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# STMicroelectronics SensorTile Tutorial: Introduction to STMicroelectronics Integrated Development Environment and DataLog Project for Windows Platforms

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## Table of Contents

<b>1. INTRODUCTION .....</b>	<b>3</b>
<b>2. INTRODUCTION TO THIS TUTORIAL.....</b>	<b>4</b>
2.1. LIST OF REQUIRED EQUIPMENT AND MATERIALS.....	4
<b>3. INTEGRATED DEVELOPMENT ENVIRONMENT INSTALLATION.....</b>	<b>5</b>
3.1. PREREQUISITE STEPS .....	5
3.2. INSTALL STM32 CUBEIDE .....	5
<b>4. PUTTY.....</b>	<b>24</b>
<b>5. ASSEMBLING THE SENSORTILE KIT.....</b>	<b>25</b>
5.1. SENSOReTILE HARDWARE PLATFORM KIT.....	25
5.1. SENSOReTILE HARDWARE VIDEO .....	25
<b>6. CONNECT THE SENSORTILE SYSTEM TO THE WINDOWS PLATFORM.....</b>	<b>33</b>
6.1. USB CONNECTORS.....	33
<b>7. IMPORT THE DATALOG PROJECT .....</b>	<b>37</b>
7.1. DOWNLOAD THE DATALOG PROJECT.....	37
<b>8. STOPPING EXECUTION AND RESTARTING A PROJECT .....</b>	<b>58</b>
<b>9. REMOVING A PROJECT FROM THE WORKSPACE.....</b>	<b>65</b>
<b>10. OPTIONAL: INTRODUCTION TO ST-LINK UTILITY .....</b>	<b>67</b>

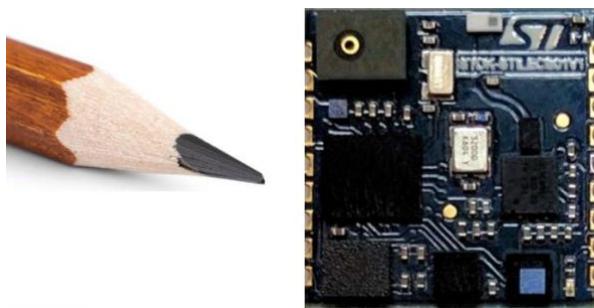


## 1. Introduction

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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 STM32CubeIDE Integrated Development Environment (IDE) 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 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 create an “image” file that can be installed in the SensorTile non-volatile storage.

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

The Tutorial steps include:

1. Installing an Integrated Development Environment (IDE) on Window.
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 PC.

[www.st.com/sensortile](http://www.st.com/sensortile)

### 2.1. List of Required Equipment and Materials

- 1) 1x STMicroelectronics SensorTile kit.
- 2) 1x STMicroelectronics Nucleo Board.
- 3) 1x Windows 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). **This must be a new data cable.**
- 5) 1x USB 2.0 A-Male to Mini-B Cable (mini USB cable). **This must be a new data cable.**
- 6) Network access to the Internet.

**Please ensure that the USB cables are data cables purchased for this kit. Many USB cables provide only charging and do not include essential data lines.**



## 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. Update your Windows operating system (OS) to the latest version (Windows 10 or newer). Open the following link on a web-browser on your Windows for more details.

<https://support.microsoft.com/en-us/help/12373/windows-update-faq>

### 3.2. Install STM32 CubeIDE

- 1) Open the following link on a web-browser on your PC to download the STM32CubeIDE Installer.
  - a) <https://www.st.com/en/development-tools/stm32cubeide.html>

The screenshot shows the 'Get Software' section of the STM32CubeIDE download page. It lists five installer options:

Part Number	General Description	Software Version	Download	Previous versions
STM32CubeIDE-DEB	STM32CubeIDE Debian Linux Installer	1.4.0	<a href="#">Get Software</a>	Select version
STM32CubeIDE-Lnx	STM32CubeIDE Generic Linux Installer	1.4.0	<a href="#">Get Software</a>	Select version
STM32CubeIDE-Mac	STM32CubeIDE macOS Installer	1.4.0	<a href="#">Get Software</a>	Select version
STM32CubeIDE-RPM	STM32CubeIDE RPM Linux Installer	1.4.0	<a href="#">Get Software</a>	Select version
STM32CubeIDE-Win	STM32CubeIDE Windows Installer	1.4.0	<a href="#">Get Software</a>	Select version

- 2) Select Get Software
  - a) This will lead to a requirement to follow the registration steps
  - b) You will enter an email address.
  - c) A gmail address is recommended since some mail servers do not forward registration emails.
  - d) If an email does not appear from the registration system, please check your spam folder.



- 3) Wait for the confirmation email
- 4) Then, click on the link in the confirmation email
- 5) Download the installer by clicking on the link **STM32CubeIDE-Win** below



- 6) Install STM32CubeIDE by double clicking on the installer file
- 7) Windows will produce this message, below



- 8) Select the More Info link in this window



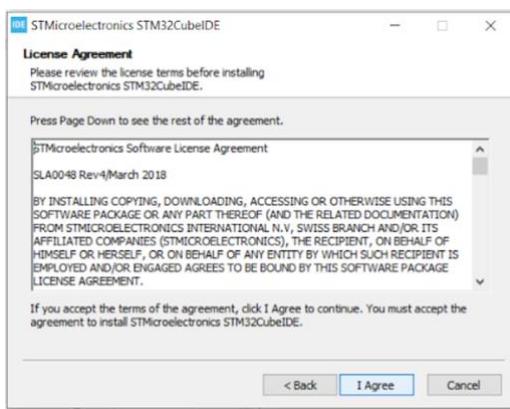
9) Windows will now produce this message, below. Select **Run Anyway**



10) Installation will start, select **Next** in the screen below.

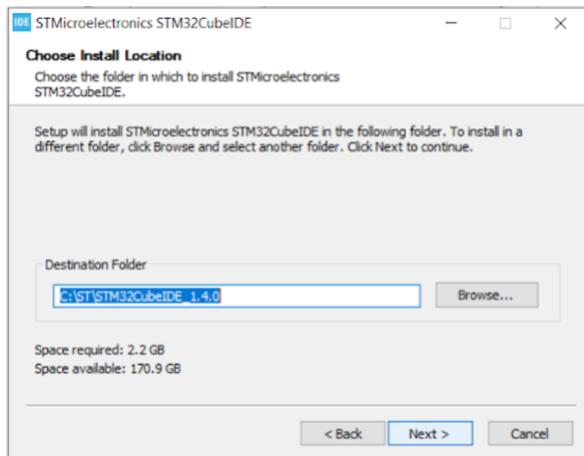


11) Select **I Agree** in the screen below.

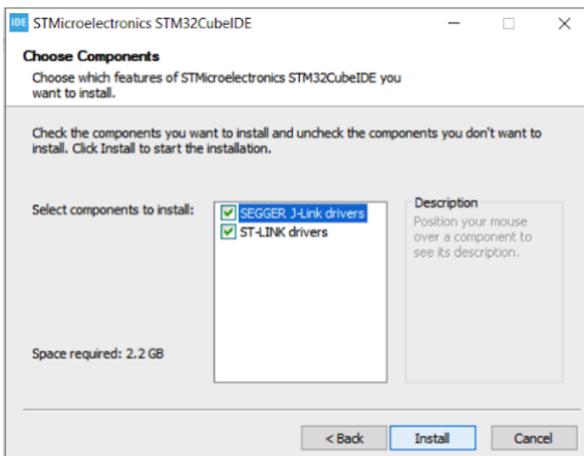




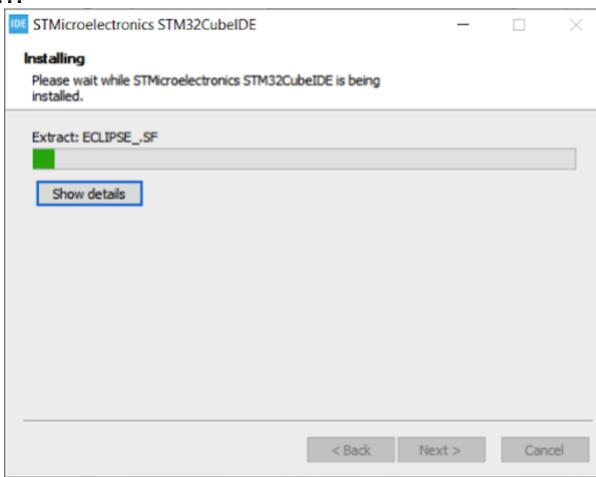
12) Select **Next** in the screen below.



13) Select **Install** in the screen below.

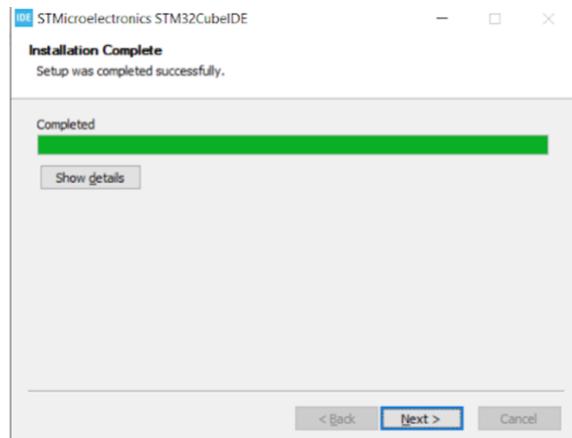


14) Wait for completion ...

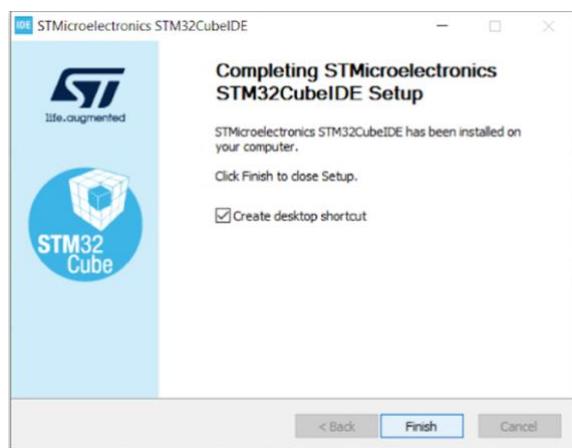




15) Select **Next** in the screen below.



16) Select **Finish** in the screen below.





17) Next, installation of ST-Link continues

18) Navigate to this Web site:

<https://www.st.com/en/development-tools/stsw-link004.html>

19) Select **Get Software** (follow registration or login steps using your registration).

The screenshot shows the ST.com website with the URL [st.com/en/development-tools/stsw-link004.html#get-software](https://www.st.com/en/development-tools/stsw-link004.html#get-software). The page title is "STM32 ST-LINK utility". There are two main buttons: "Get Software" and "Download databrief". Below these buttons is a navigation bar with tabs: Overview (ACTIVE), Resources, Tools & Software. A sidebar on the right has a "Feedback" button. At the bottom, there's a download section with files "en.stsw-stlink01.zip" and "en.st-stm32cubeid...zip".

20) Wait for the confirmation email

21) Then, click on the link in the confirmation email

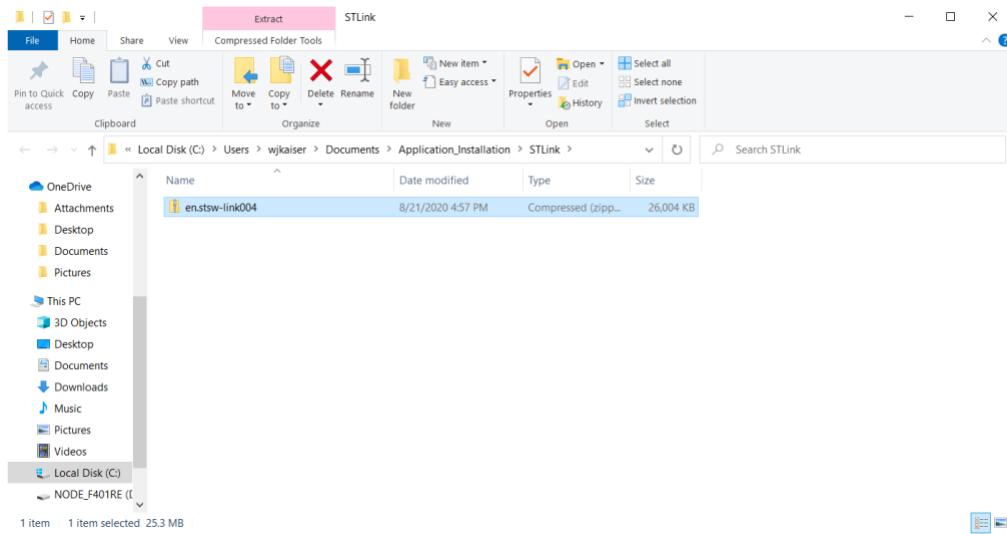
22) Select **Get Software**

The screenshot shows a "Get Software" page for the part number STSW-LINK004. The page title is "Get Software". The table has columns: Part Number, General Description, Software Version, Supplier, and Download. The data row is: STSW-LINK004, STM32 ST-LINK utility, 4.5.0, ST, Get Software.

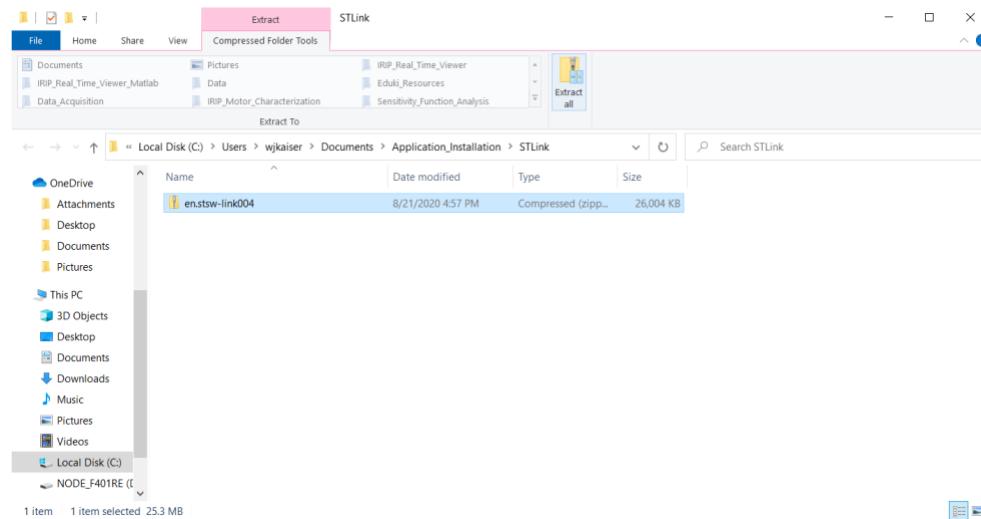
Part Number	General Description	Software Version	Supplier	Download
STSW-LINK004	STM32 ST-LINK utility	4.5.0	ST	<b>Get Software</b>



23) Find the Installer in the directory to which you downloaded this, for example, as below.

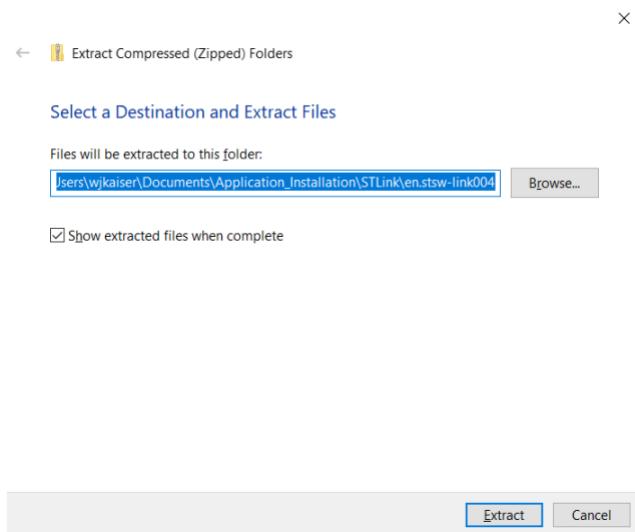


24) Select the File and select Extract All

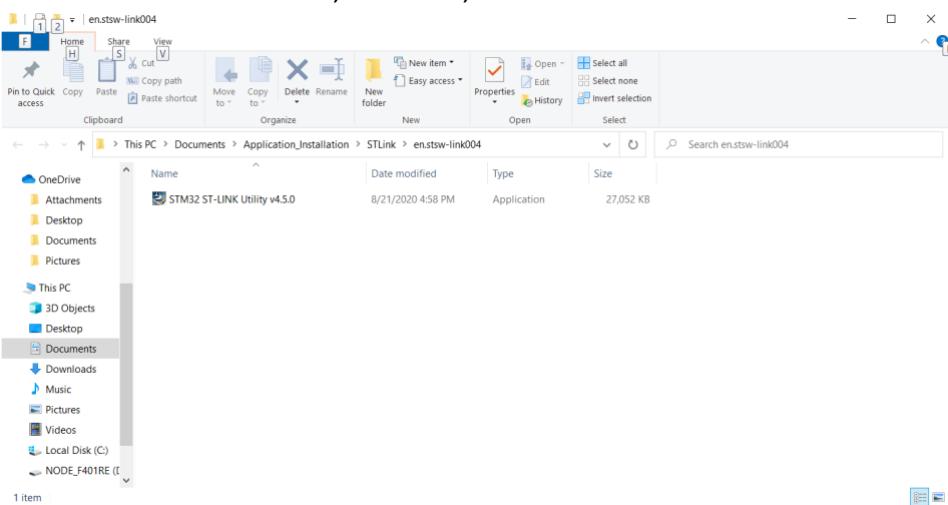




25) The unzip process will occur, select **Extract** below.

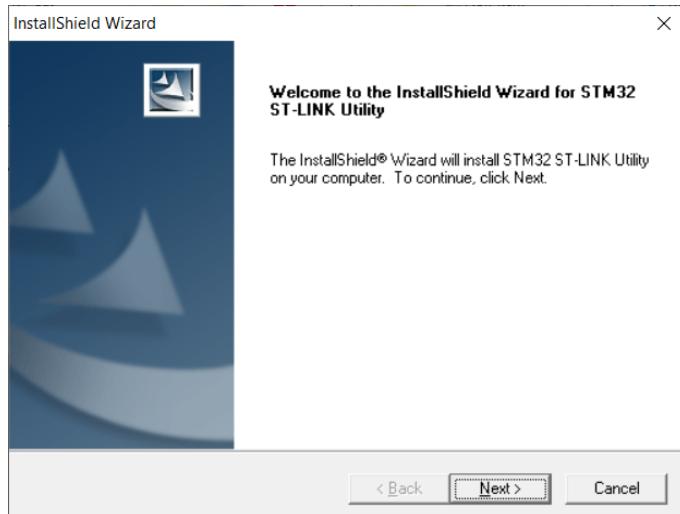


26) When the file has been extracted, as below, **double-click on the file**.

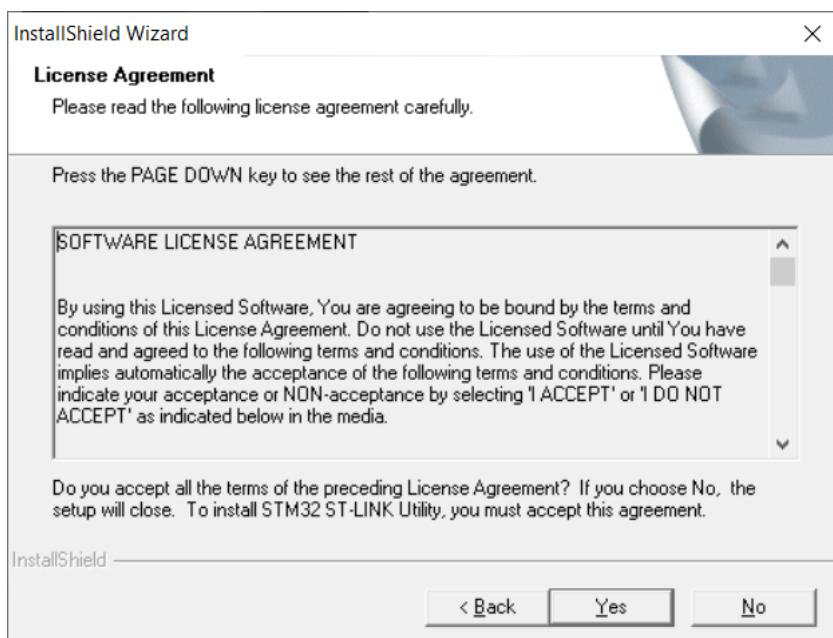




27) Installation will begin, click **Next**, below.

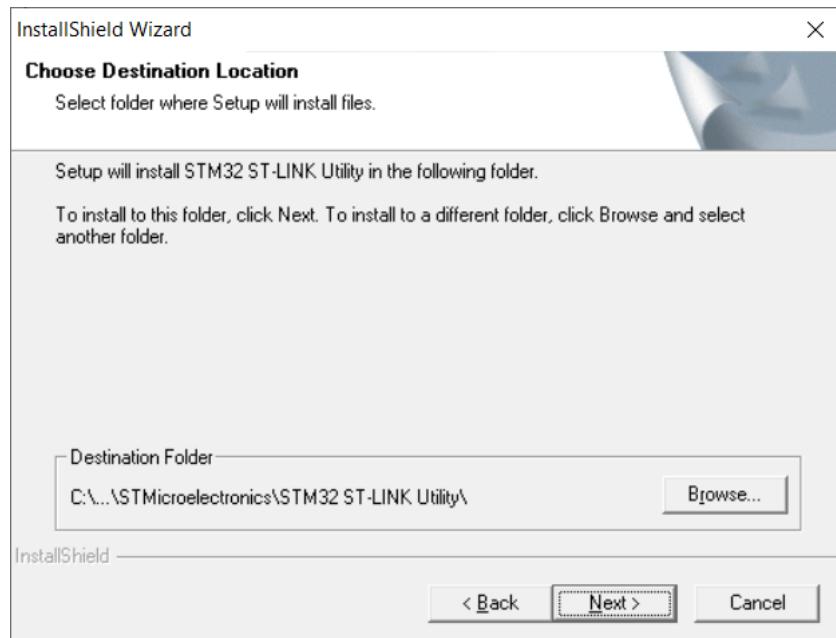


28) Click **Yes**, below.

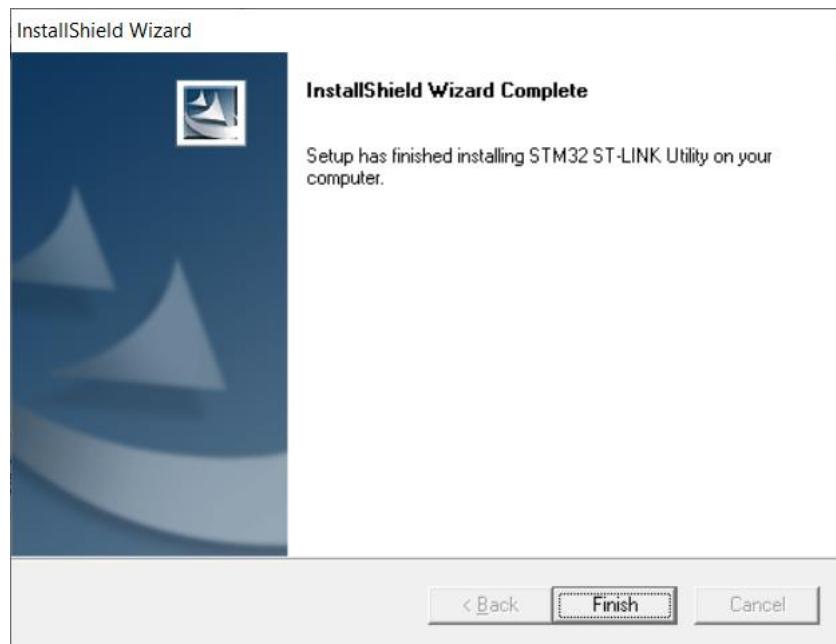




29) Click **Next**, below.

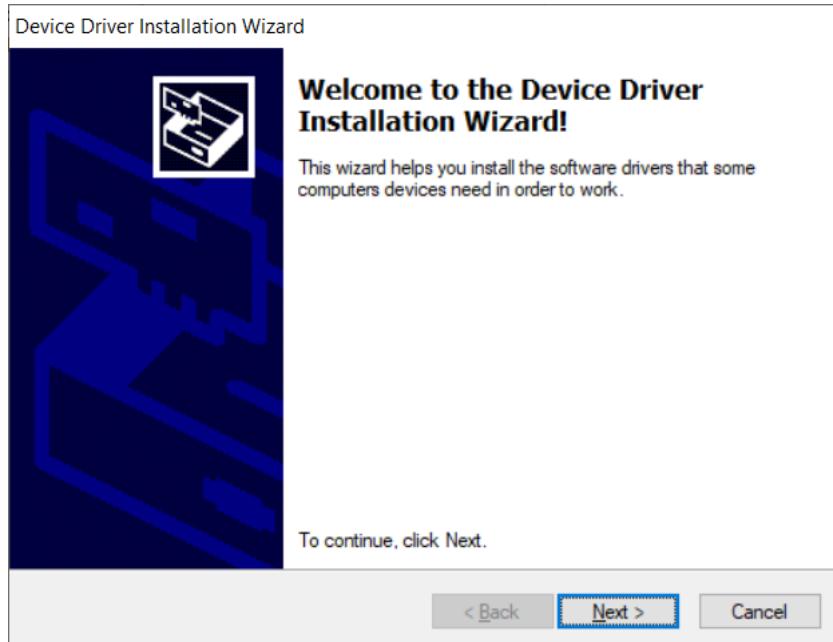


30) Click **Finish**, below.





