Real Time Embedded Systems - Recitation 1

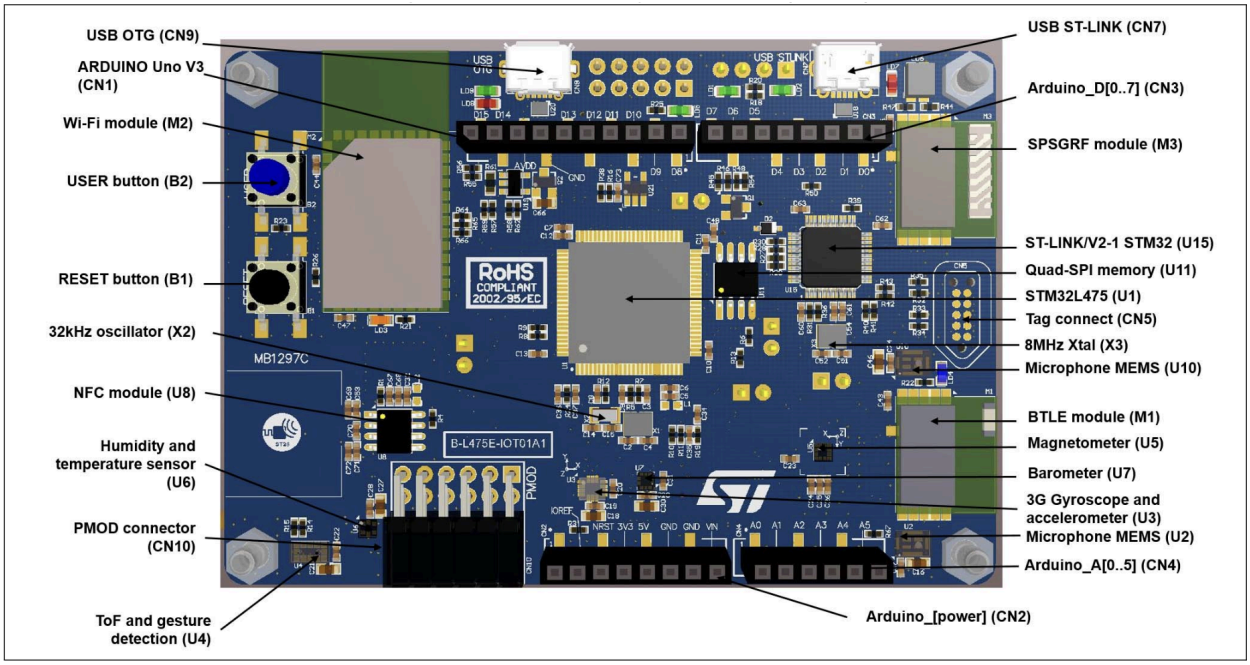
Environment Setup --> Visual Studio Code + PlatformIO

Introduction --> What is Mbed OS?

https://os.mbed.com/mbed-os/
- Cortex-M RTOS Kernel (Real Time Core)
- Dev Tools
  - PlatfromIO IDE and CLI (We will be using this one in class)
  - ARM Mbed Studio, Online Compiler, Mbed CLI (Alternate IDE)
- IoT Connectivity
- Integrated Security --> (TLS/SPM)
- Management Services/ Code Testing

[1] Board and Cable Links:

- Board: **B-L475E-IOT01A Discovery kit for IoT node**: User Manual



- User Manual UM2153 (schematics) and UM2052(ST Guide) : Documentation Link

- Where to buy B-L475E-IOT01A Discovery kit:
  - ST eStore Link
  - Digikey Link
  - Mouser Link

