2017-06-06T15:28:44 INFO src/common.c: Device connected is: L4 device, id 0x10076415
2017-06-06T15:28:44 INFO src/common.c: SRAM size: 0x18000 bytes (96 KiB), Flash: 0x100000 bytes
(1024 KiB) in pages of 2048 bytes
2017-06-06T15:28:44 INFO src/common.c: Attempting to write 4308 (0x10d4) bytes to stm32 address:
134217728 (0x8000000)
Flash page at addr: 0x08001000 erasedEraseFlash - Page:0x2 Size:0x800
2017-06-06T15:28:44 INFO src/common.c: Finished erasing 3 pages of 2048 (0x800) bytes
2017-06-06T15:28:44 INFO src/common.c: Starting Flash write for F2/F4/L4
2017-06-06T15:28:44 INFO src/flash_loader.c: Successfully loaded flash loader in sram
size: 4308
2017-06-06T15:28:44 INFO src/common.c: Starting verification of write complete
2017-06-06T15:28:44 INFO src/common.c: Flash written and verified! jolly good!
```

Figure 51: Flashing the bootloader.

9. Disconnect the USB cables connecting the SensorTile and the Nucleo board's to the Mac. This will power down the devices, enabling us to safely disconnect the SWD connection between the SensorTile board and the Nucleo board.
10. Disconnect the SWD cable connecting the SensorTile board to the Nucleo board.
11. Reconnect SensorTile board to your Mac. Do not reconnect the Nucleo board to your Mac.
12. Notice that the SensorTile device immediately starts streaming data over serial USB connection to your Mac by examining the blinking LED.
13. Examine the data transmitted from the SensorTile by repeating step 9 from 5.5 Debug.
14. You will now observe complete system operation with a stand-alone, automatically operating SensorTile IoT system.