31) Click **Next**, below.



32) Click **Finish**, below.





33) The last step in Tool installation is for a driver enabling communication to the SensorTile.

34) Navigate to this Web page

<https://www.st.com/en/development-tools/stsw-stm32102.html>

35) Select **Get Software** (follow registration or login steps using your registration).

The screenshot shows the ST website with the URL <https://www.st.com/en/development-tools/stsw-stm32102.html>. The page is titled "STM32 Virtual COM Port Driver". It features a "Get Software" button and a "Download databrief" button. Below these buttons are tabs for "Overview" and "Resources". A sidebar on the right has a "Feedback" button. The page content includes a note about compatibility with x86 and x64 platforms and a detailed description of the software package.

36) Wait for the confirmation email

37) Then, click on the link in the confirmation email

38) Select **Get Software** (follow registration or login steps using your registration).



my.st.com | My Drive - Google | STM32CubeIDE | UCLA - STMicroelectronics | 1\_Introduction\_ | Inbox (15,763) | STSW-STM3210 | +

Get Software

Part Number	General Description	Software Version	Supplier	Download
STSW-STM32102	STM32 Virtual COM Port Driver	1.5.0	ST	<a href="#">Get Software</a>

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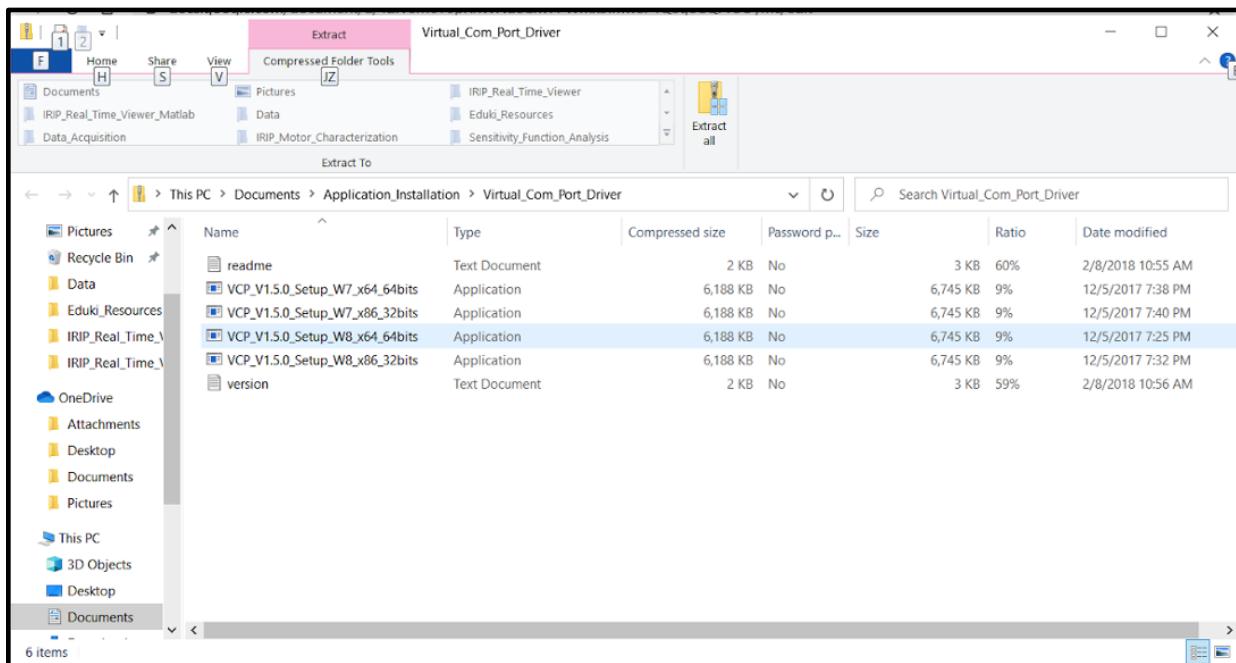
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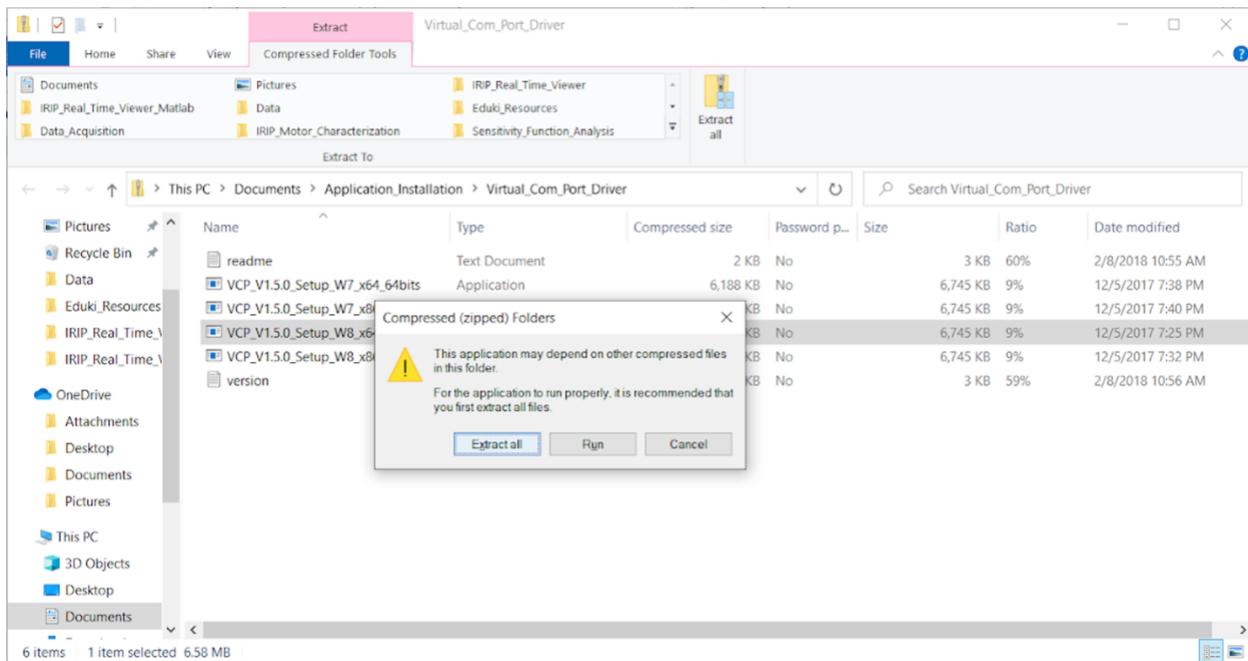
39) Find the Installer file in the directory to which you downloaded this, for example, as below.



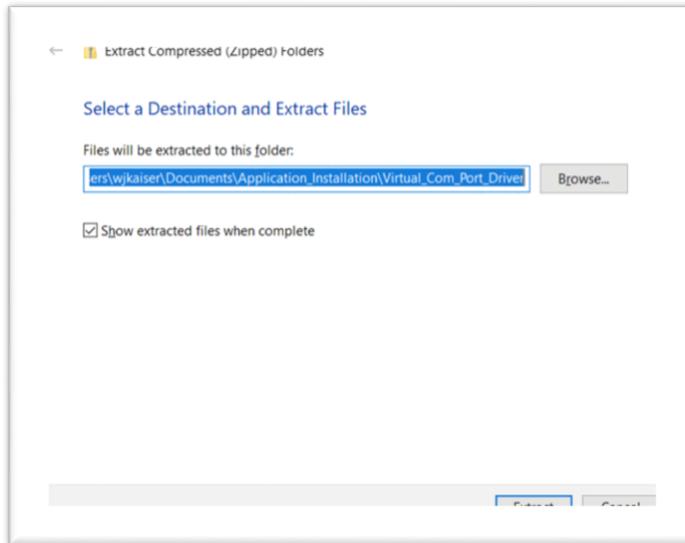


40) Select the File **VCP\_V1.5.0\_Setup\_W8\_x64\_64bits**

41) Select this file and select **Extract All**

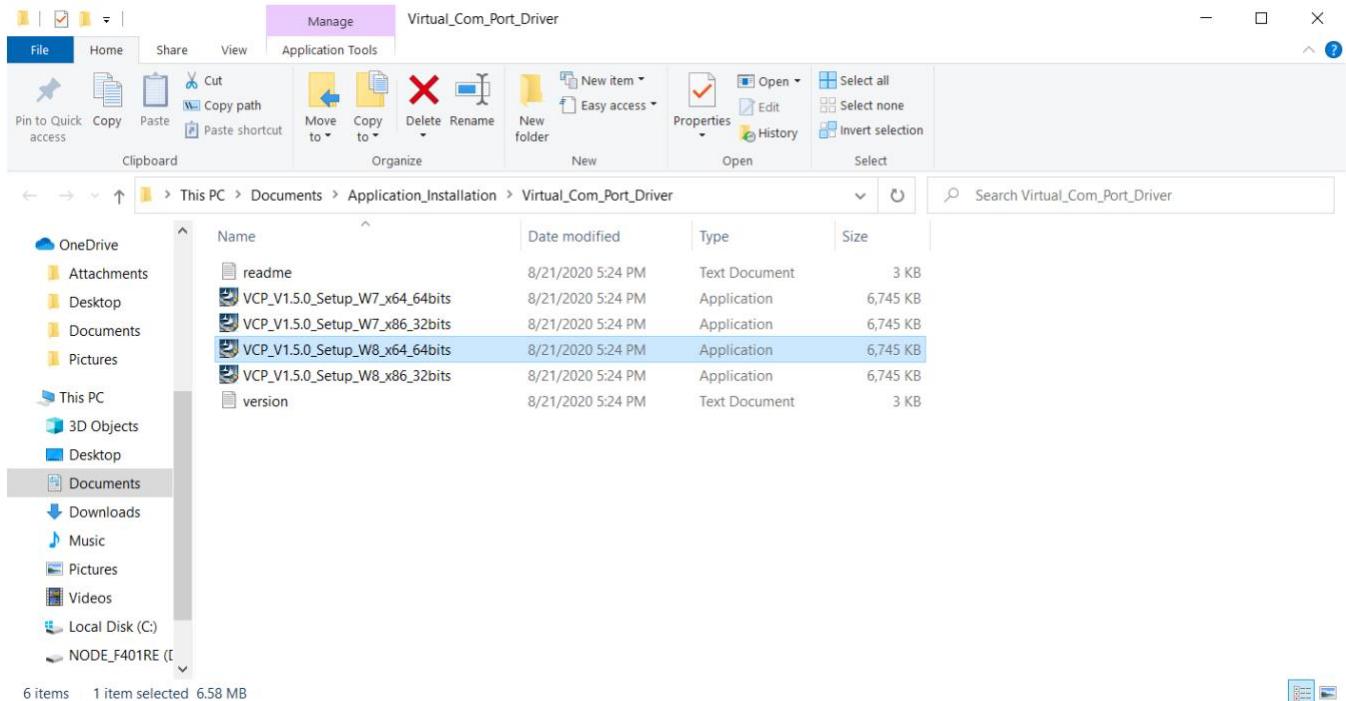


42) Select **Extract** below

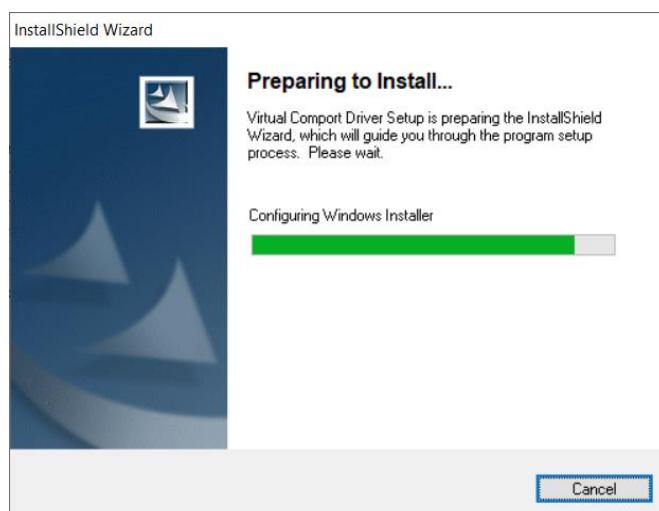


43) The extracted file will appear.

44) Double click on **VCP\_V1.5.0\_Setup\_W8\_x64\_64bits** as shown below.

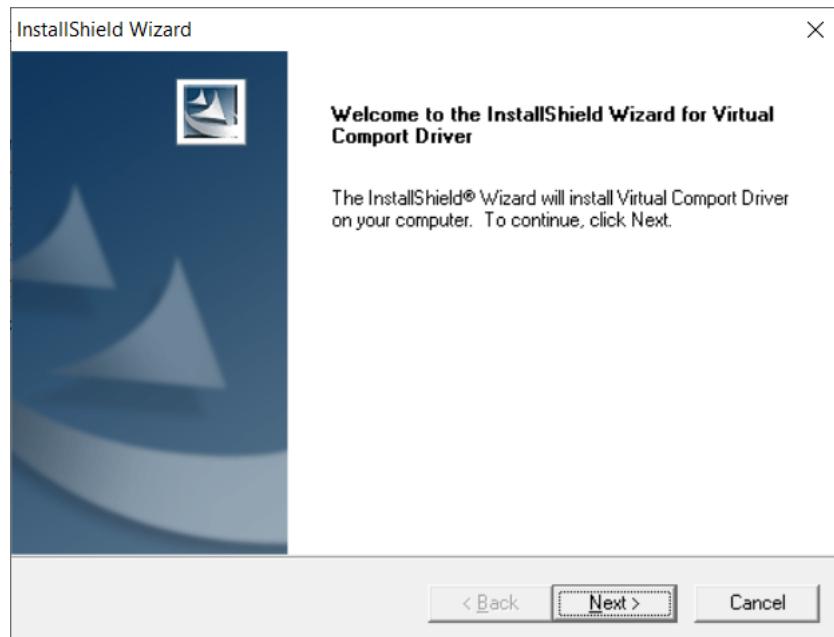


#### 45) Installation will start in the screen below

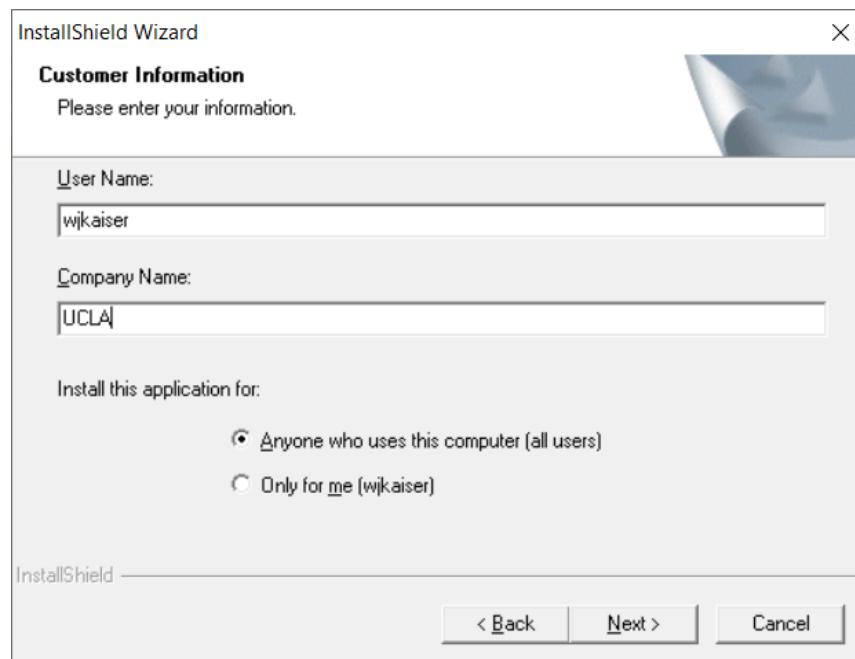




46) Select **Next** below

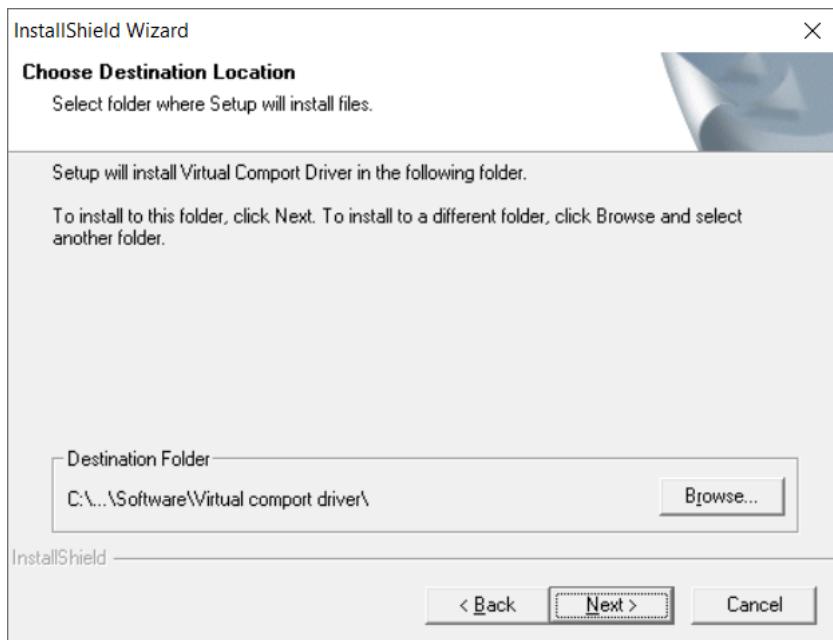


47) Enter a Company Name (this may be the word "Personal") and Select **Next** below

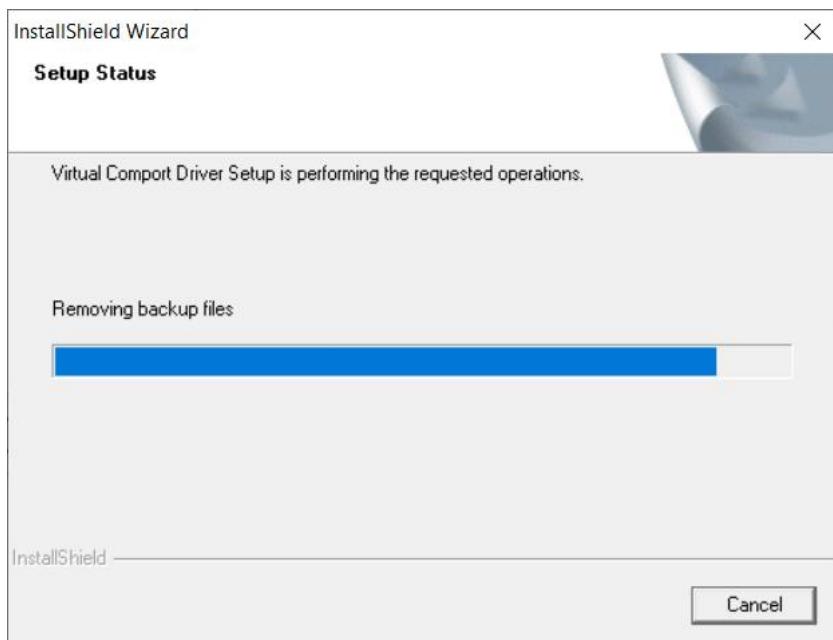




48) Select **Next** below

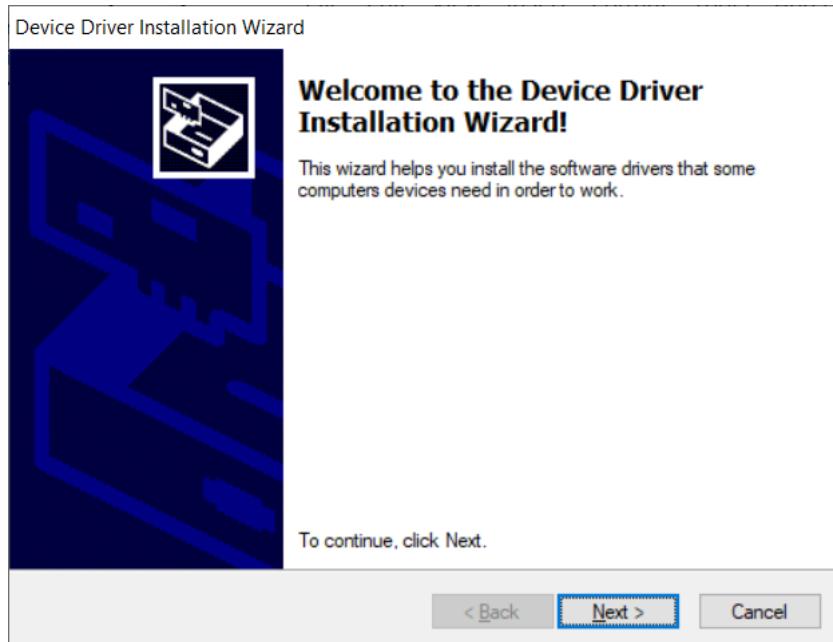


49) Wait for setup to continue

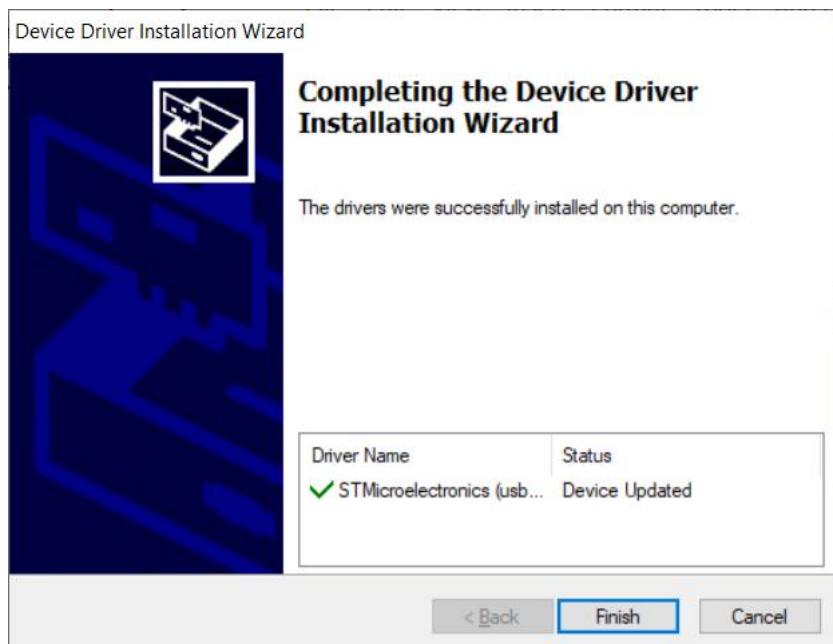




50) A new Window below will appear, Select **Next**

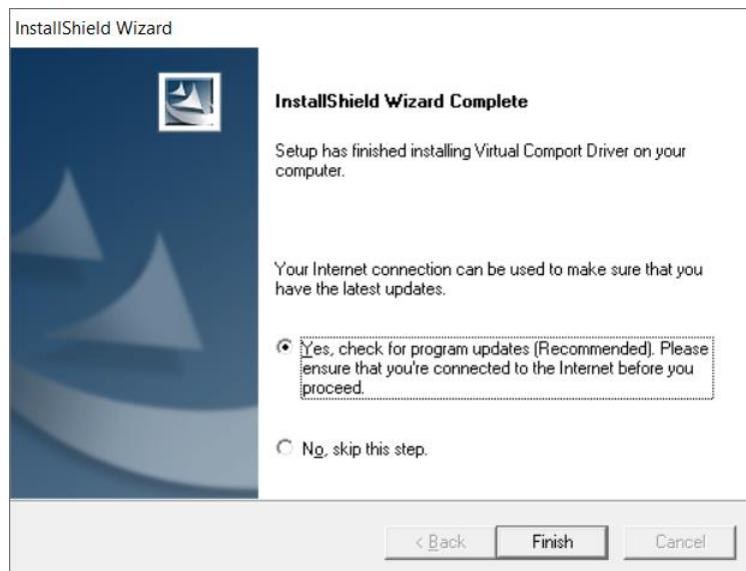


51) Select **Finish** below

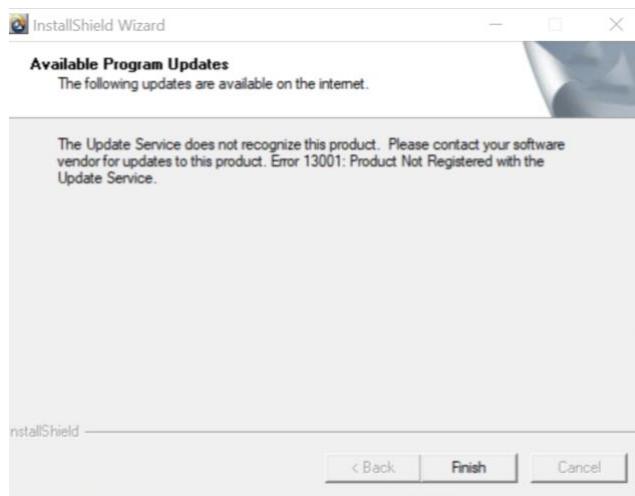




52) Select Finish in this window below as well.



53) The following window may also appear depending on your Windows version. If this appears, just select Finish in this window below as well.





## 4. PuTTY

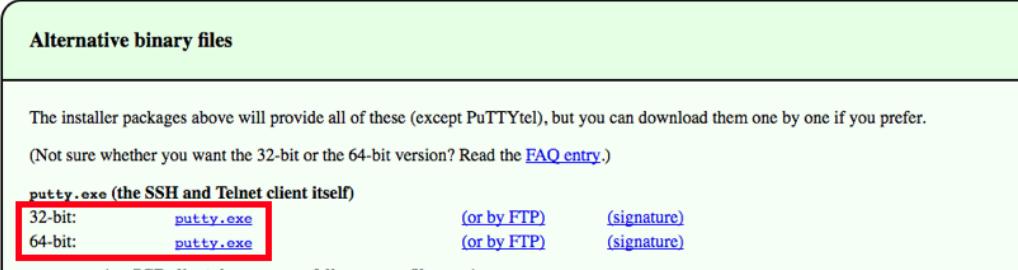
PuTTY is an ideal serial interface terminal system, developed originally by Simon Tatham for the Windows platform. PuTTY is open source software that is available with source code and is developed and supported by a group of volunteers. PuTTY supports serial communication (as will be used in SensorTile, as well as SSH protocols).

PuTTY is the program that will enable viewing of the transmitted by the SensorTile board over serial USB connection to your personal computer.

54) Open the following web-link on your personal computer.

<https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html>

55) Download the correct executable binary file for your operating system as highlighted in Figure .



The installer packages above will provide all of these (except PuTTYtel), but you can download them one by one if you prefer.  
(Not sure whether you want the 32-bit or the 64-bit version? Read the [FAQ entry](#).)

**putty.exe** (the SSH and Telnet client itself)

32-bit:	<a href="#">putty.exe</a>	(or by FTP)	<a href="#">(signature)</a>
64-bit:	<a href="#">putty.exe</a>	(or by FTP)	<a href="#">(signature)</a>

For SCP client, see command line sources file below.

Figure 15: Downloading the correct PuTTY binary file.

56) Double click the file to launch it. Note: This file is an **EXECUTABLE BINARY FILE**, this file is NOT an installer. As such, make sure you do not delete this file after you execute it once. You may also want to create a shortcut to this application on your desktop for ease of access.



## 5. Assembling the SensorTile Kit

### 5.1. SensorTile Hardware Platform Kit

This section describes assembly of the SensorTile Kit.

Be very careful in this section, if the wire connections are not configured correctly, the boards could be permanently damaged.

### 5.1. SensorTile Hardware Video

**It is very important to watch this video first before proceeding**

<https://drive.google.com/file/d/18Jxhp0tnJQ5v3jmpUbSF6NUin58nMZ9a/view?usp=sharing>

- 57) Remove the SensorTile and SensorTile cradle board from its packaging. Avoid bending the connector pins

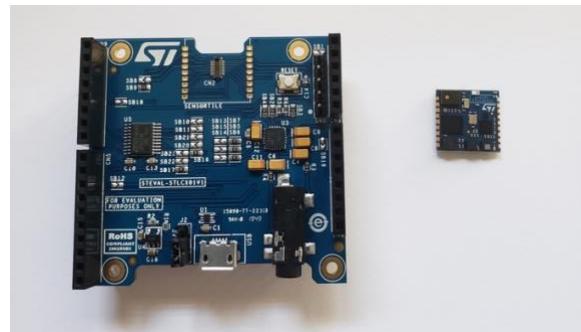


Figure 2. SensorTile Cradle Board (left) and SensorTile (right)

- 58) Place the SensorTile on the SensorTile Cradle board in the position shown. Press down to seat the SensorTile in its connector.

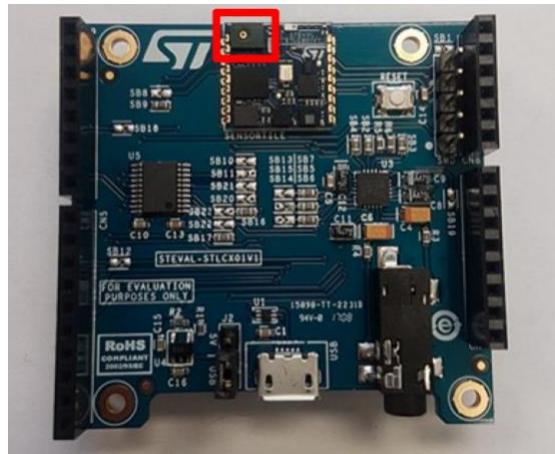


Figure 3: Ensure the orientation of the SensorTile on the larger Cradle board matches this figure.



59) Add adhesive (Scotch Tape) to the Cradle Board wrapping over the SensorTile to ensure that it remains anchored in position.

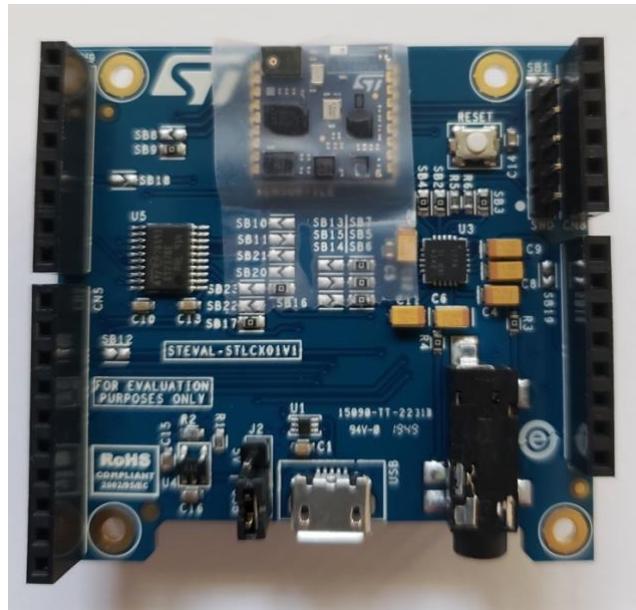


Figure 4. SensorTile on Cradle Board with protective layer of adhesive tape.



Figure 5. SensorTile on Cradle Board with protective layer of adhesive tape.



60) Remove and examine the Nucleo Board

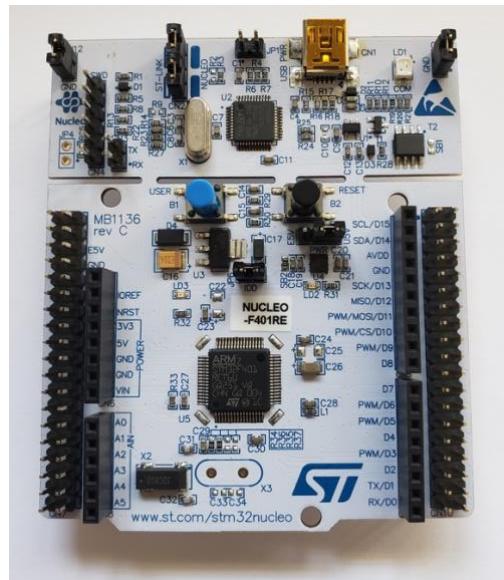


Figure 6. Nucleo F401RE Board.

61) Note the CN2 jumpers on the Nucleo Board

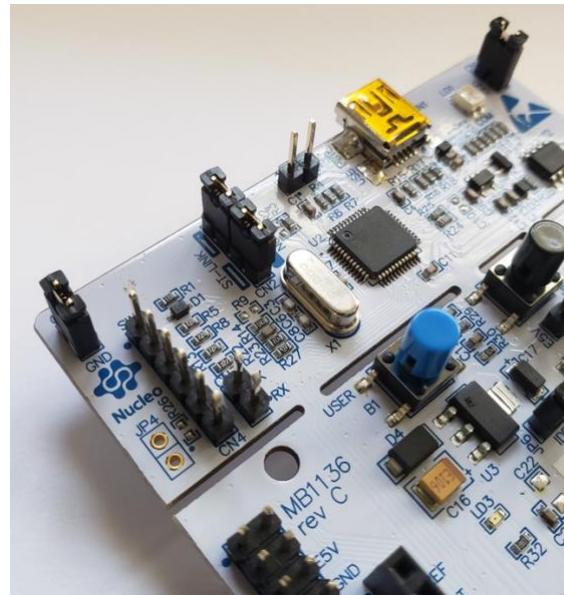


Figure 7. Nucleo F401RE Board – Note CN2 Jumpers at Center of image.



62) Remove the CN2 jumpers on the Nucleo Board. (These should always be removed. However, you may save the jumpers).

63) All other jumpers should remain.

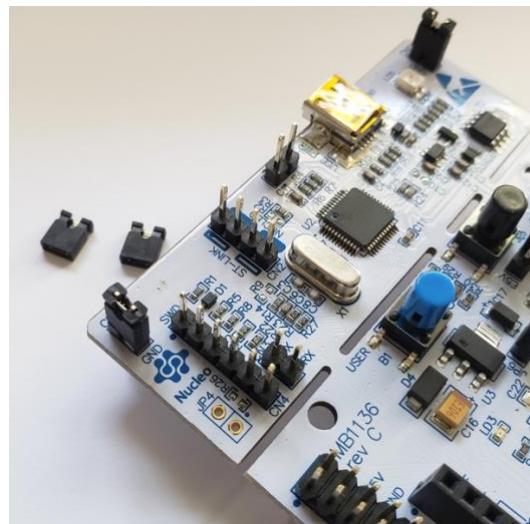


Figure 8. Nucleo F401RE Board – Note CN2 Jumpers Removed at Center of Image

64) Place the Nucleo left of the Cradle board with USB connectors facing downwards.

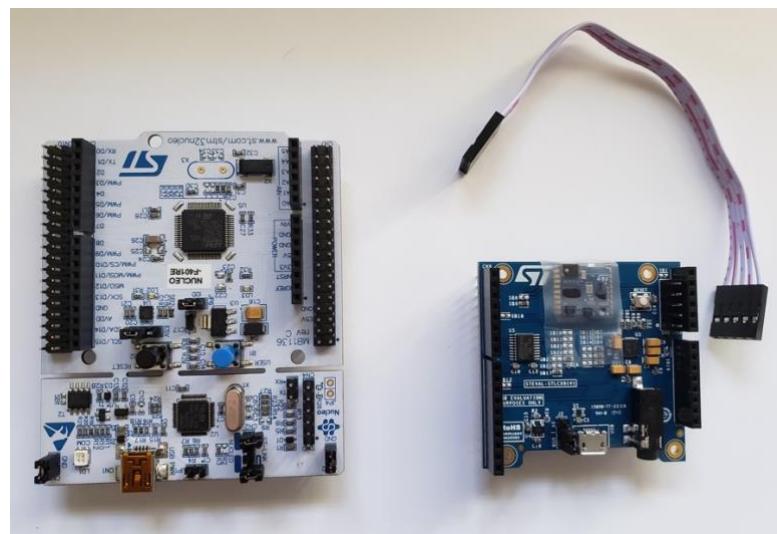


Figure 9. Nucleo Board (left) and SensorTile Cradle Board (right) with SWD Cable Note that USB connectors are oriented downwards in this image.



65) Connect the SWD cable to the Cradle board.

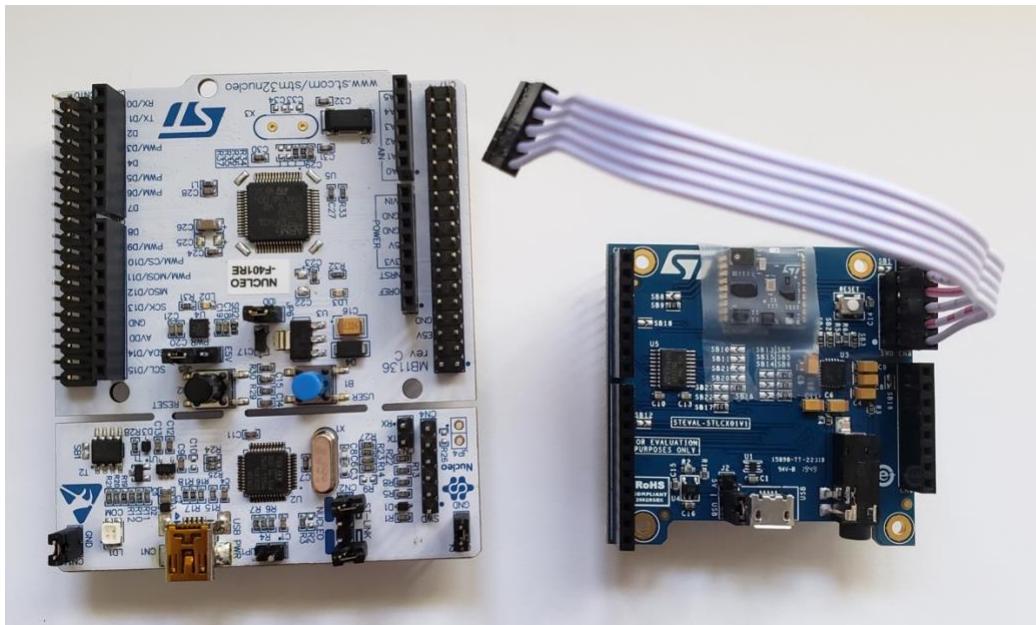


Figure 10. Nucleo Board (left) and SensorTile Cradle Board (right) with SWD Cable connected to five pins on Cradle Board. Note that USB connectors are oriented downwards in this image.

66) Connect the SWD cable to the Nucleo Board without twisting the cable. Place the SWD cable into the LOWER 5 PINS of the 6-PIN connector on the Nucleo Board

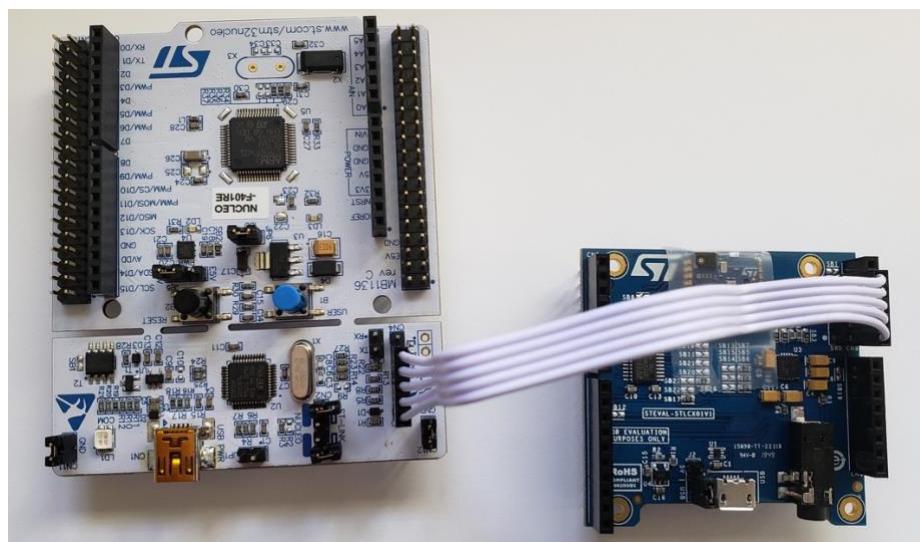


Figure 11. . Nucleo Board (left) and SensorTile Cradle Board (right) with SWD Cable connected to lower 5 pins of the 6-pin connector on the Nucleo Board. Note that USB connectors are oriented downwards in this image.



67) Ensure that the SWD cable connection matches the configuration shown below.

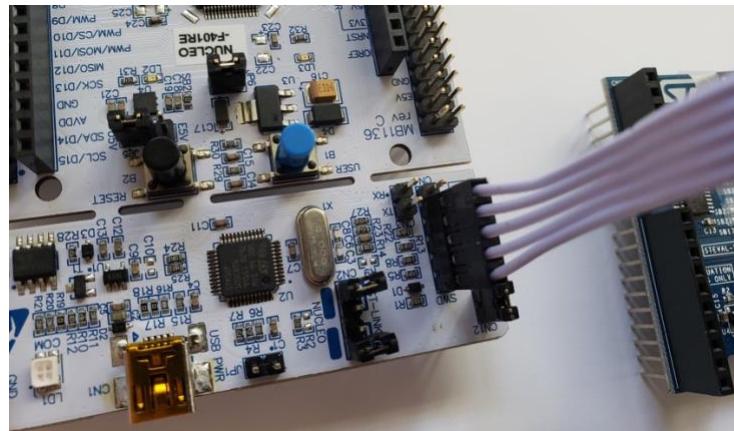


Figure 12. Nucleo Board (left) and SensorTile Cradle Board (right) with SWD Cable connected to lower 5 pins Nucleo Board. Note that USB connectors are oriented downwards in this image.

68) Ensure that the SWD cable connection matches the configuration shown below.

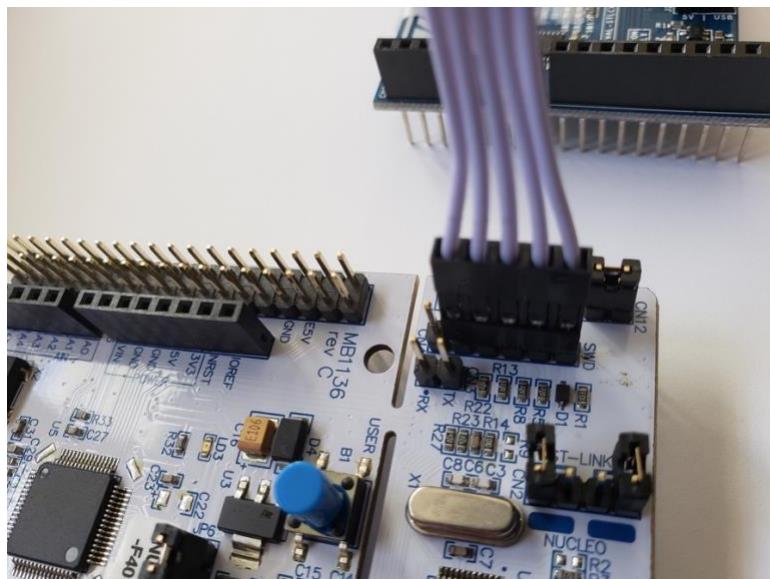


Figure 13. . Nucleo Board (left) and SensorTile Cradle Board (right) with SWD Cable connected to lower 5 pins Nucleo Board. Note that USB connectors are oriented downwards in this image.



69) Now, RETAIN THE CABLE IN PLACE. Rotate the Cradle Board on top of the Nucleo Board so that the pins on the underside of the Cradle Board match the corresponding connector on the Nucleo Board.



Figure 14. SensorTile Cradle Board is placed on top of the Nucleo board without removing the cable and only by “flipping” the SensorTile Cradle Board on top of the Nucleo Board so that its connector pins are aligned with the corresponding connector on the Nucleo Board..

70) Now, ensure that all pins match and no pins are bent. Then press the two boards together.

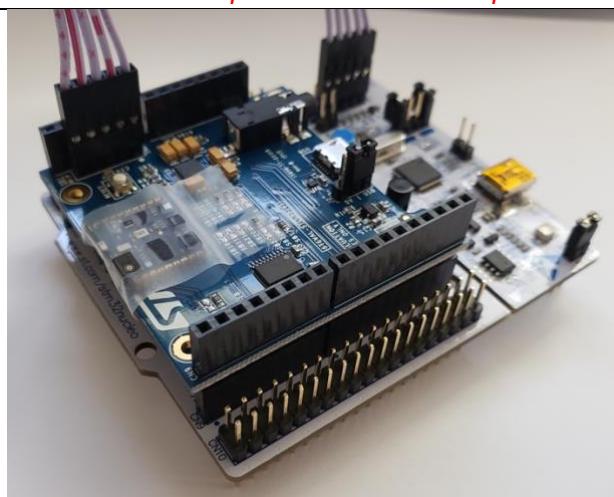
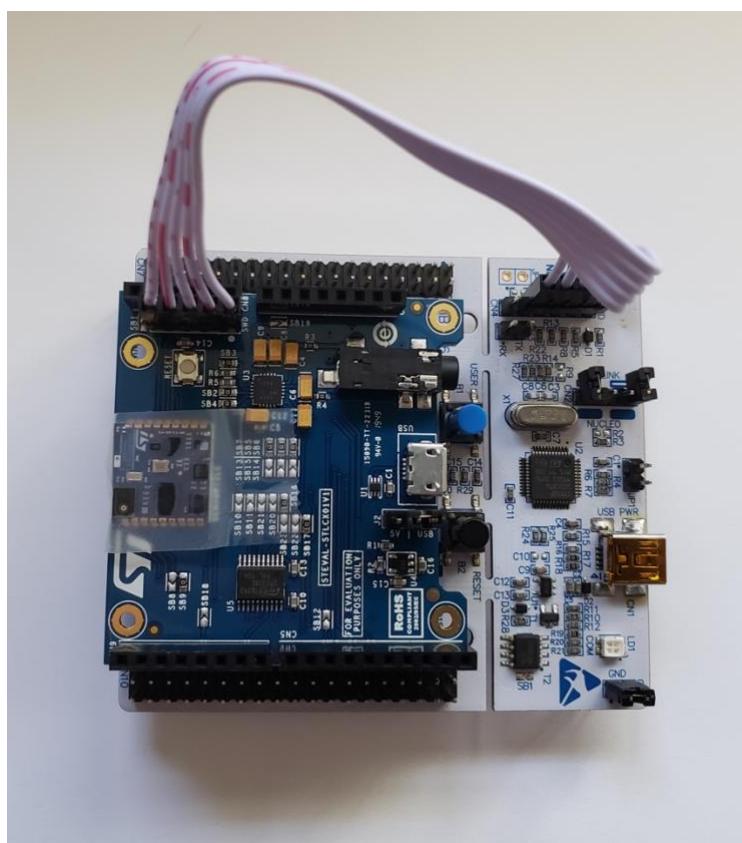


Figure 15. . SensorTile Cradle Board is placed on top of the Nucleo board without removing the cable and only by “flipping” the SensorTile Cradle Board on top of the Nucleo Board so that its connector pins are aligned with the corresponding connector on the Nucleo Board. In this image the boards have been pressed together after ensuring that all pins are aligned.



*Figure 16. The fully assembled system.*



## 6. Connect the SensorTile System to the Windows Platform

### 6.1. USB Connectors

**71) First, determine the connector type on the Windows system platform**

1. Windows system with **Two USB-A Ports** with both at one side or one at left side and one at right side



2. Windows system with **One USB-A Port**



3. Windows system with **Two USB-C Ports**





#### 4. Windows system with One USB-C Port



#### 2. Cables, Connectors and Connections

##### 1. Windows system with Two USB-A Ports with one at left side and one at right side

- A. One USB-A to Micro-USB Cable
- B. One USB-A to Mini-USB Cable
- C. Connect Both USB-A Cables to Mac Ports**

##### 2. Windows system with One USB-A Port

- A. One USB-A to Micro-USB Cable
- B. One USB-A to Mini-USB Cable
- C. USB Hub (USB-A to USB-A)
- D. Connect Hub to Windows system USB-A Port**
- E. Connect Both USB-A Cables to Hub Ports**





**3. Windows system with Two USB-C Ports**

- A. One USB-A to Micro-USB Cable
- B. One USB-A to Mini-USB Cable
- C. Two USB-C to USB-A Adapters
- D. Connect Both USB-C to USB-A Adapters to Windows system Ports**

**E. Connect Both USB-A Cables to USB-A Ports on Adapters**



**4. Windows system with One USB-C Port**

- A. One USB-A to Micro-USB Cable
- B. One USB-A to Mini-USB Cable
- C. One USB-C to USB-A Adapters
- D. Connect One USB-C to USB-A Adapters to Windows system Port**



**E. Connect Hub to Adapter USB-A Port**



**F. Connect Both USB-A Cables to Hub Ports**



**72) Attach the MiniUSB Cable to the Nucleo and the MicroUSB Cable to the SensorTile Cradle Board.**

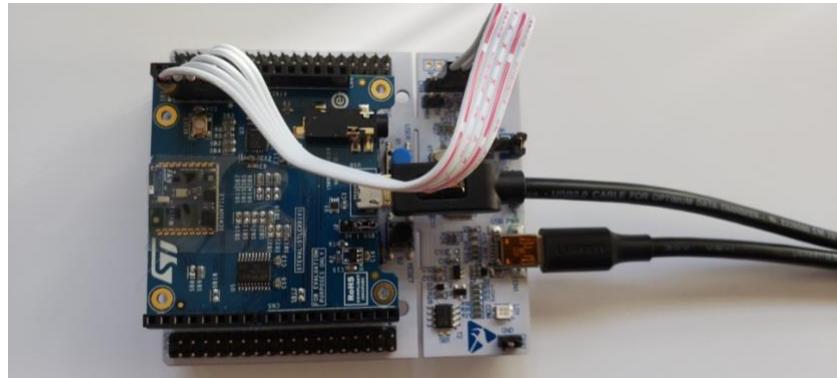


Figure 17. Attach the MiniUSB Cable to the Nucleo and the MicroUSB Cable to the SensorTile



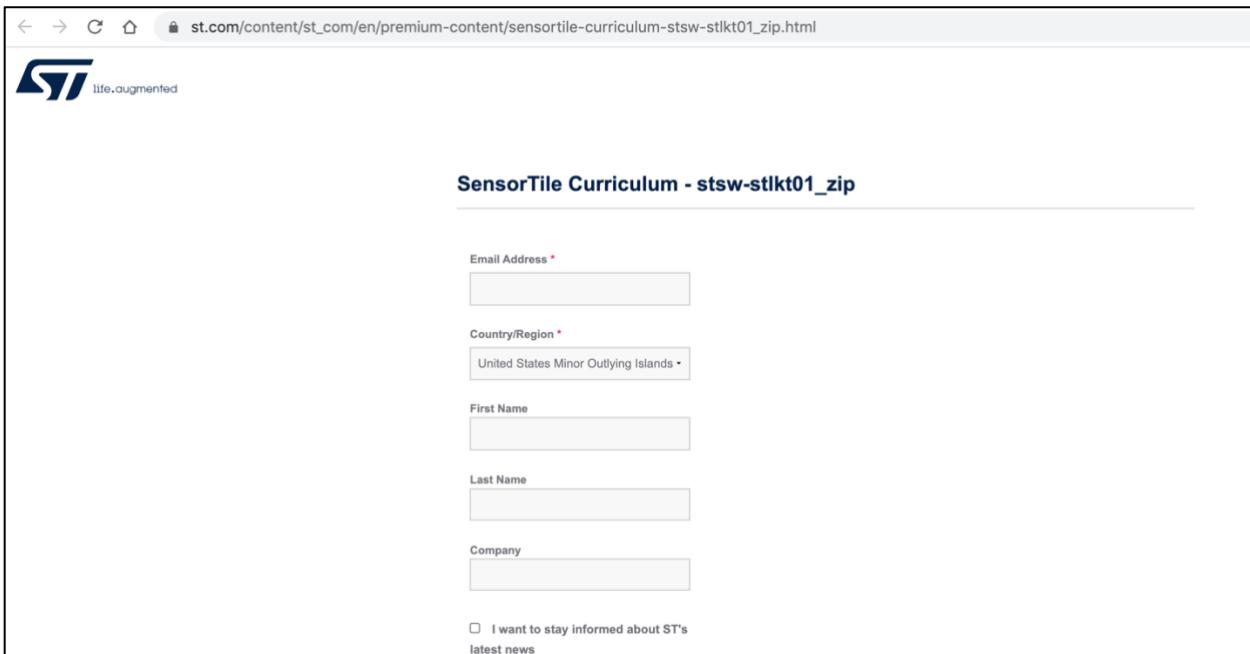
## 7. Import the DataLog Project

### 7.1. Download the DataLog Project

73) Open the following link on a web-browser on your PC.

[http://www.st.com/content/st\\_com/en/premium-content/sensortile-curriculum-stsw-stlkt01\\_zip.html](http://www.st.com/content/st_com/en/premium-content/sensortile-curriculum-stsw-stlkt01_zip.html)

74) This web page will appear



The screenshot shows a web browser displaying a registration form for the "SensorTile Curriculum - stsw-stlkt01\_zip". The URL in the address bar is "st.com/content/st\_com/en/premium-content/sensortile-curriculum-stsw-stlkt01\_zip.html". The page features the ST logo and the tagline "life.augmented". The form includes fields for Email Address, Country/Region (set to "United States Minor Outlying Islands"), First Name, Last Name, and Company. There is also a checkbox for staying informed about ST's latest news.

Email Address \*

Country/Region \*

United States Minor Outlying Islands

First Name

Last Name

Company

I want to stay informed about ST's latest news

75) Enter your previous registration information



76) Scroll to the bottom of the page and accept the terms and click on **Submit**

I consent that ST (as data controller according to the Privacy Policy) will keep a record of my navigation history and use that information as well as the personal data that I have communicated to ST for marketing purposes relevant to my interests. My personal data will be provided to ST affiliates and distributors of ST in countries located in the European Union and outside of the European Union for the same marketing purposes [READ MORE >>](#)

-----

I understand that I can withdraw my consent at any time through opt-out links embedded in communication I receive or by managing my account settings. I can also exercise other user's rights at any time as described in the Privacy Policy.

I have read and understood the [Terms of Use](#) and [Privacy Policy](#) \*

**Submit**

77) This message will appear. You may close the window.

X

**Your registration has been successfully submitted!**

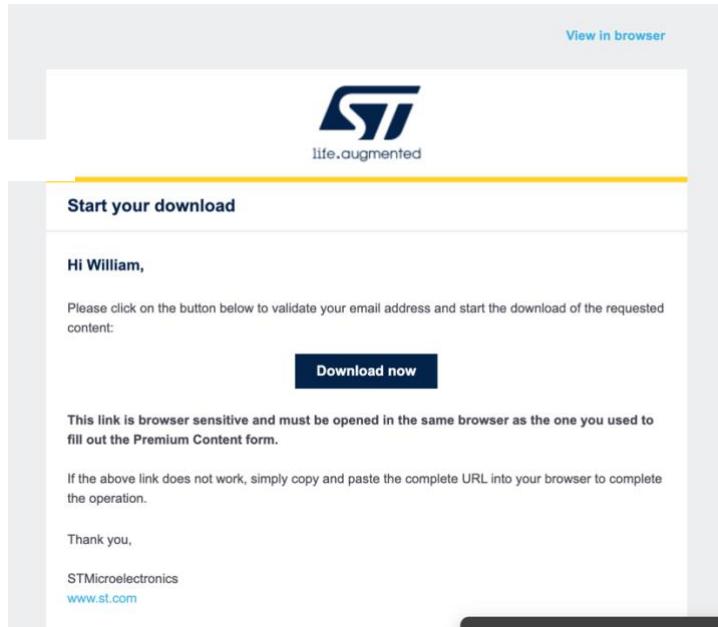
To validate your email and start the download, please click on the link inside the email that has been sent to you. This link will be valid for 24 hours. Please check your spam filters in case you did not receive the mail.

78) Then follow the registration or login steps using your previous registration

79) Wait for the confirmation email.



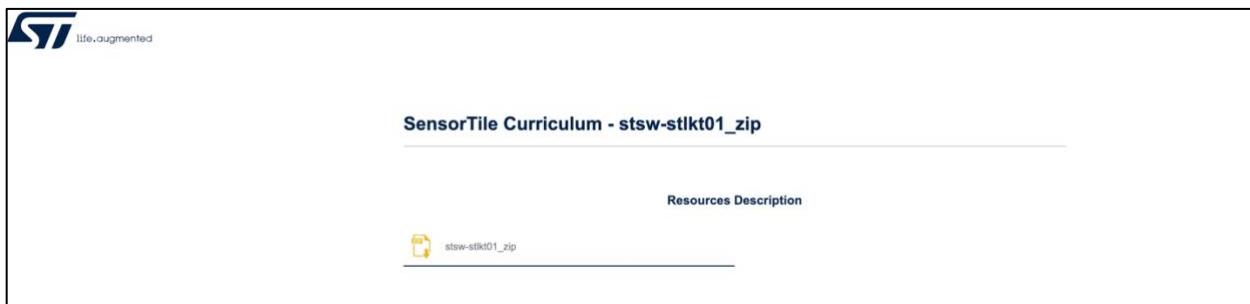
80) Check your email **inbox** and **spam** folders for the email. Click on the link indicated in the email



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

82) Then, click on the link in the confirmation email to **Download Now**

83) This web page will appear



84) Double click on the zip file, **stsw-stlkt01\_zip**

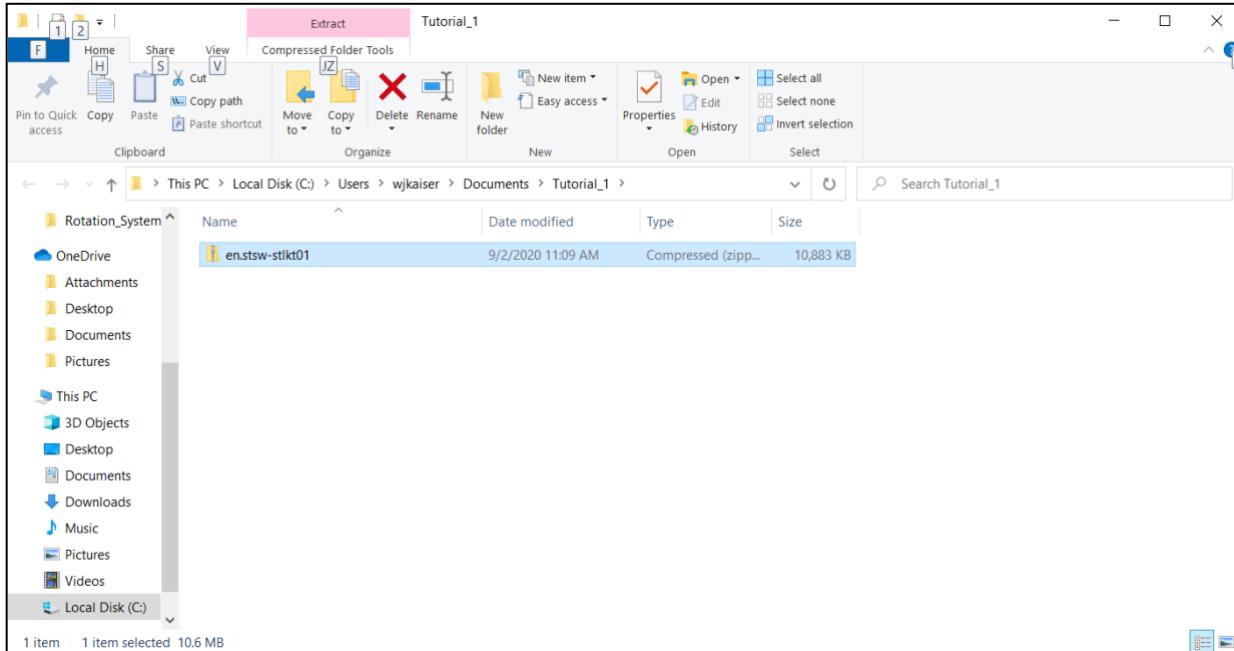
85) **Create a directory named Tutorial\_1 (without spaces) in your file system**

86) **Download into this directory**

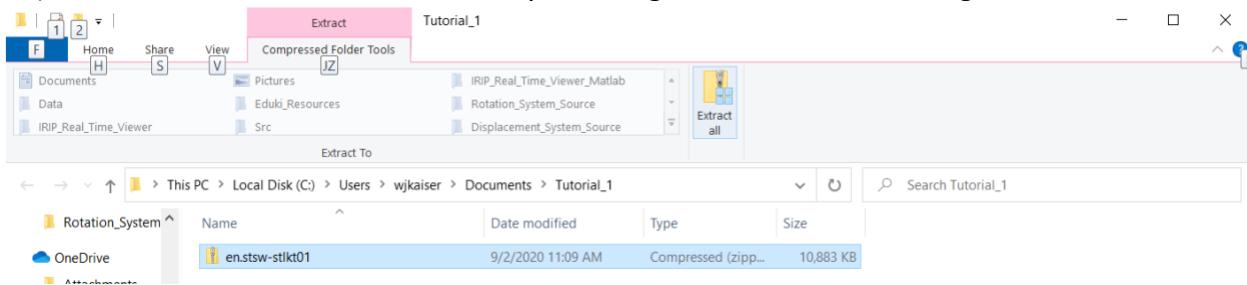


87) The full path of the directory should resemble the following.

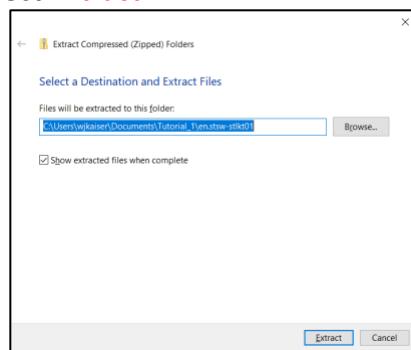
📁 > This PC > Local Disk (C:) > Users > wjkaiser > Documents > Tutorial\_1 >



88) Extract the contents of the archive by selecting the archive and clicking on **Extract All**

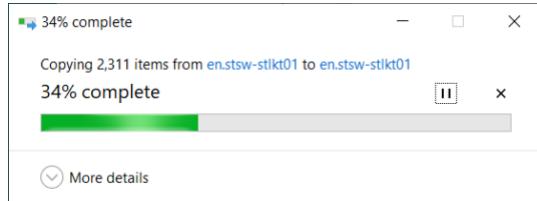


89) This window will appear, select **Extract All**

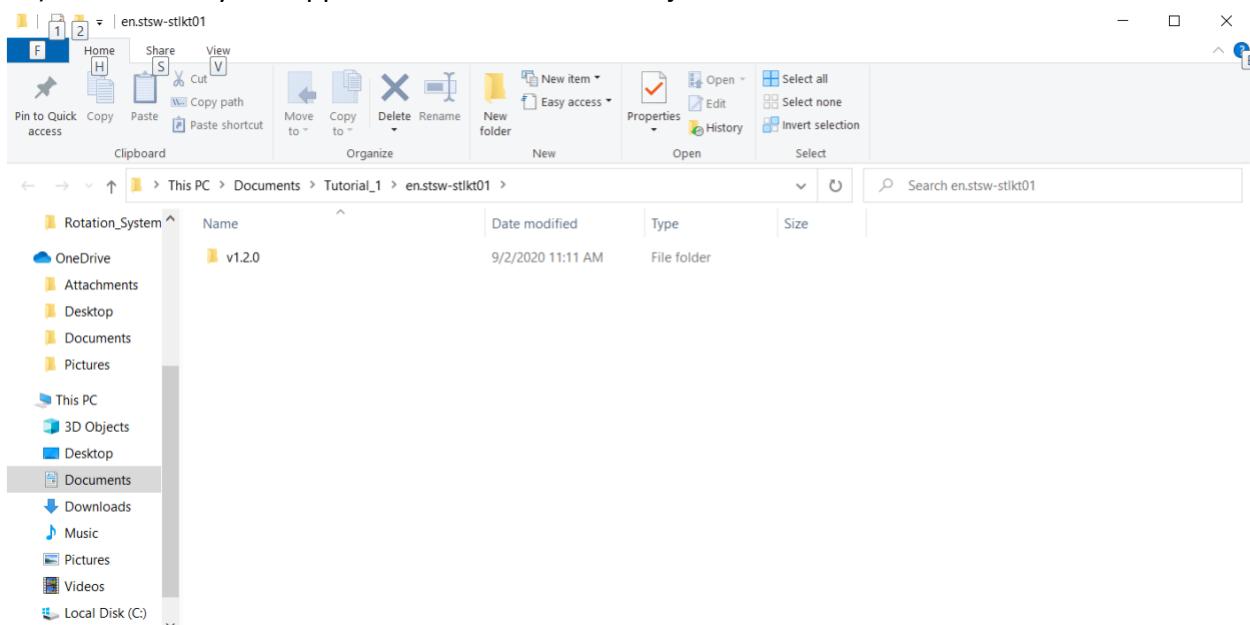




90) Wait for completion



91) This directory will appear. This contains the Project files.



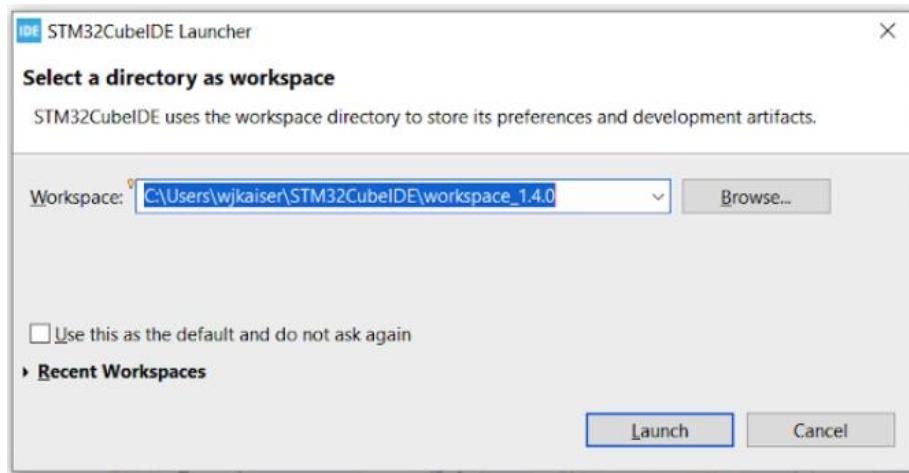
92) Now, start STM32CubeIDE by double-clicking on the application

93) You may find the application by entering STM32CubeIDE in the Windows Search Bar.

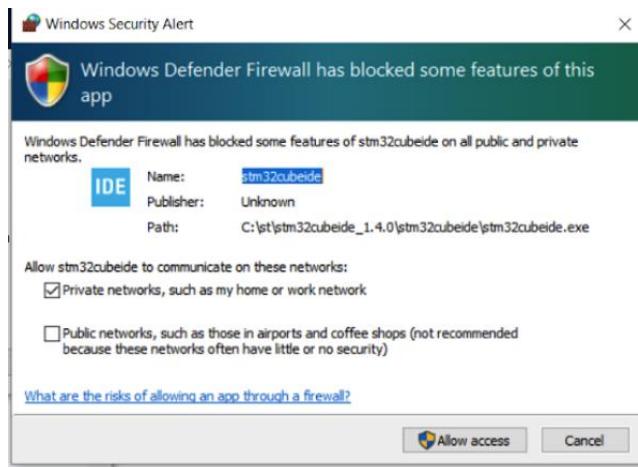


94) This screen will below appear. Use the **default workspace directory**, and click "Ok"

- a) Note: Ensure that the workspace you select does not contain any spaces. If the path to the workspace contains spaces, the IDE will not be able to compile the projects.

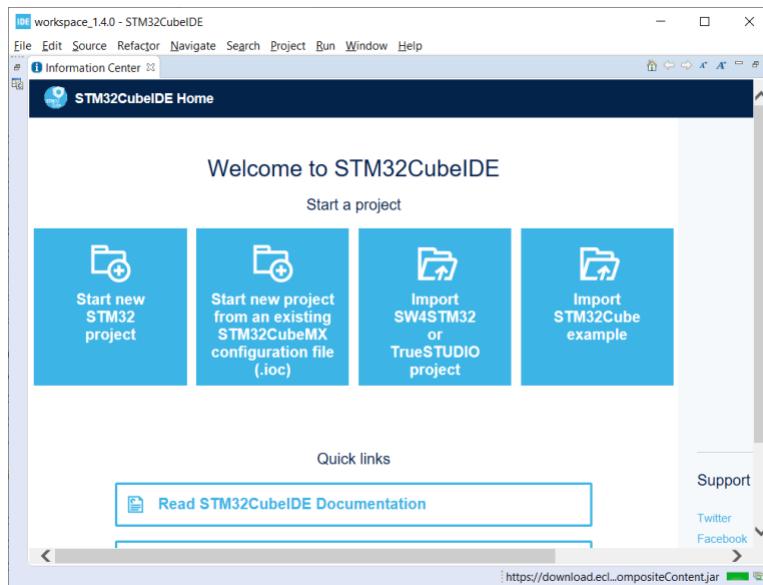


95) This screen will appear. Click **Allow Access**.

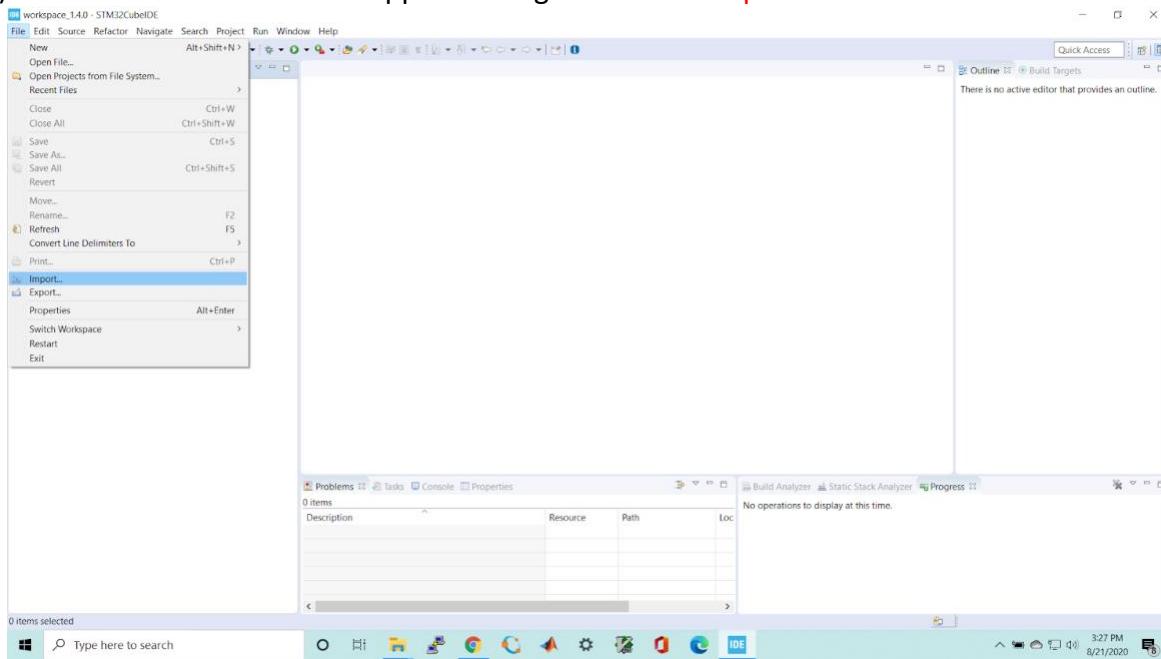




96) If you see a welcome screen below, close it by clicking the “x” in the top left corner of the tab.

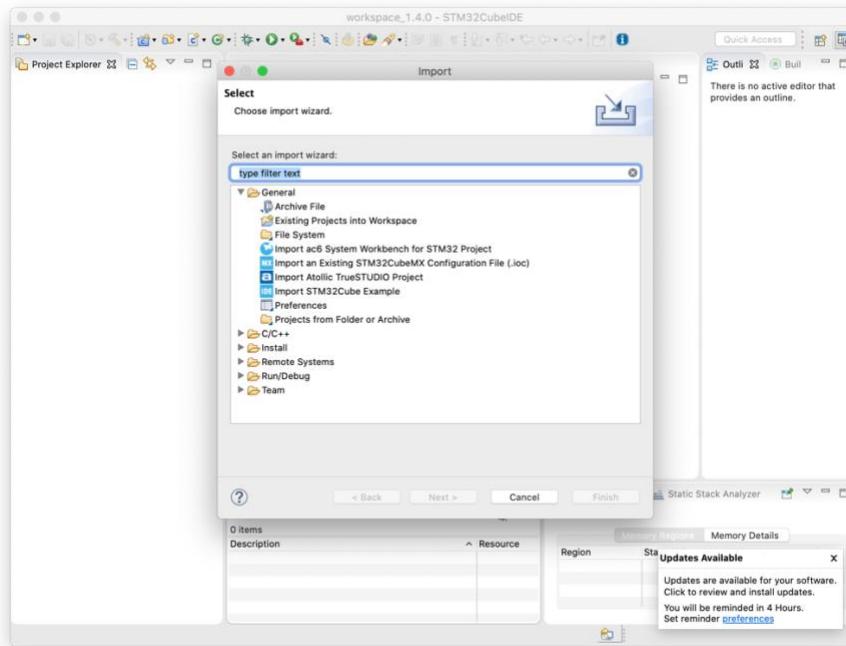


97) This screen below will now appear. Navigate to **File > Import** as shown below



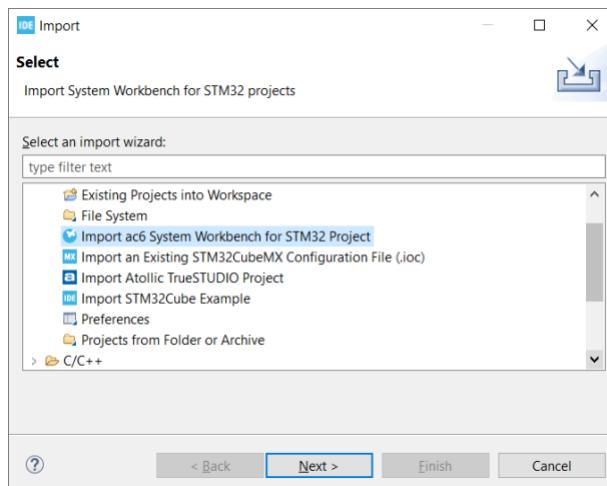


98) This window below will appear. Click on **General**



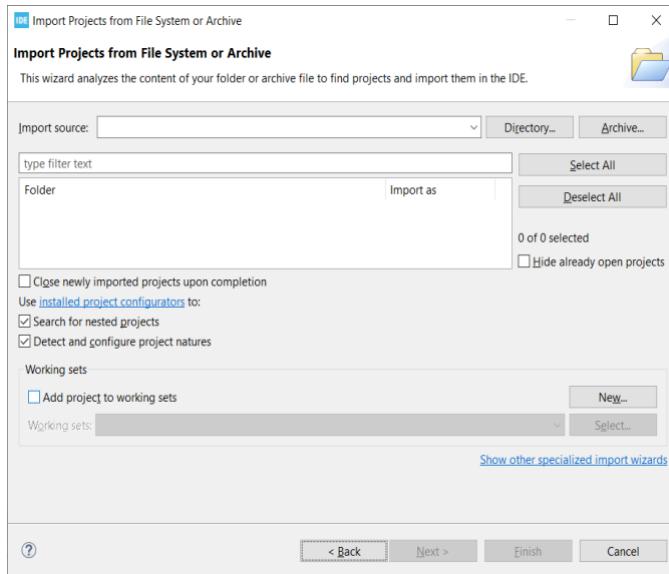
99) In the next window below, select **Import ac6 System Workbench for STM32 Project**.

**PLEASE NOTE THIS CHOICE IS CRITICAL**



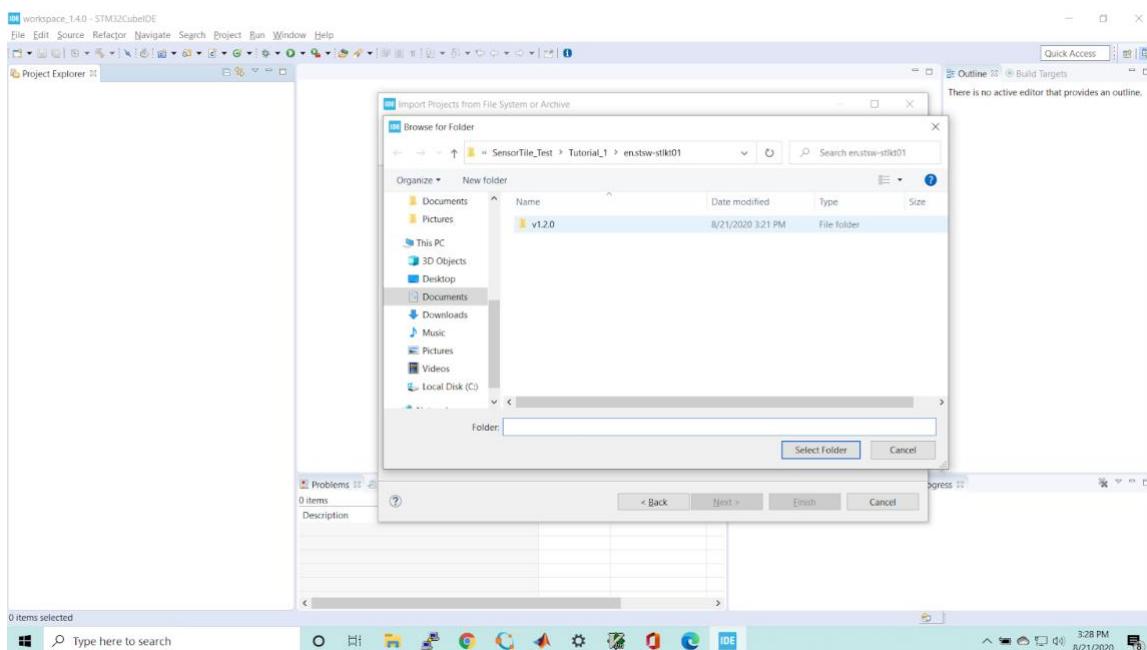


100) The next screen below will appear. Click on Directory



101) Navigate to the directory containing the **v1.20** directory as below. For example, this may be

> This PC > Documents > Tutorial\_1 > en.stsw-stlkt01





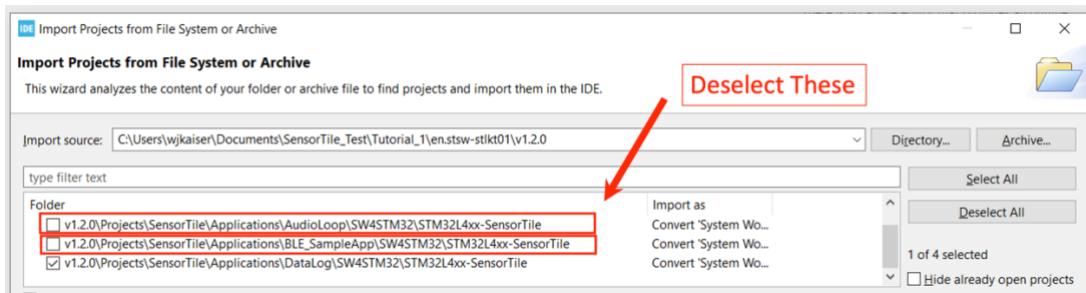
**102) DO NOT CLICK FINISH UNTIL YOU COMPLETELY READ THROUGH THESE STEPS.**

There are three projects in the v1.2.0 folder. ONLY ONE SHOULD BE IMPORTED

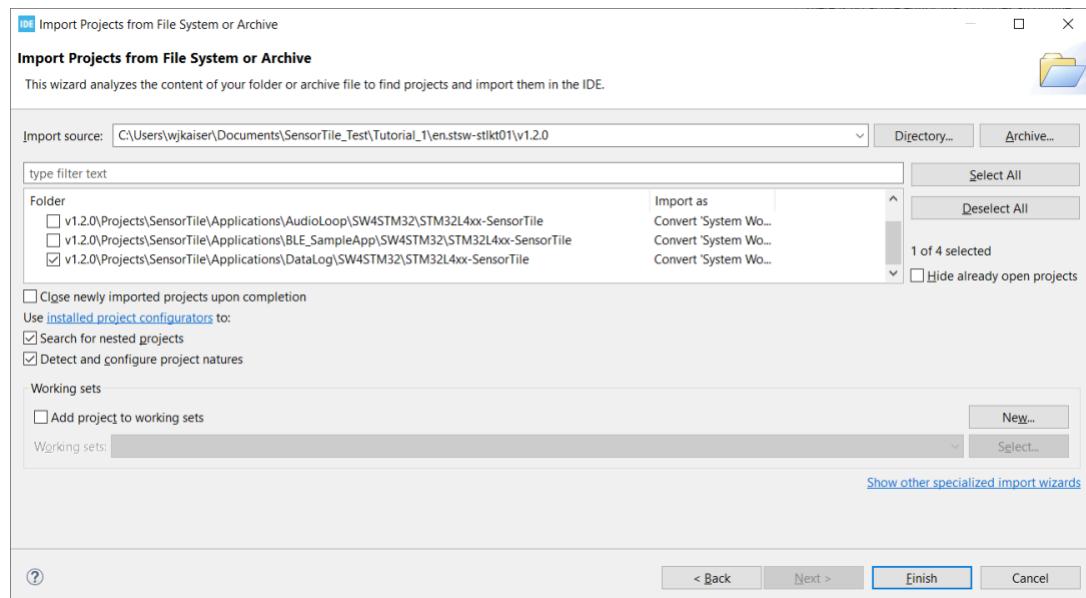
**103) The projects box should be populated with 3 projects.**

- a) **AudioLoop (Deselect This).**
- b) **BLE\_SampleApp (Deselect This).**
- c) DataLog (Keep this selected).**

**104) Uncheck the boxes next to AudioLoop and BLE\_Sample App as shown below.**



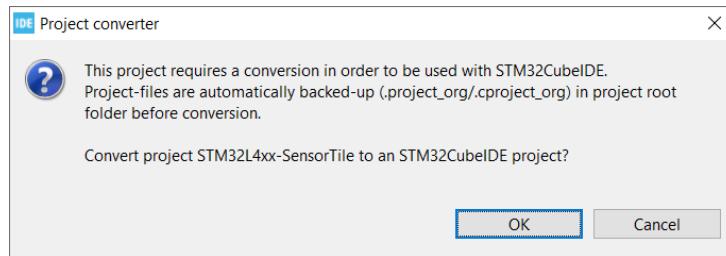
**105) Leave other checkboxes as they are shown below**



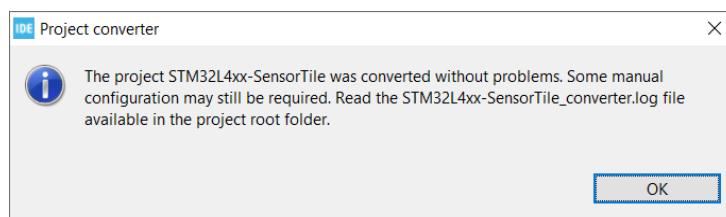
**106) Click **Finish** with only the Datalog project selected**



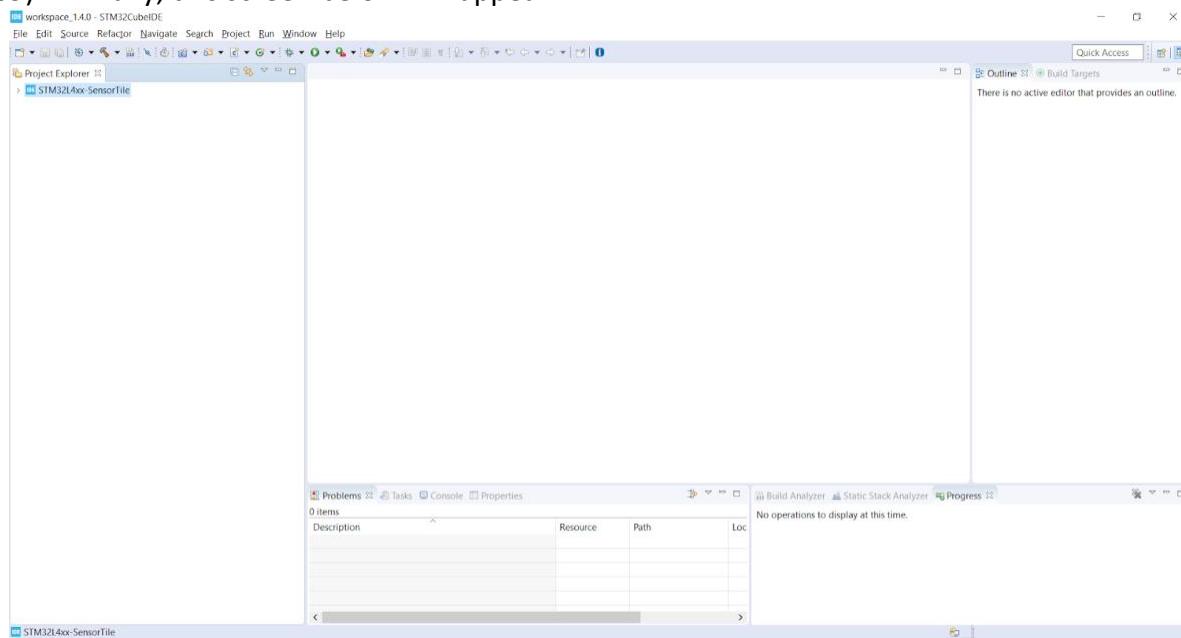
107) This screen will below appear – Select OK



108) This screen will below appear – Select OK

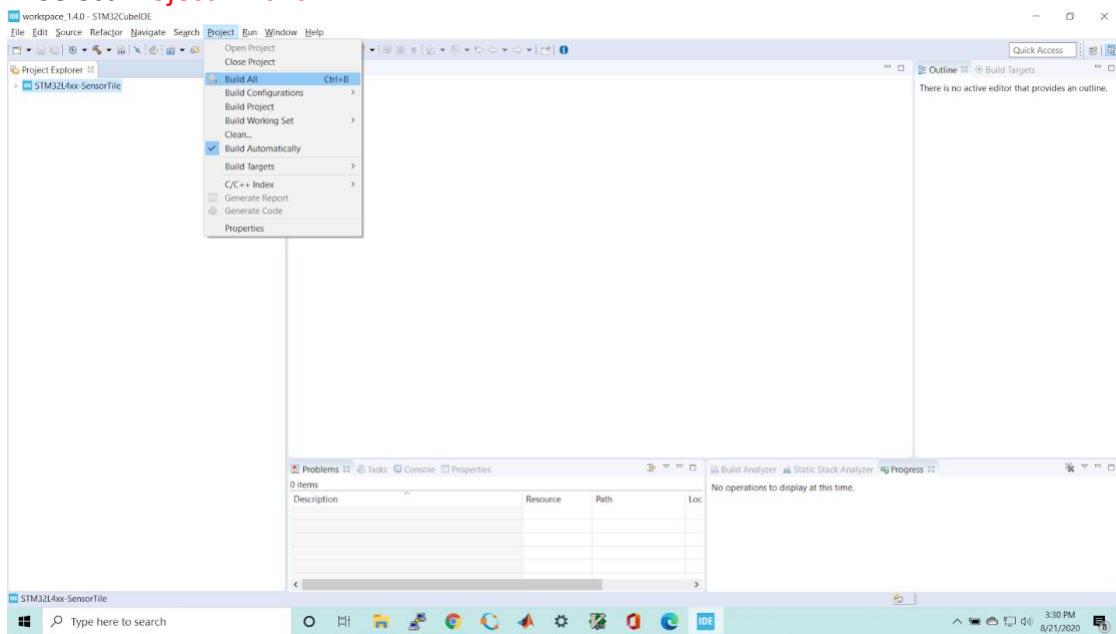


109) Finally, this screen below will appear

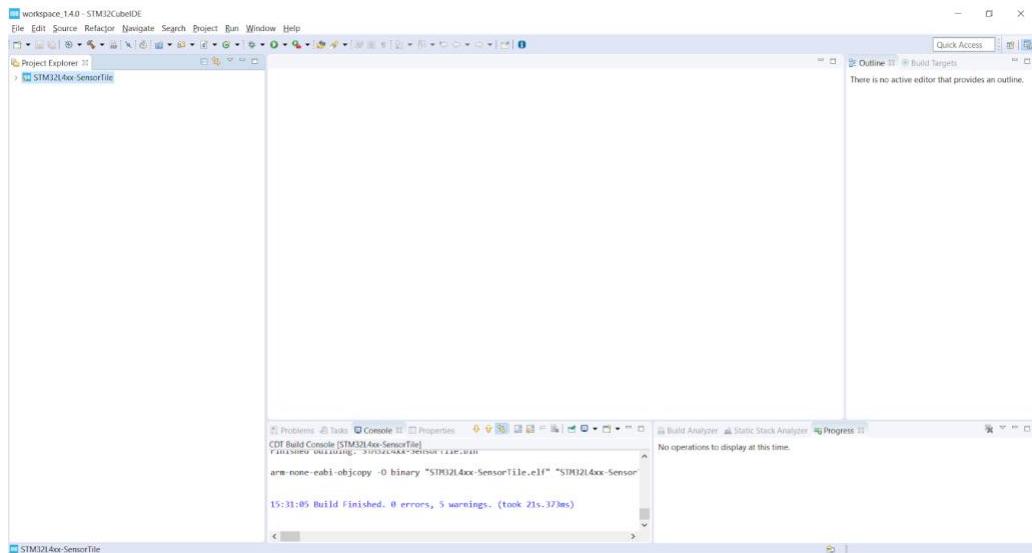




**110) Select Project > Build All**



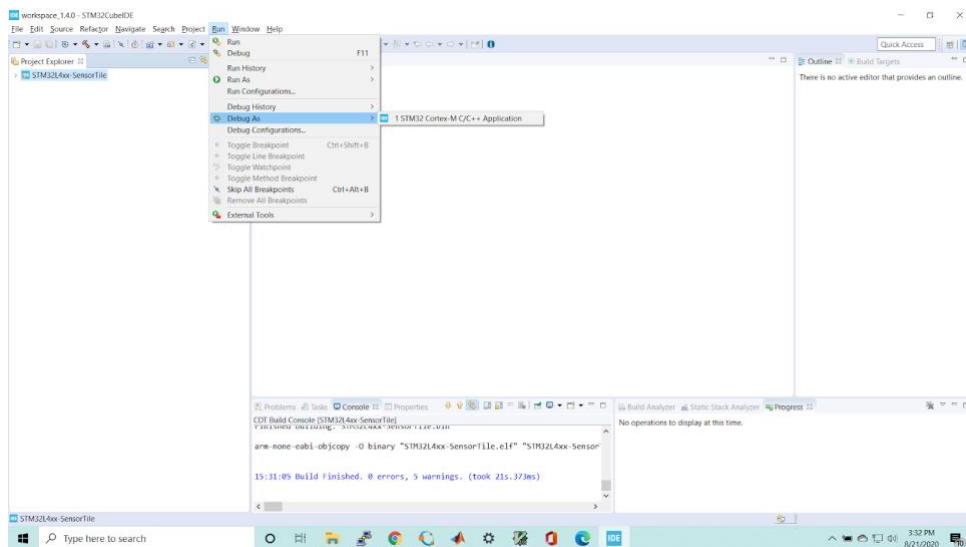
**111) This screen below will appear**



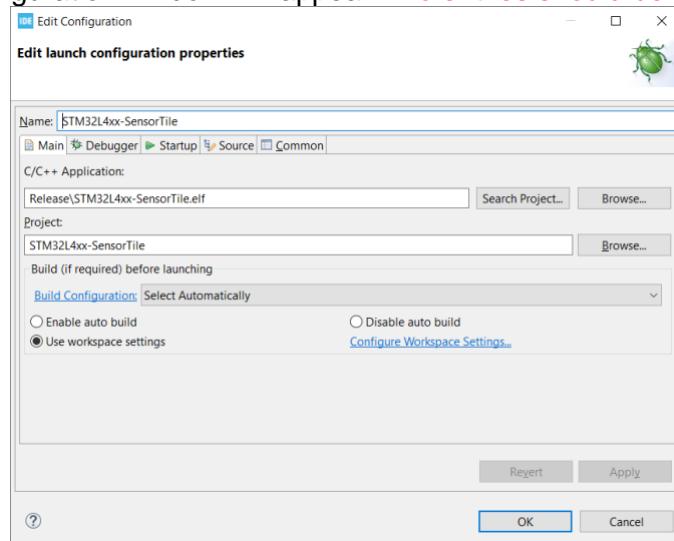


112) Highlight the Project STM32L4xx-SensorTile in the Project Explorer window tab with a single mouse click

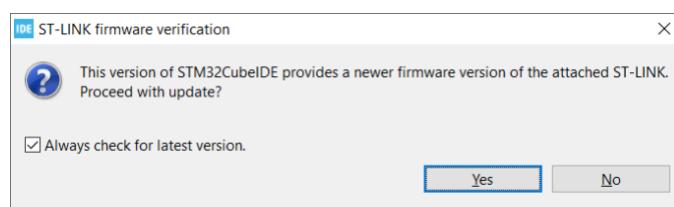
113) Now, select Run > Debug As > STM32 Cortex-M C/C++



114) A system configuration window will appear. **No entries should be changed.** Click OK.

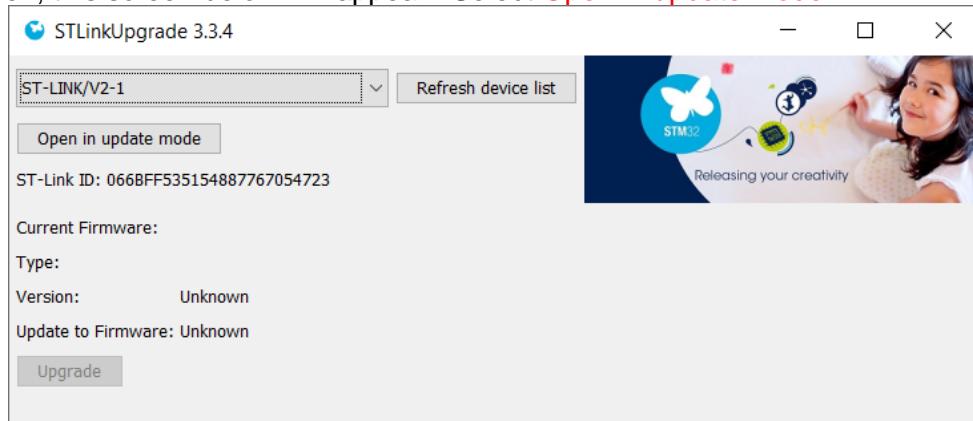


115) During the first operation, this window below will appear. Select Yes.

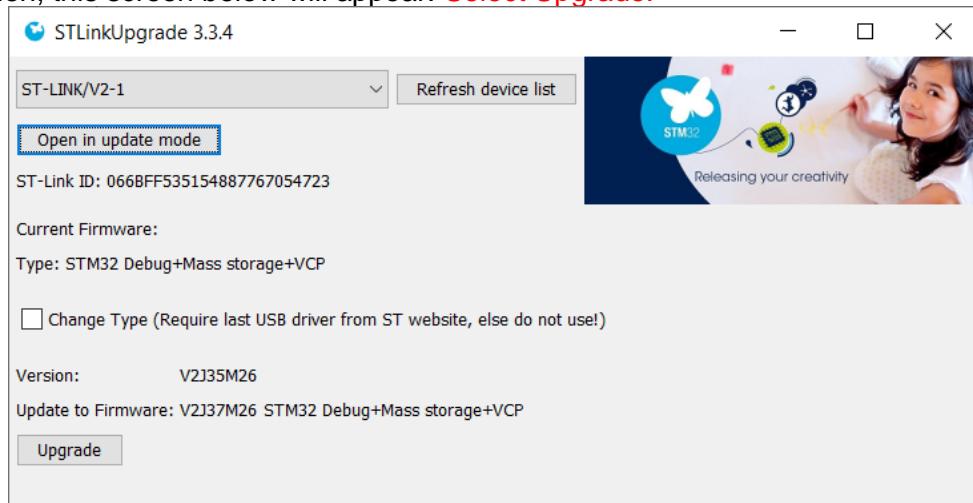




116) Then, this screen below will appear. Select **Open in update mode**



117) Then, this screen below will appear. Select **Upgrade**.



118) After completion of this step, return to the STM32CubeIDE application.

119) Highlight the Project STM324Lxx-SensorTile in the Project Explorer window tab with a single mouse click

120) Now, select **Run > Debug As > STM32 Cortex-M C/C++**



The screenshot shows the STM32CubeIDE interface. The code editor displays C++ code for initializing LEDSMD and RTC. The project explorer shows 'STM32L4xx-SensorTile'. The build console shows a successful build:

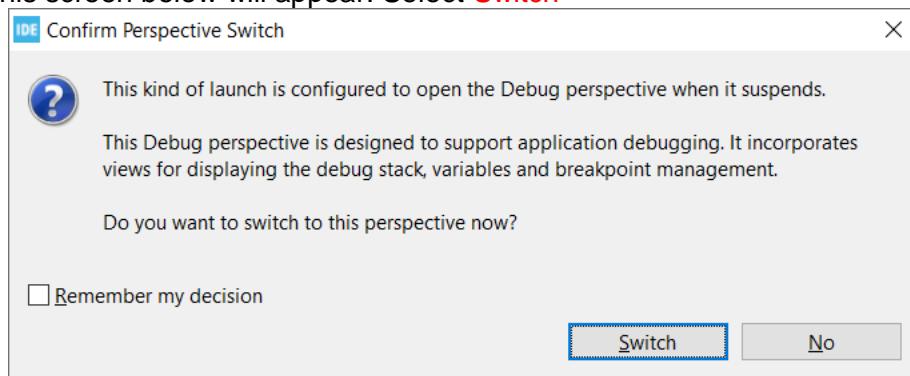
```
arm-none-eabi-objcopy -O binary "STM32L4xx-SensorTile.elf" "STM32L4xx-SensorTile.rom"
17:08:32 Build Finished. 0 errors, 0 warnings. (took 1s.537ms)
```

1.

121) The screen below may appear. You may select **Allow Access**

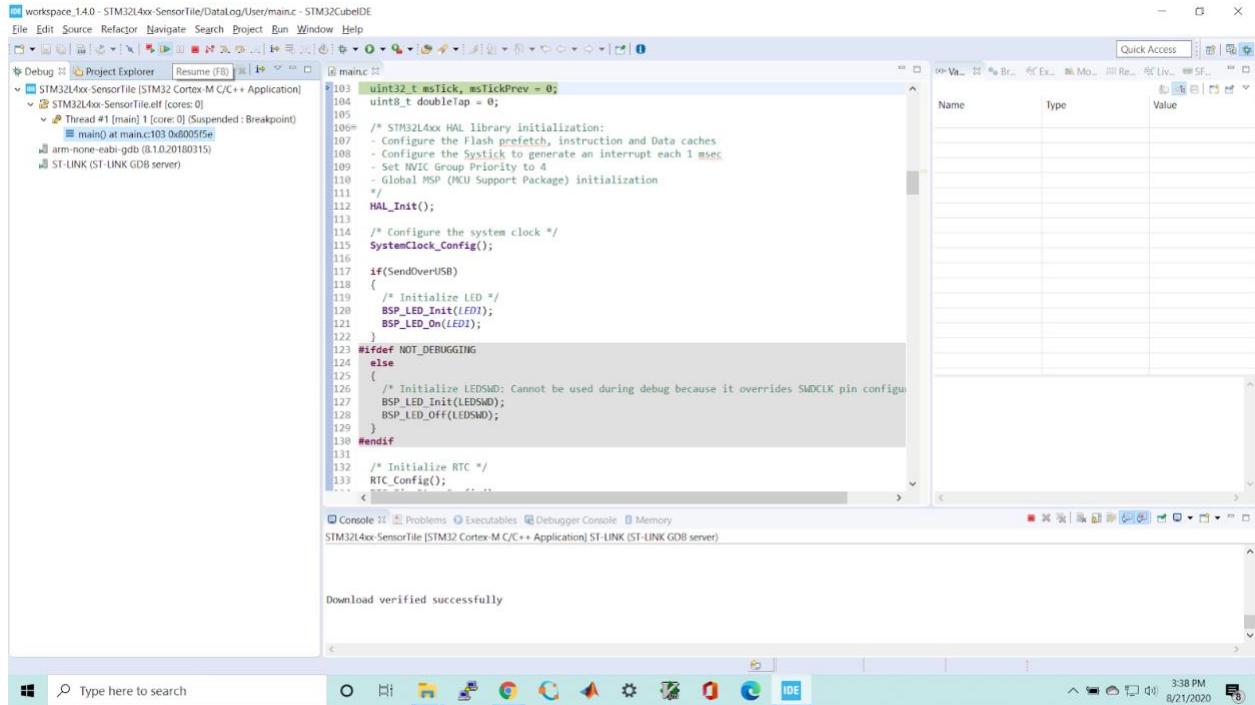


122) Finally, this screen below will appear. Select **Switch**





123) The SensorTile system is now ready to operate. This screen will appear



The screenshot shows the STM32CubeIDE interface. The Project Explorer shows a single project named "STM32L4xx-SensorTile [STM32 Cortex-M C/C++ Application]". The main.c file is open in the code editor, showing the initialization code for the HAL library, SystemClock, LED, and RTC. A memory dump table is visible on the right side of the interface.

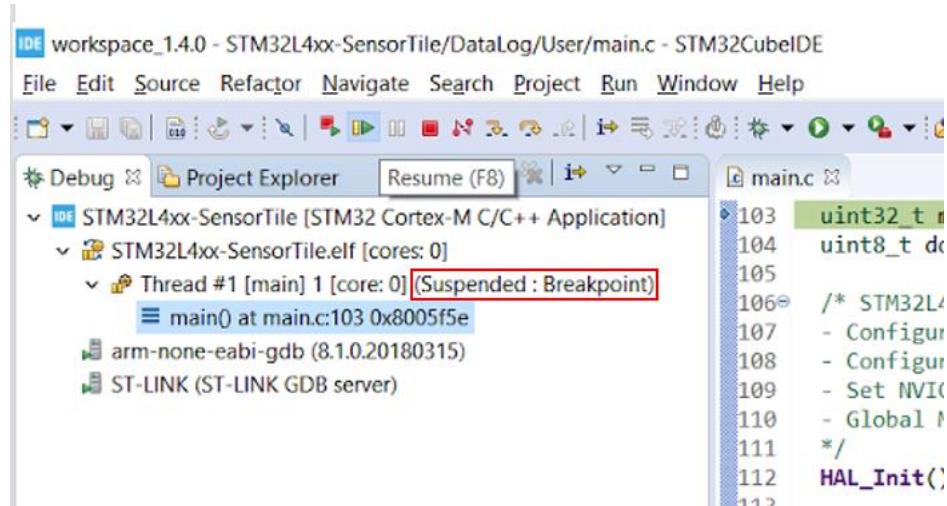
```

103 uint32_t msTick, msTickPrev = 0;
104 uint8_t doubleTap = 0;
105
106 /* STM32L4xx HAL library initialization:
107 - Configure the Flash prefetch, instruction and Data caches
108 - Configure the Systick to generate an interrupt each 1 msec
109 - Set NVIC Group Priority to 4
110 - Global MSP (MCU Support Package) initialization
111 */
112 HAL_Init();
113
114 /* Configure the system clock */
115 SystemClock_Config();
116
117 if(SendOverUSB)
118 {
119     /* Initialize LED */
120     BSP_LED_Init(LED1);
121     BSP_LED_On(LED1);
122 }
123 #ifndef NOT_DEBUGGING
124 else
125 {
126     /* Initialize LEDSDMD: Cannot be used during debug because it overrides SWDCLK pin configuration */
127     BSP_LED_Init(LEDSDMD);
128     BSP_LED_Off(LEDSDMD);
129 }
130 #endif
131
132 /* Initialize RTC */
133 RTC_Config();

```

Download verified successfully

124) Note that the SensorTile system is indicated as suspended.

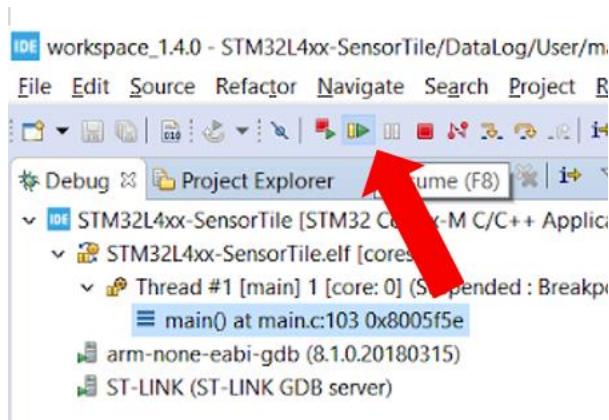


The screenshot shows the STM32CubeIDE interface. The Project Explorer shows a project named "STM32L4xx-SensorTile [STM32 Cortex-M C/C++ Application]". Under the project, there is a file named "main.c" which is currently selected. In the code editor, line 103 is highlighted. The status bar at the bottom of the interface shows the message "Download verified successfully".

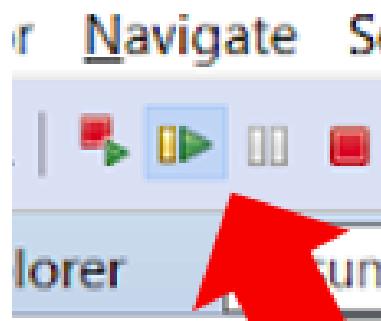
The status bar also displays the date and time: 8/21/2020 3:38 PM.



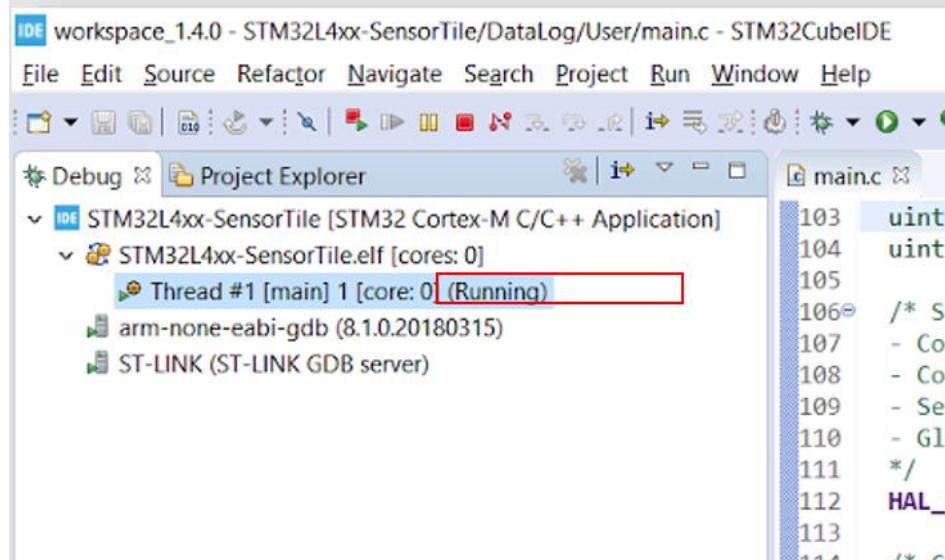
125) Note the **Resume** button. This is the green right-facing triangle.



126) Click on the **Resume** button. This is the green right-facing triangle.



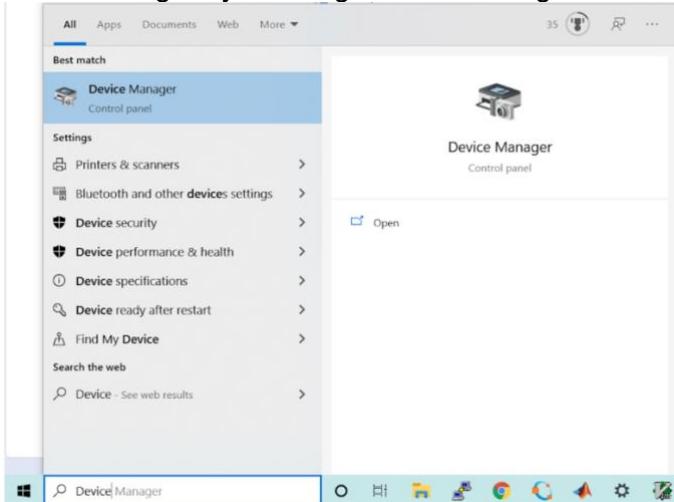
127) The system status will now show “**Running**”



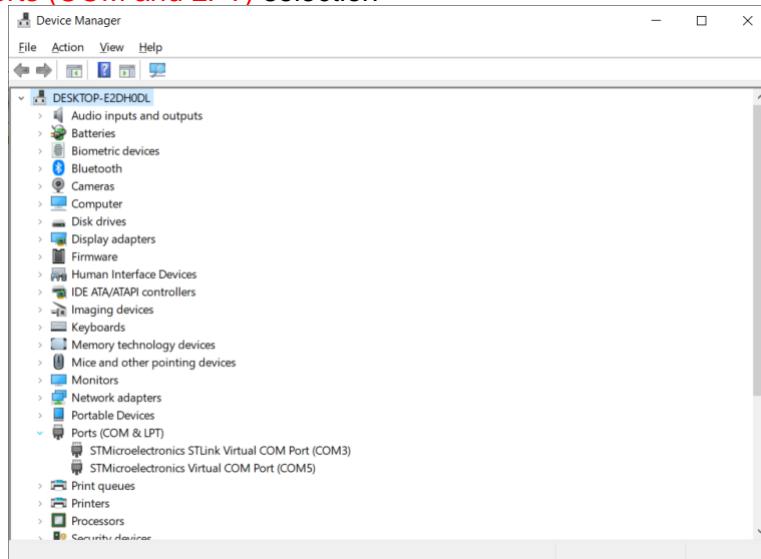


128) Now, we will proceed to determine the Serial Port assigned to the SensorTile by the Windows operating system.

129) Open up the Device Manager by entering “device manager” in the Windows search bar.

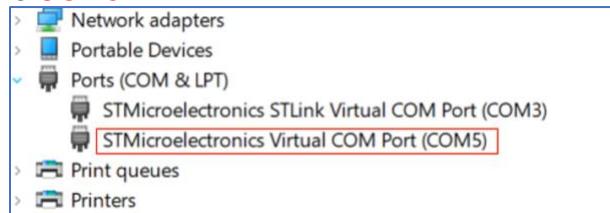


130) Expand the Ports (COM and LPT) selection



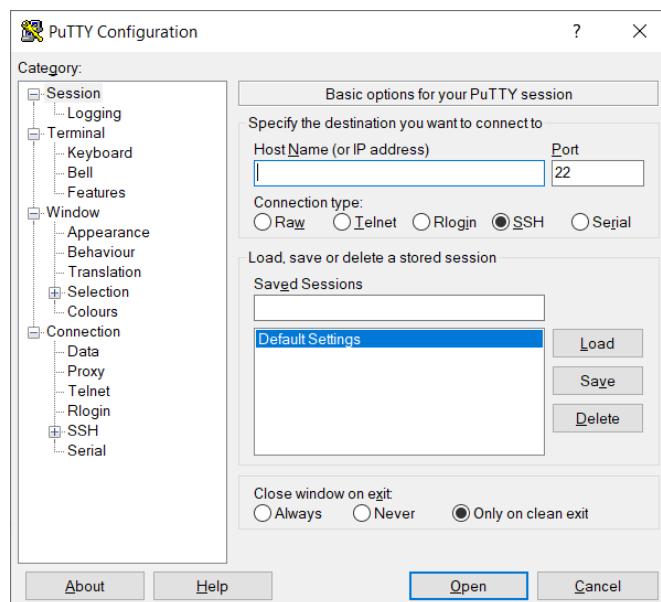


- 131) Find the COM port number indicated for the STMicroelectronics Virtual COM Port. In this example, the Port is **COM5**.



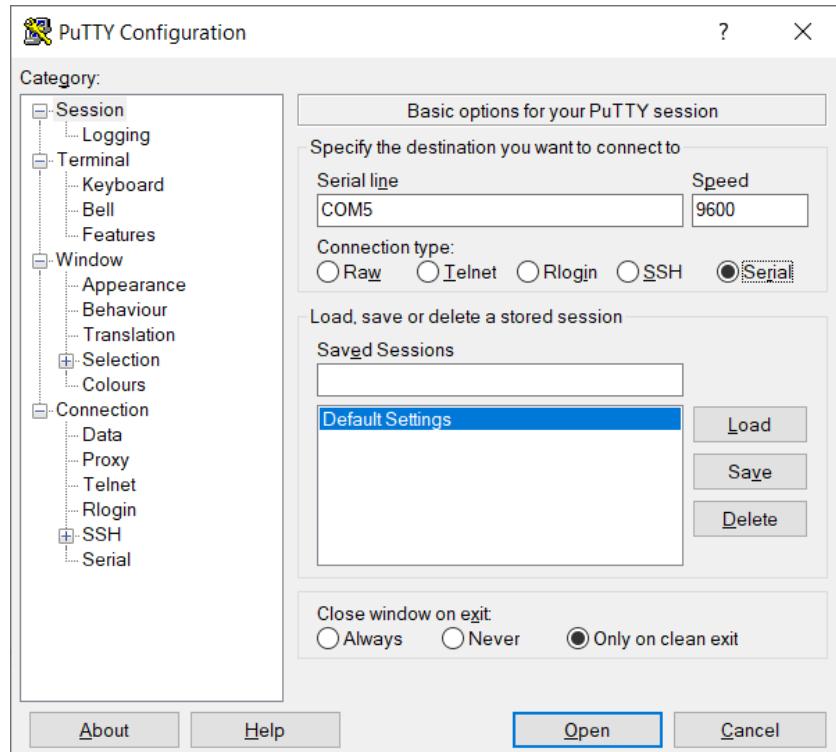
- 132) Start the Putty Application. This may be started by entering putty in the Windows Search Bar.

- 133) This screen will appear





- 134) Check the **Serial checkbox**, enter the **COM Port** found above, and enter **9600** for Baud Rate.

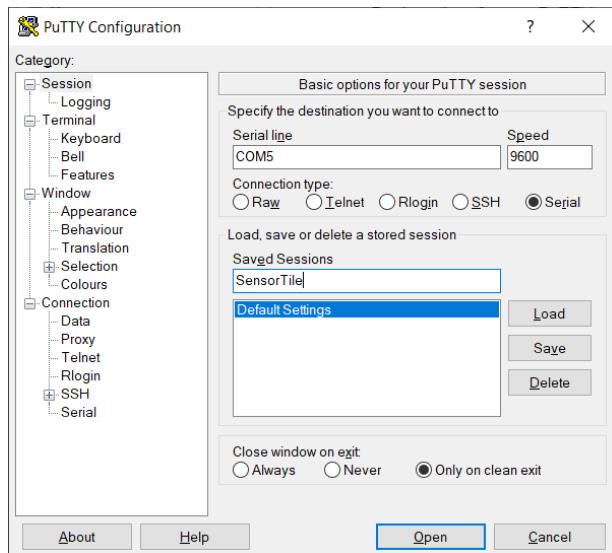


- 135) Now, a live session showing real time data from the SensorTile Accelerometer, Microgyroscope, and Barometric Pressure Sensor should appear.

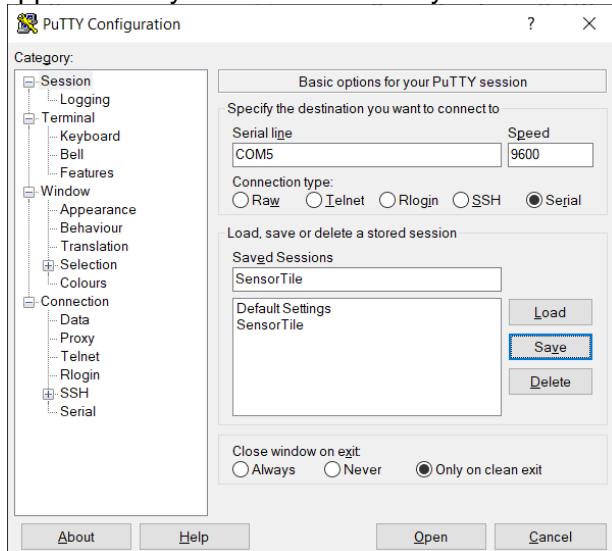
```
COM5 - PuTTY
ACC_X: -115, ACC_Y: -152, ACC_Z: 975
GYR_X: 2170, GYR_Y: -3430, GYR_Z: 0
MAG_X: -216, MAG_Y: -175, MAG_Z: -412
PRESS: 972.01
    TimeStamp: 00:10:26.13
ACC_X: -116, ACC_Y: -151, ACC_Z: 975
GYR_X: 2170, GYR_Y: -3430, GYR_Z: 0
MAG_X: -216, MAG_Y: -172, MAG_Z: -412
PRESS: 972.01
    TimeStamp: 00:10:26.23
ACC_X: -116, ACC_Y: -151, ACC_Z: 976
GYR_X: 2170, GYR_Y: -3430, GYR_Z: 0
MAG_X: -210, MAG_Y: -168, MAG_Z: -420
PRESS: 972.01
    TimeStamp: 00:10:26.33
ACC_X: -115, ACC_Y: -151, ACC_Z: 974
GYR_X: 2170, GYR_Y: -3430, GYR_Z: 0
MAG_X: -214, MAG_Y: -171, MAG_Z: -409
PRESS: 972.03
    TimeStamp: 00:10:26.42
ACC_X: -116, ACC_Y: -151, ACC_Z: 976
GYR_X: 2170, GYR_Y: -3430, GYR_Z: 0
MAG_X: -208, MAG_Y: -172, MAG_Z: -420
PRESS: 972.01
```



136) Now, the next time you use Putty, you can save the settings. Enter a name under Saved Sessions and click **Save**



137) The session will appear. Putty can be activated by double-clicking on the entry.

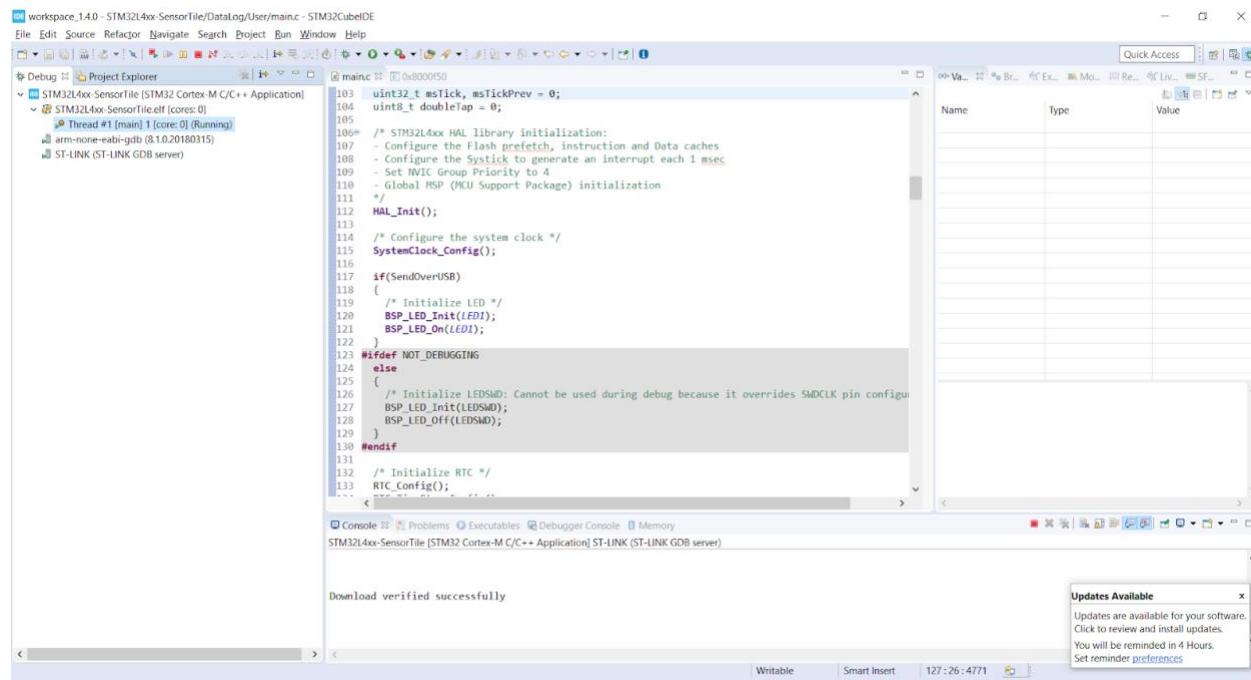


138) If any problems appear in usage, ensure that the COM Port number is correct by checking Device Manager.



## 8. Stopping Execution and Restarting a Project

- 139) There are many times when it is needed to halt execution on the SensorTile, remove the SensorTile application, and build a new application.
- 140) To proceed, first close the Putty application
- 141) Then, navigate to the Debug Window on the STM32CubeIDE.
- 142) This is selected by pressing on the “Bug” symbol at the upper right corner

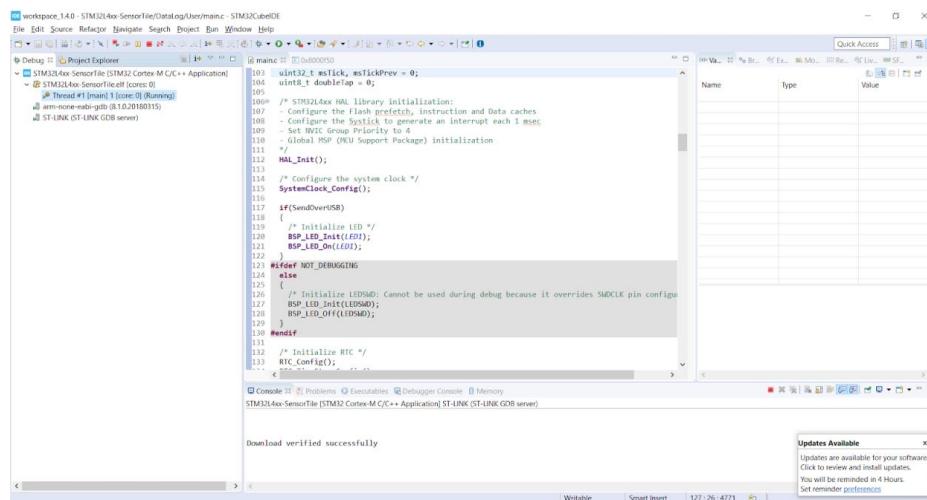


The screenshot shows the STM32CubeIDE interface. The main window displays the code for 'main.c' in the STM32L4xx-SensorTile project. The code includes initialization for the system clock, LED, and RTC. A gray rectangular selection highlights a portion of the code between lines 123 and 132. In the top right corner of the code editor, there is a small red icon resembling a bug or a stop sign, which is the symbol mentioned in the text. The bottom right corner of the screen shows a 'Updates Available' notification from the IDE.

- 143) This is the “Bug” symbol



144) The screen should appear this way:



145) If the screen does not appear in this format, select Window > Perspective > Reset Perspective



Screenshot of the STM32CubeIDE interface showing the code editor with main.c open. The code includes comments for HAL library initialization, system clock configuration, and LED initialization. A terminal window shows "Download verified successfully". A status bar at the bottom right indicates "11:56 AM 8/22/2020".

```

103     /* Configure the flash prefetch, instruction and Data caches
104     - Configure the Systick to generate an interrupt each 1 msec
105     - Set Global Priority to 4
106     - Set SubPriority to 0
107     - Global MSP (MSK Support Package) initialization
108 */
109
110     HAL_MSP_Config();
111
112     /* Configure the system clock */
113     SystemClock_Config();
114
115     /* If Serial over USART */
116
117     if(SerialOverUSART)
118     {
119         /* Initialize LED */
120         BSP_LED_Init(LED1);
121         BSP_LED_On(LED1);
122
123         #ifndef NOT_DEBUGGING
124         else
125
126             /* Initialize LED5D0: Cannot be used during debug because it overrides SdDCLK pin config
127             BSP_LED_Init(LED5D0);
128             BSP_LED_On(LED5D0);
129         */
130     #endif
131
132     /* Initialize RTC */
133     RTC_Config();
134
135 }

```

146) Now, press on the Red Square “Terminate” button as below.

Screenshot of the STM32CubeIDE interface showing the code editor with main.c open. The code includes comments for HAL library initialization, system clock configuration, and LED initialization. A terminal window shows "Download verified successfully". A status bar at the bottom right indicates "11:56 AM 8/22/2020".

```

103     /* Configure the flash prefetch, instruction and Data caches
104     - Configure the Systick to generate an interrupt each 1 msec
105     - Set Global Priority to 4
106     - Set SubPriority to 0
107     - Global MSP (MSK Support Package) initialization
108 */
109
110     HAL_MSP_Config();
111
112     /* Configure the system clock */
113     SystemClock_Config();
114
115     /* If Serial over USART */
116
117     if(SerialOverUSART)
118     {
119         /* Initialize LED */
120         BSP_LED_Init(LED1);
121         BSP_LED_On(LED1);
122
123         #ifndef NOT_DEBUGGING
124         else
125
126             /* Initialize LED5D0: Cannot be used during debug because it overrides SdDCLK pin config
127             BSP_LED_Init(LED5D0);
128             BSP_LED_On(LED5D0);
129         */
130     #endif
131
132     /* Initialize RTC */
133     RTC_Config();
134
135 }

```

Screenshot of the STM32CubeIDE interface showing the project explorer. The "Terminate (Ctrl+F2)" button is highlighted in red. The project list includes "SensorTile [STM32 Cortex-M C/C++ Application]", "#1 [main] 1 [core: 0] (Running)", and "eabi-gdb (8.1.0.20180315)". A status bar at the bottom right indicates "11:56 AM 8/22/2020".

147) The screen will now appear with the application shown as terminated



workspace\_14.0 - STM32L4xx-SensorTile/DataLog/User/main.c - STM32CubeIDE

```

File Edit Source Refactor Navigate Search Project Run Window Help
Debug Project Explorer main.c [main.c]
<terminated> STM32L4xx-SensorTile [STM32 Cortex-M C/C++ Application] ST-LINK (ST-LINK GDB)
  <terminated, exit value: 0> arm-none-eabi-gdb (8.1.2019031)
  <terminated, exit value: -2147418112> ST-LINK (ST-LINK GDB)

103     uint32_t msTick, msTickPrev = 0;
104
105     uint8_t doubleTap = 0;
106
107     /* STM32L4xx HAL library initialization:
108      - Configure the Flash prefetch, instruction and Data caches
109      - Configure the SysTick to generate an interrupt each 1 msec
110      - Set NVIC Group Priority to 4
111      - Global MSP (MCU Support Package) initialization
112    */
113
114     HAL_Init();
115
116     /* Configure the system clock */
117     SystemClock_Config();
118
119     #if(SendOverUSB)
120
121         /* Initialize LED */
122         BSP_LED_Init(LED1);
123         BSP_LED_On(LED1);
124
125     #endif
126
127     /* Initialize RTC */
128     RTC_Config();
129
130 #endif

```

Console Problems Executables Debugger Console Memory

<terminated> STM32L4xx-SensorTile [STM32 Cortex-M C/C++ Application] ST-LINK (ST-LINK GDB server)

Download verified successfully

Debugger connection lost.  
Shutting down...

Updates Available

Updates are available for your software.  
Click to review and install updates.  
You will be reminded in 4 Hours.  
Set reminder preferences

Type here to search

148) Then, remove this terminated application with the Remove All Terminated Launches button

workspace\_14.0 - STM32L4xx-SensorTile/DataLog/User/main.c - STM32CubeIDE

```

File Edit Source Refactor Navigate Search Project Run Window Help
Debug Project Explorer main.c [main.c]
<terminated> STM32L4xx-SensorTile [STM32 Cortex-M C/C++ Application] ST-LINK (ST-LINK GDB)
  <terminated, exit value: 0> arm-none-eabi-gdb (8.1.2019031)
  <terminated, exit value: -2147418112> ST-LINK (ST-LINK GDB)

103     uint32_t msTick, msTickPrev = 0;
104
105     uint8_t doubleTap = 0;
106
107     /* STM32L4xx HAL library initialization:
108      - Configure the Flash prefetch, instruction and Data caches
109      - Configure the SysTick to generate an interrupt each 1 msec
110      - Set NVIC Group Priority to 4
111      - Global MSP (MCU Support Package) initialization
112    */
113
114     HAL_Init();
115
116     /* Configure the system clock */
117     SystemClock_Config();
118
119     #if(SendOverUSB)
120
121         /* Initialize LED */
122         BSP_LED_Init(LED1);
123         BSP_LED_On(LED1);
124
125     #endif
126
127     /* Initialize RTC */
128     RTC_Config();
129
130 #endif

```

Console Problems Executables Debugger Console Memory

<terminated> STM32L4xx-SensorTile [STM32 Cortex-M C/C++ Application] ST-LINK (ST-LINK GDB server)

Download verified successfully

Debugger connection lost.  
Shutting down...

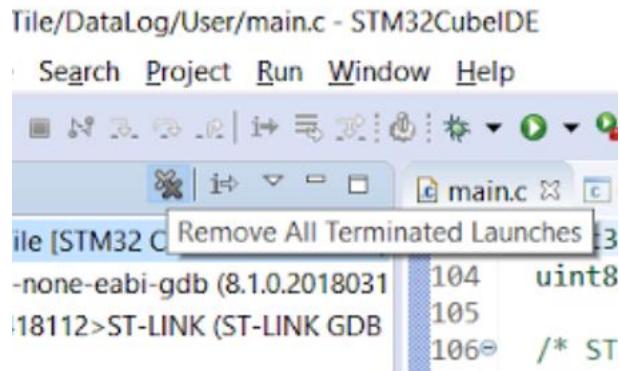
Updates Available

Updates are available for your software.  
Click to review and install updates.  
You will be reminded in 4 Hours.  
Set reminder preferences

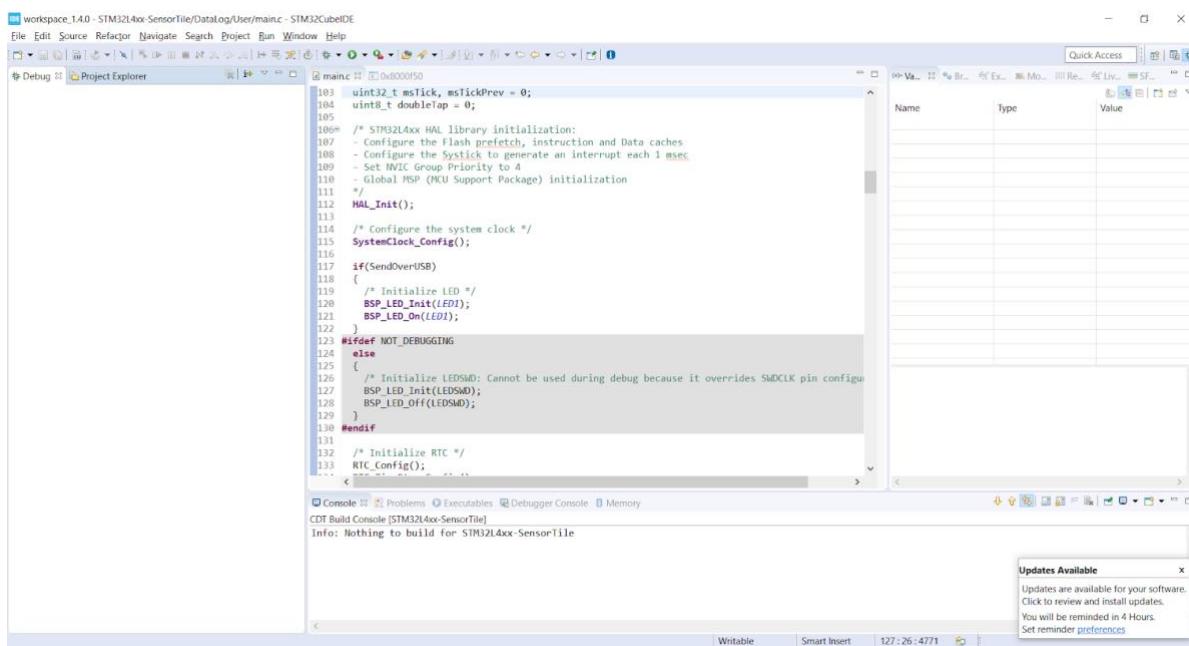
Type here to search



149) The Remove All Terminated Launches button



150) Now, the Debug tab in the screen will show no terminated launches





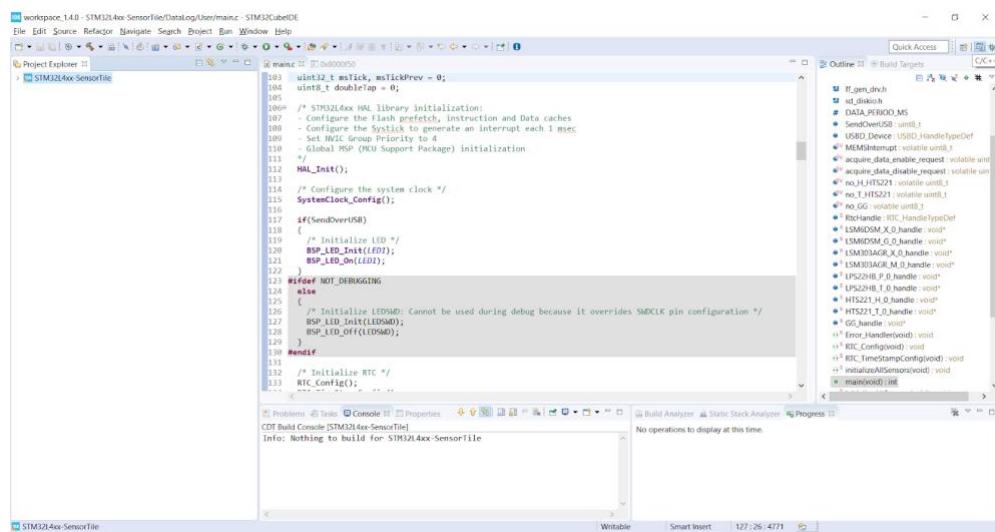
151) Navigate back to the C/C++ window by clicking on the symbol at upper right

152) The C/C++ window window selector symbol at upper right

-   □   ×



153) The C/C++ window will appear



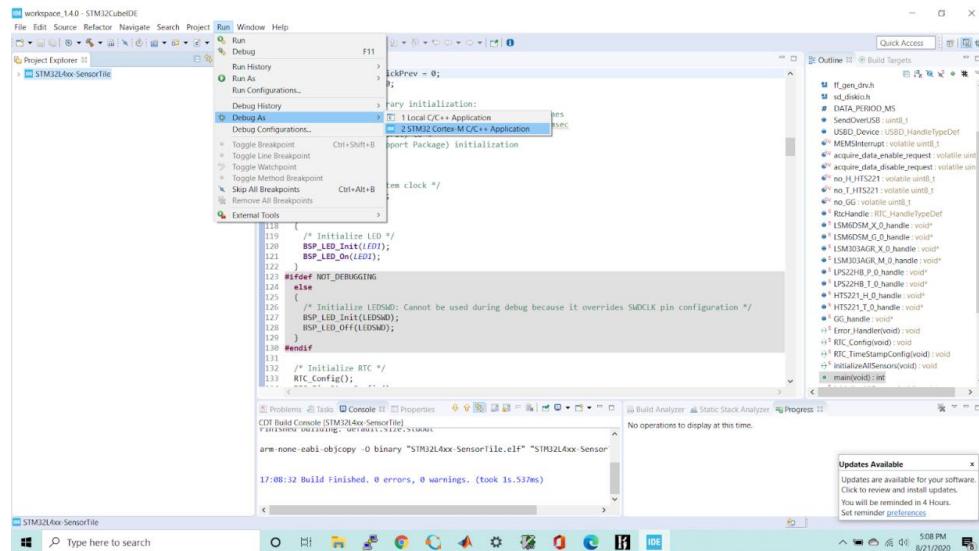
```

1 main.c [main]
2
3 uint32_t msTick = 0;
4 uint32_t doubleTap = 0;
5
6 /* STM32L4xx HAL library initialization:
7  * - Configure the Flash prefetch, Instruction and Data caches
8  * - Initialize Systick to generate an interrupt each 1 ms
9  * - Set NVIC Group Priority to 4
10 * - Global MSP (MCU Support Package) initialization
11 */
12 HAL_Init();
13
14 /* Configure the system clock */
15 SystemClock_Config();
16
17 if(SendOverRSB)
18 {
19     /* Initialize LED */
20     BSP_LED_Init(LED1);
21     BSP_LED_On(LED1);
22 }
23 #endif NOT_DEBUGGING
24 else
25 {
26     /* Initialize LED0D: Cannot be used during debug because it overrides SMDCK pin configuration */
27     BSP_LED_Init(LED0D);
28     BSP_LED_On(LED0D);
29 }
30 #endif
31
32 /* Initialize RTC */
33 RTC_Config();
34 ...

```



154) Select Run > Debug As > STM32 Cortex-M C/C++ Application once again and test with the Putty application as in previous steps





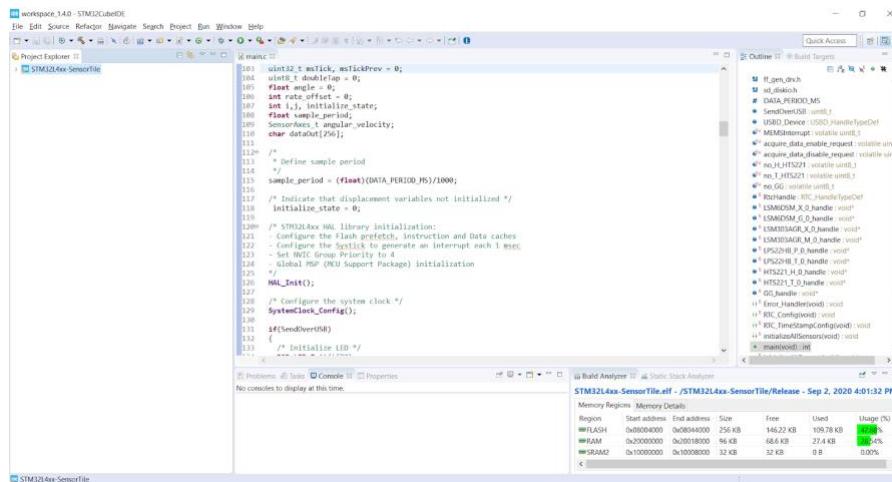
## 9. Removing a Project from the Workspace

After development and testing of a Project is completed, it will be important to remove the Project from the Workspace **but not delete the Project**.

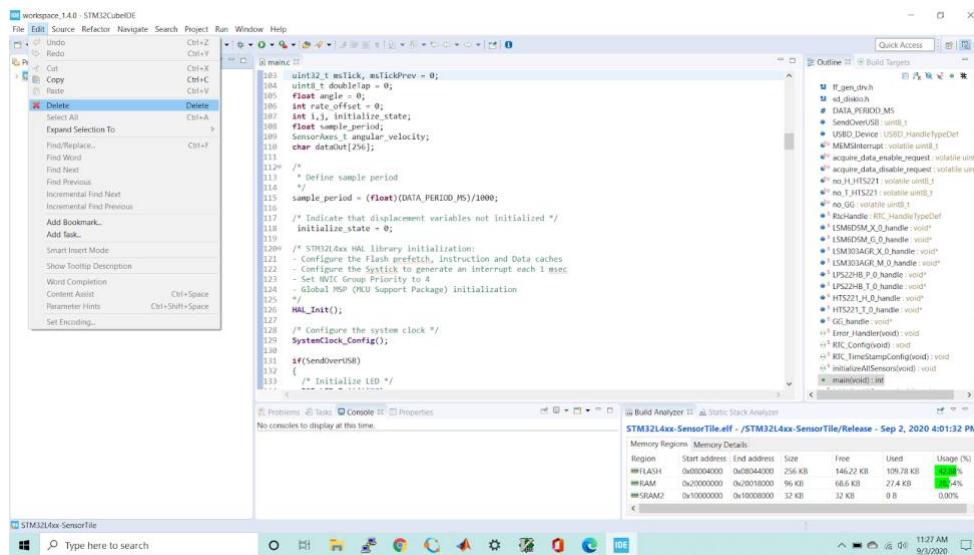
This will permit the import of a new Project.

155) Navigate to the C/C++ Window

156) If the screen does not appear in this format, select Window > Perspective > Reset Perspective

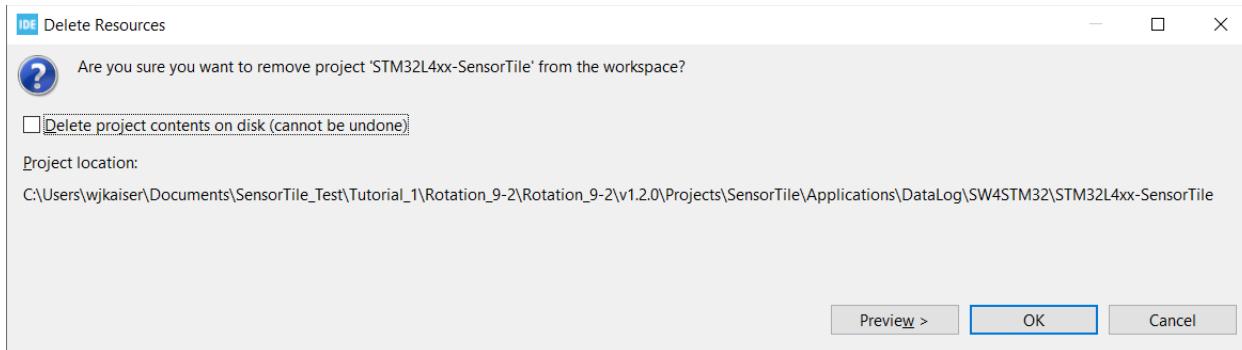


157) Highlight the Project in the Project Explorer tab and the select Edit > Delete





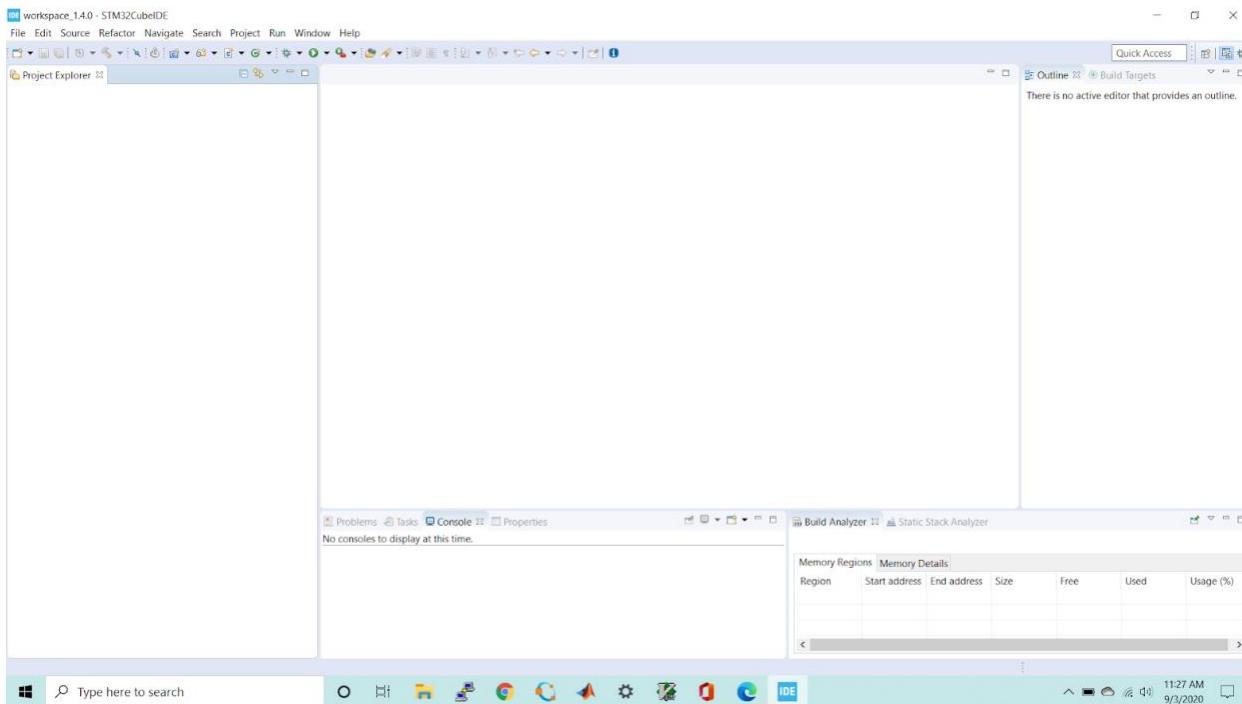
158) After clicking Delete this window will appear



159) **Do Not Check the Box** – there is no need to delete the Project from the file system. You may wish to retain this so that it can be imported later.

160) Just click **OK**.

161) This screen will appear with no Projects shown.



162) This successfully completes the installation of the STM32CubeIDE, the ST-Link systems and imports an important project.



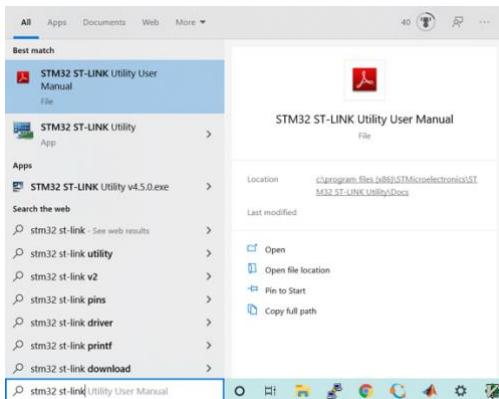
## 10. Optional: Introduction to ST-Link Utility

---

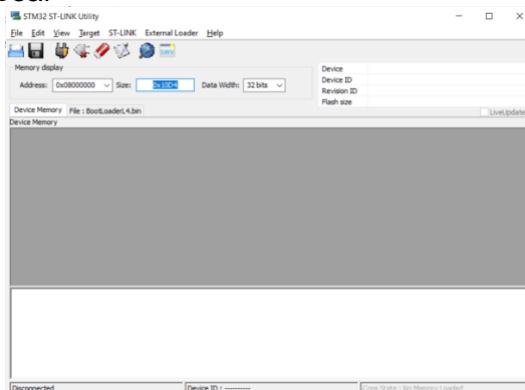
This section describes the method that enables writing of SensorTile application executable files to SensorTile non-volatile memory. After completion of this step, the SensorTile system may operate independently of a computing platform and requires only a USB power source.

This process will install a Bootloader executable that launches at the time that the SensorTile receives power or is reset. This process also installs an application – in this case, Datalog.

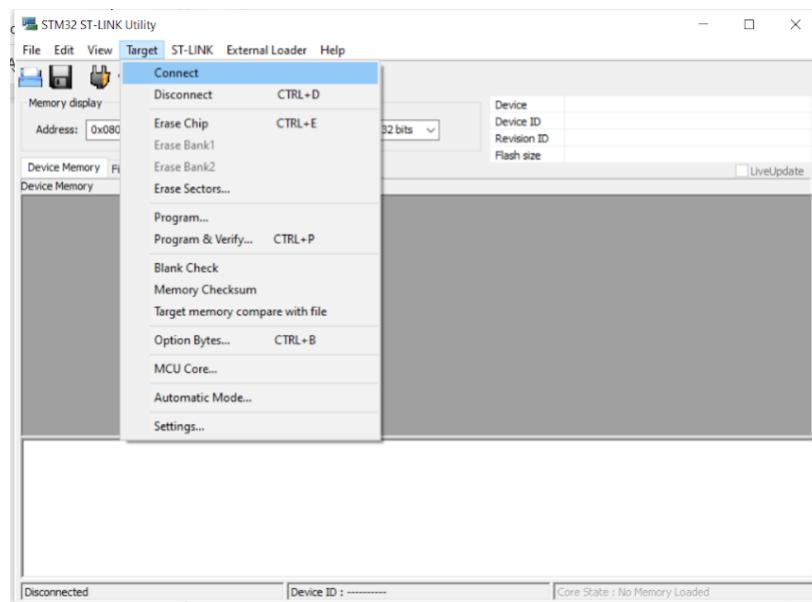
- 163) First, terminate any currently executing applications using the method of Section 8
- 164) Then Start ST-Link by entering ST-Link in the Windows search bar, as below



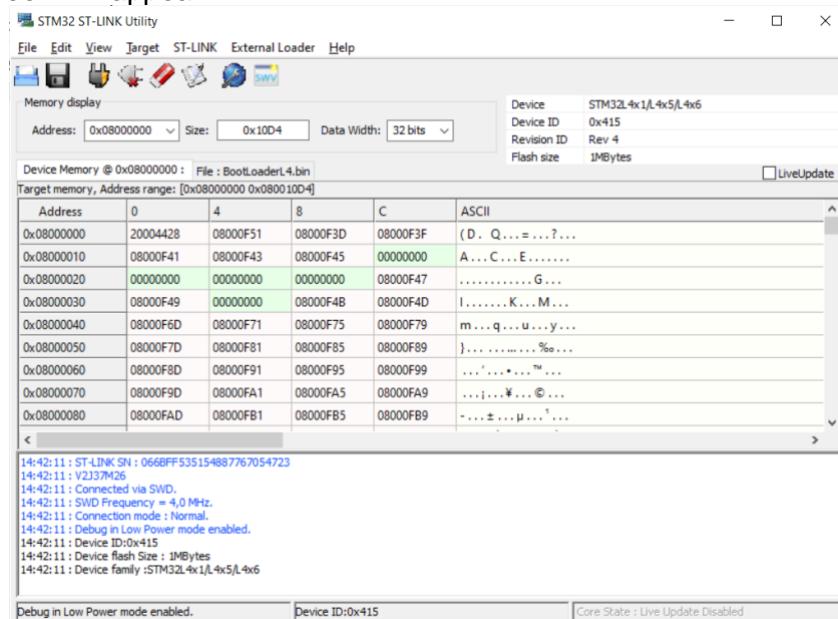
- 165) This window will appear



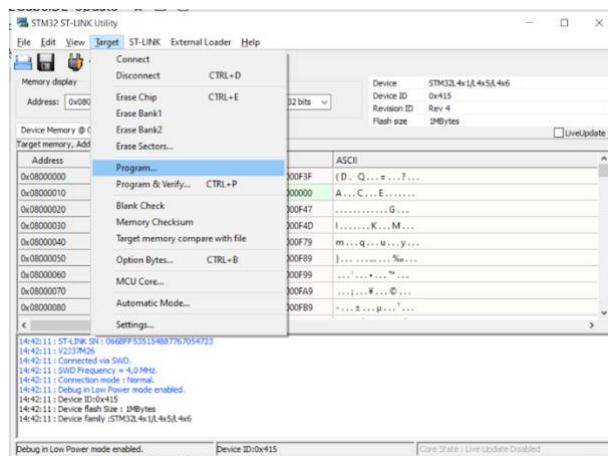
- 166) Ensure that the SensorTile system is connected to the Windows platform via both USB cables.
- 167) Then, select Target > Connect



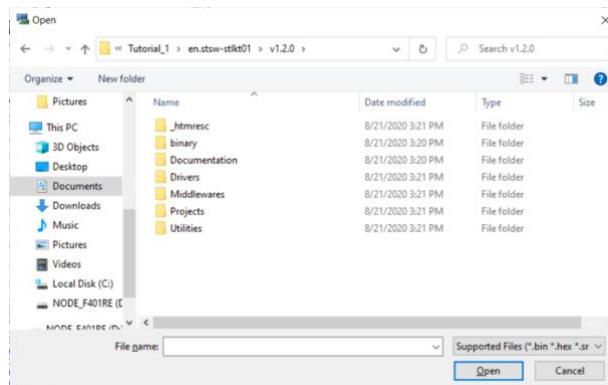
168) This screen will appear



169) Select Target > Program

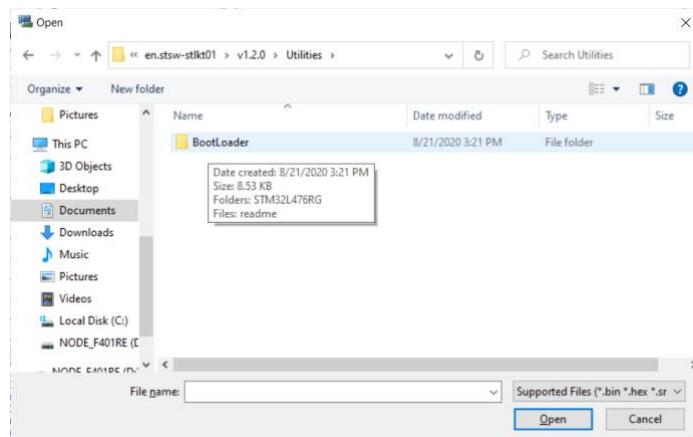


170) A directory search window will appear. Now, navigate to the directory that includes the SensorTile project – follow these screen examples



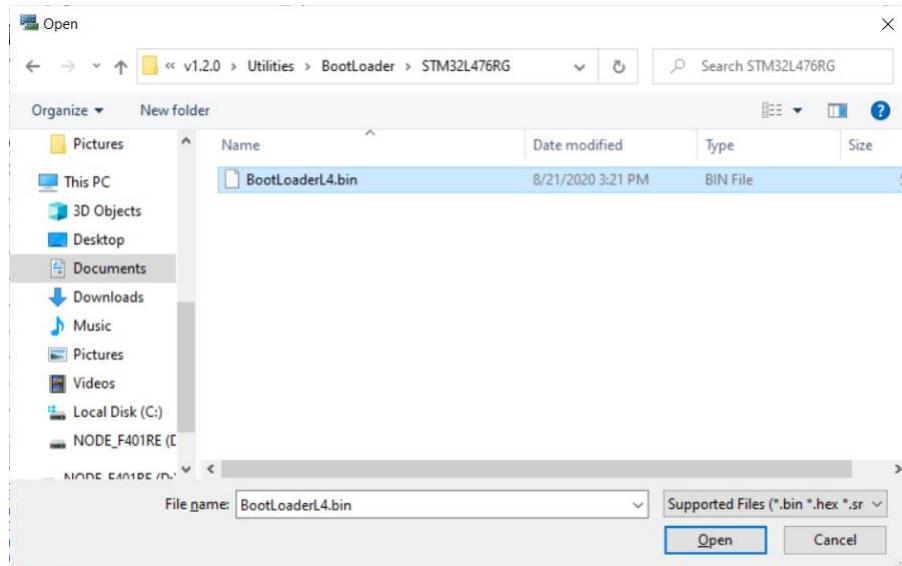
171) Now, navigate to the directory that includes the SensorTile Bootloader – This will be

...\\v1.2.0\\Utilities\\BootLoader





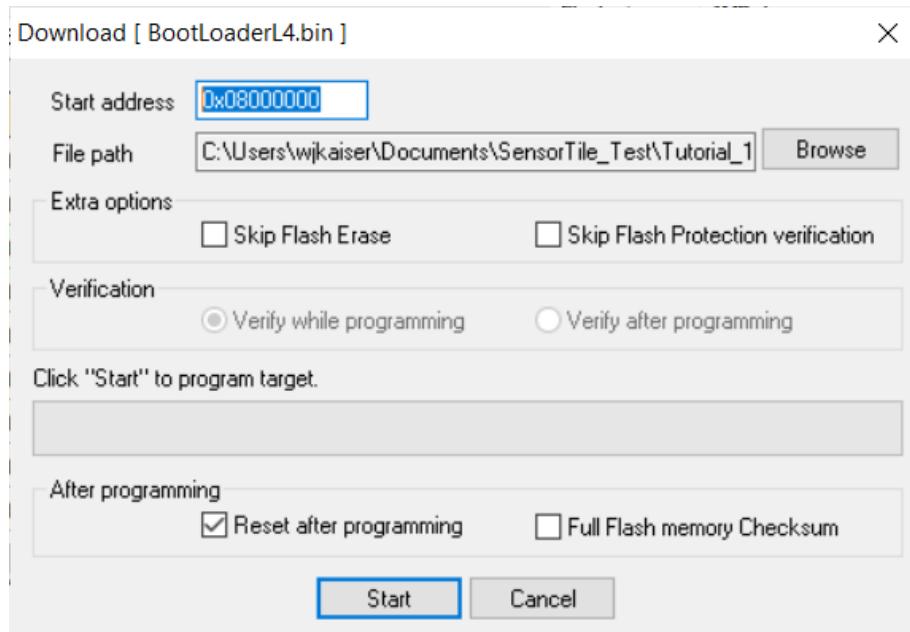
172) Open the Bootloader directory enter **STM32L476RG** and select **BootLoaderL4.bin**



173) Now, the Download screen will appear.

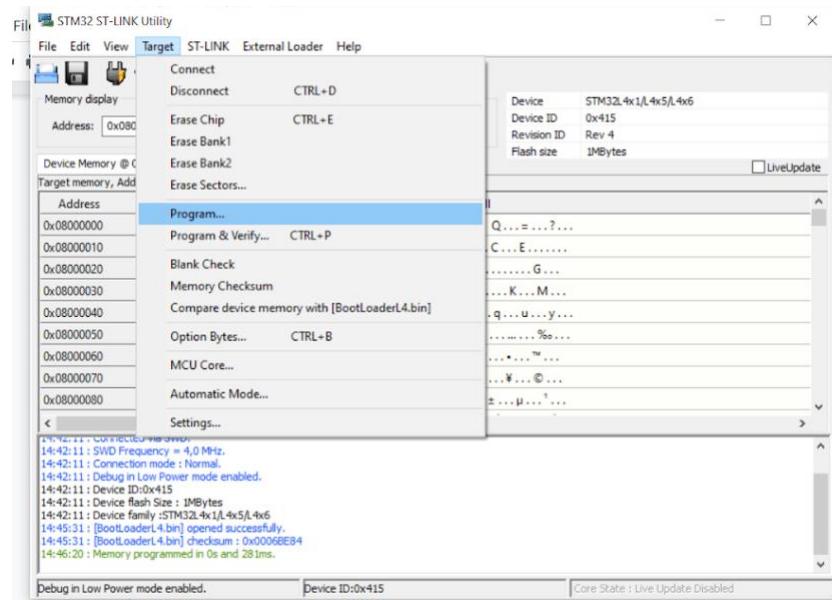
Ensure that the Start address is **0x08000000**.

This is an 8 digit hexadecimal number



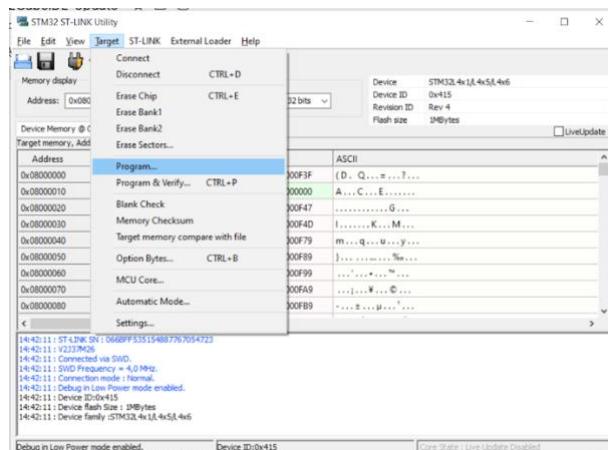


174) Click Start. This screen will appear

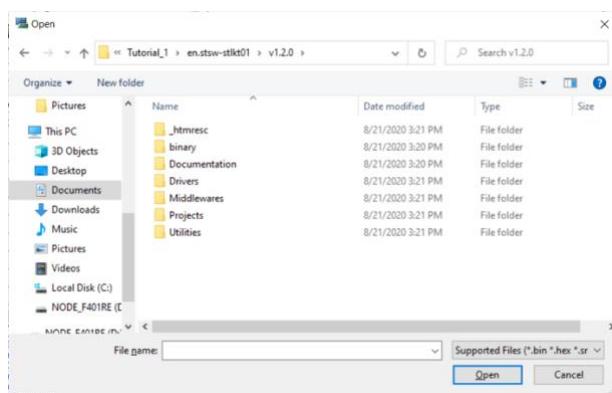


175) Now, installation of the Datalog application will proceed.

176) Select Target > Program

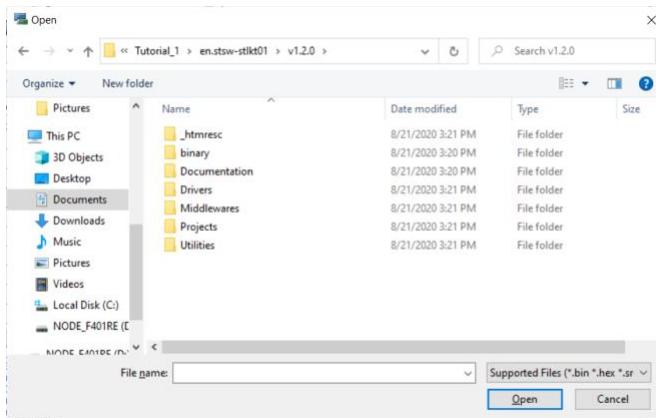


177) A directory search window will appear. Now, navigate to the directory that includes the SensorTile project – follow these screen examples

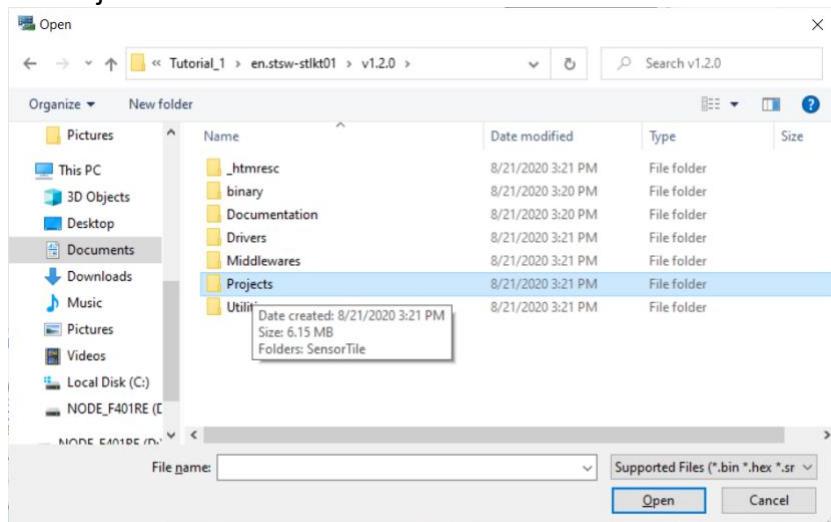


178) A directory search window will appear. Now, navigate to the directory that includes the SensorTile project – This will be

**...\\v1.2.0\\**

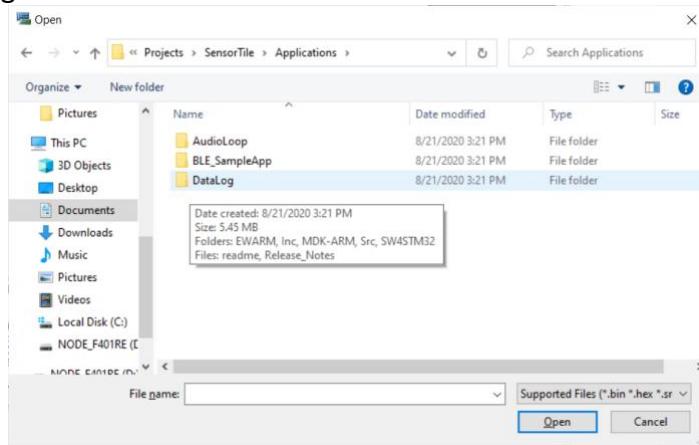


179) Navigate to Projects

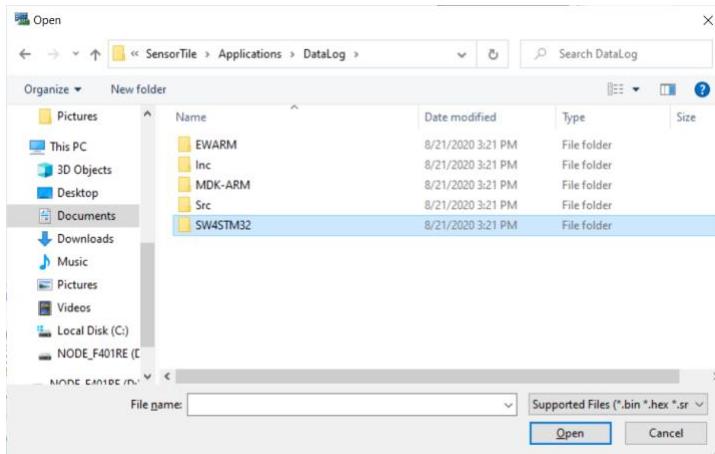




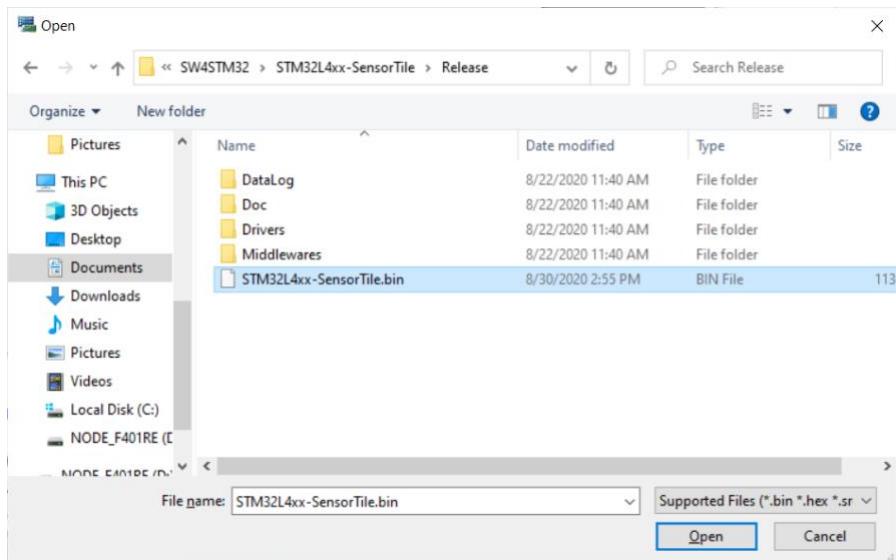
### 180) Select Datalog



### 181) Select SW4STM32



### 182) Select STM32L4XX-SensorTile.bin then click Open



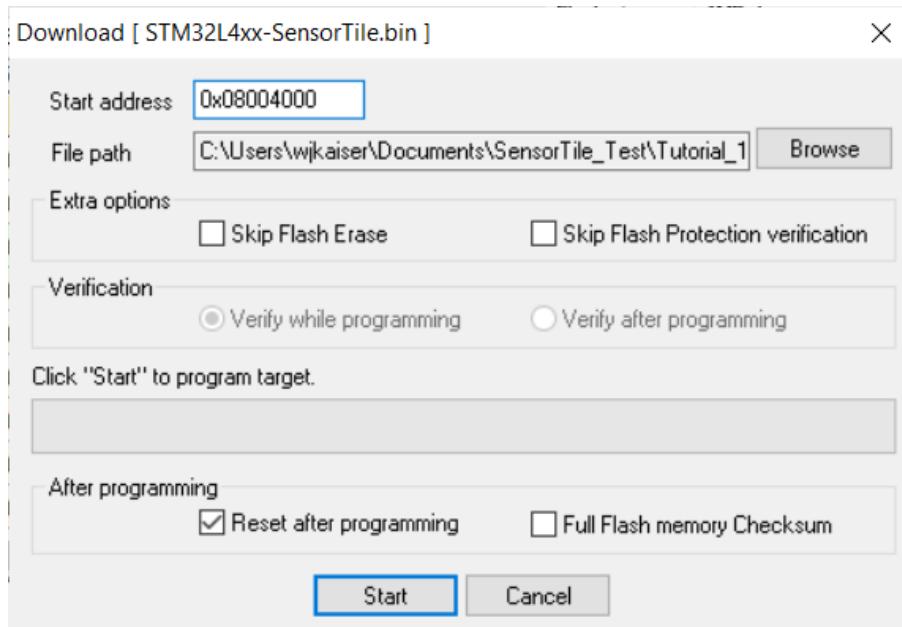


183) Now, the Download screen will appear.

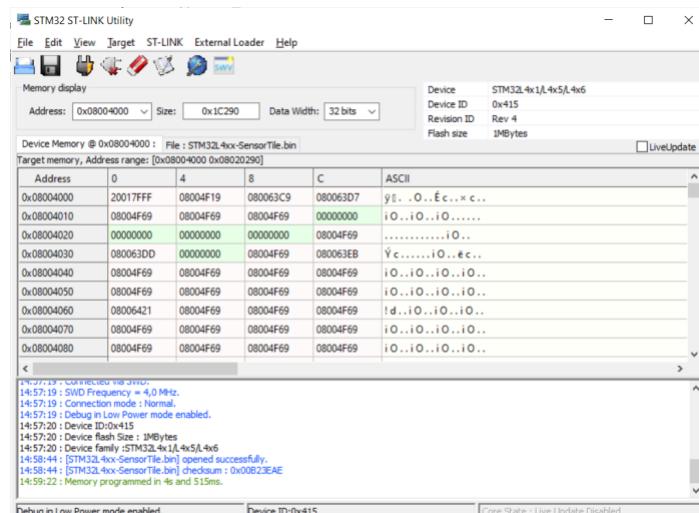
Ensure that the Start address is 0x08004000.

This is an 8 digit hexadecimal number

**NOTE THIS ADDRESS IS DIFFERENT FROM THE BOOTLOADER START ADDRESS**

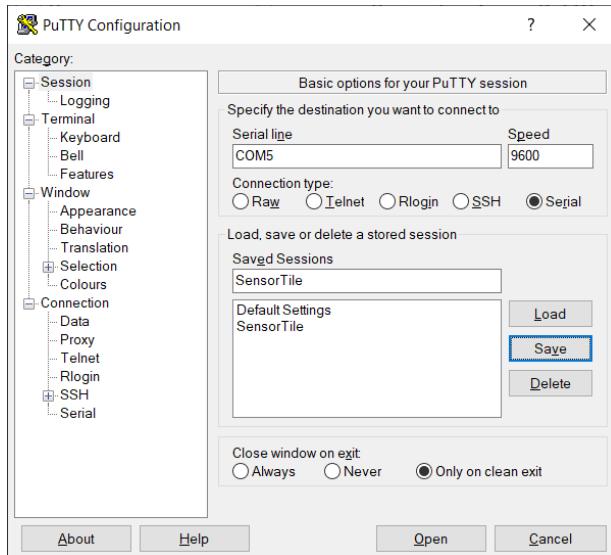
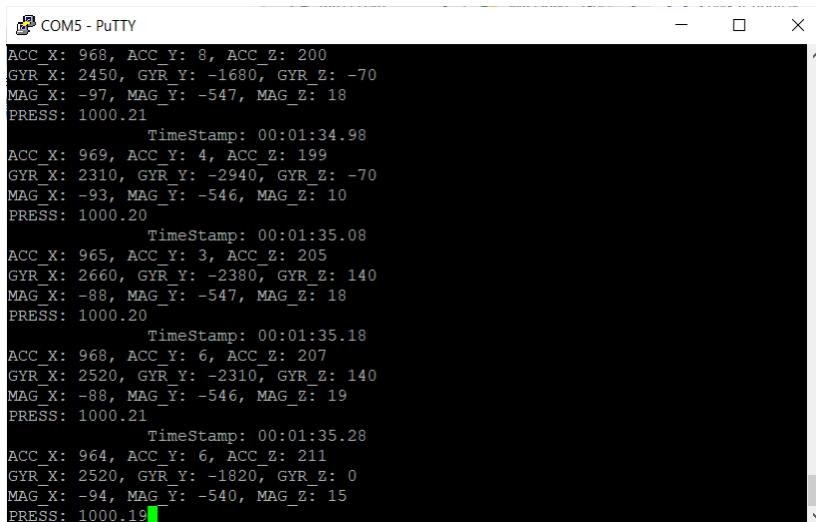


184) Click Start. This screen will appear





- 185) The SensorTile is now operating. A Putty session may be started.
- 186) The SensorTile may be disconnected from the Windows platform and reconnected at a later time. Only the SensorTile cradle board will require a USB connection.

```
ACC_X: 968, ACC_Y: 8, ACC_Z: 200
GYR_X: 2450, GYR_Y: -1680, GYR_Z: -70
MAG_X: -97, MAG_Y: -547, MAG_Z: 18
PRESS: 1000.21
    TimeStamp: 00:01:34.98
ACC_X: 969, ACC_Y: 4, ACC_Z: 199
GYR_X: 2310, GYR_Y: -2940, GYR_Z: -70
MAG_X: -93, MAG_Y: -546, MAG_Z: 10
PRESS: 1000.20
    TimeStamp: 00:01:35.08
ACC_X: 965, ACC_Y: 3, ACC_Z: 205
GYR_X: 2660, GYR_Y: -2380, GYR_Z: 140
MAG_X: -88, MAG_Y: -547, MAG_Z: 18
PRESS: 1000.20
    TimeStamp: 00:01:35.18
ACC_X: 968, ACC_Y: 6, ACC_Z: 207
GYR_X: 2520, GYR_Y: -2310, GYR_Z: 140
MAG_X: -88, MAG_Y: -546, MAG_Z: 19
PRESS: 1000.21
    TimeStamp: 00:01:35.28
ACC_X: 964, ACC_Y: 6, ACC_Z: 211
GYR_X: 2520, GYR_Y: -1820, GYR_Z: 0
MAG_X: -94, MAG_Y: -540, MAG_Z: 15
PRESS: 1000.19
```