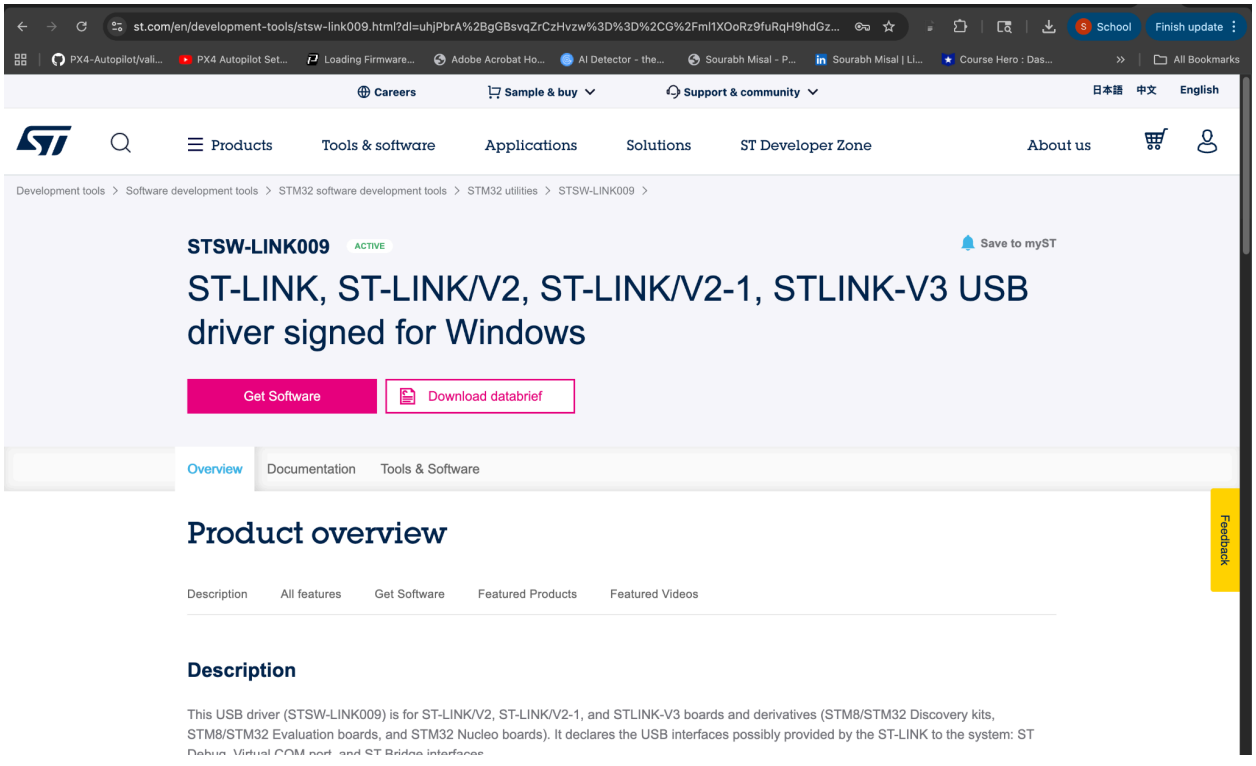
- Product Overview (Latest version) : Product Link

- Cable :
  - Type A to Micro USB Link
  - Type C to Micro USB Link

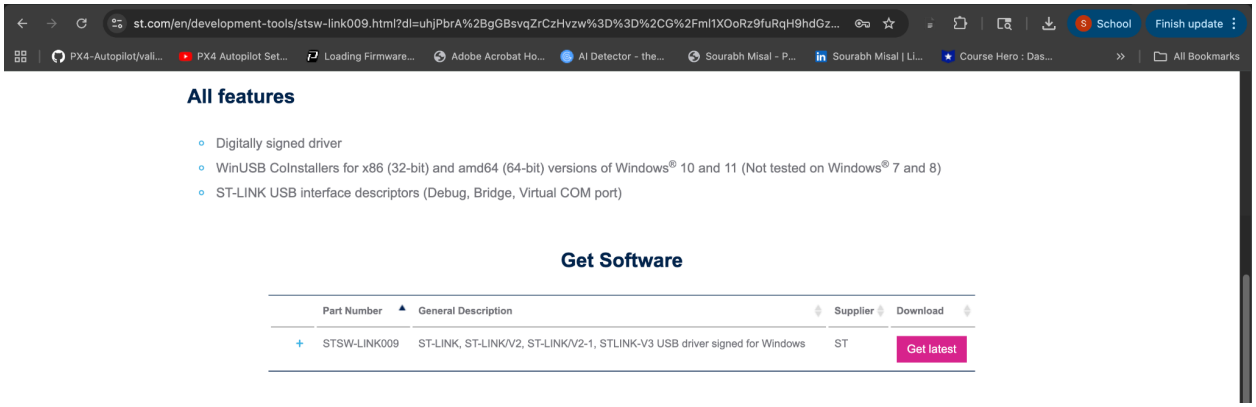
[3] VSCode Installation: Link

[4] (For Windows) Install ST Link USB Drivers:

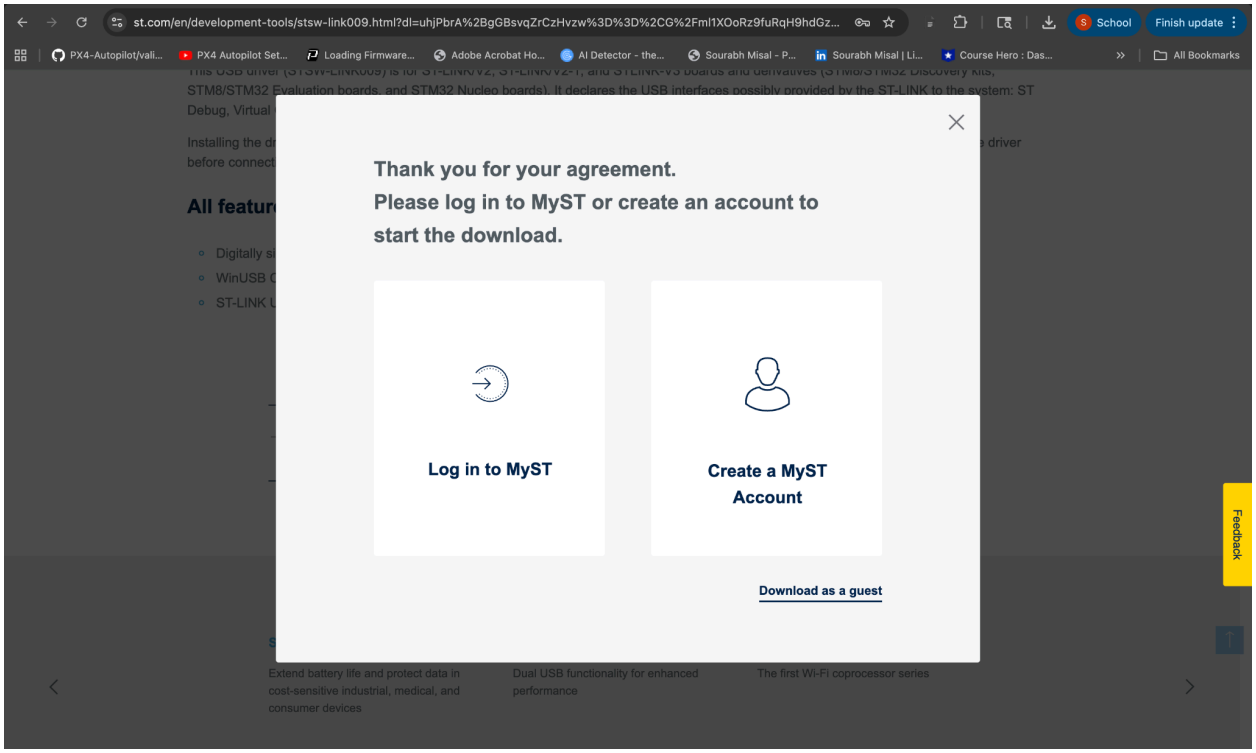
- Please go to the Website Link and click on Get Software



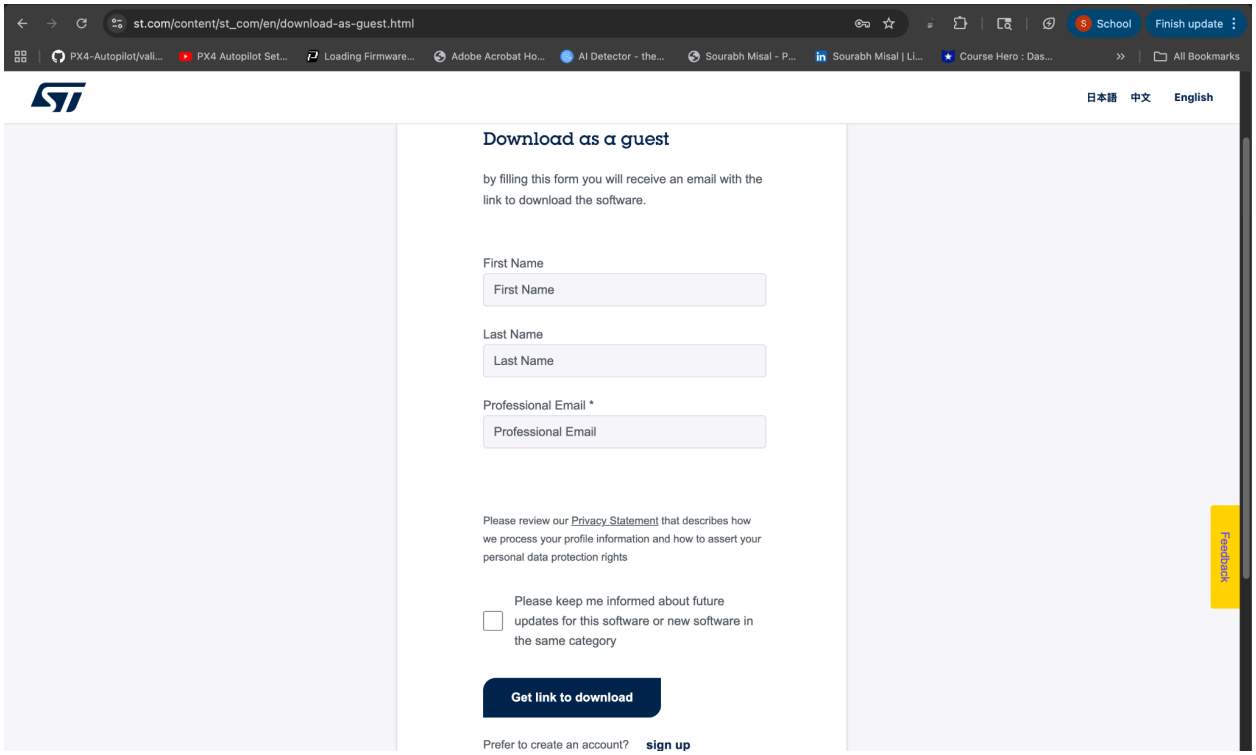
- After click, it takes you to the bottom of the webpage. Then click on Get latest button.



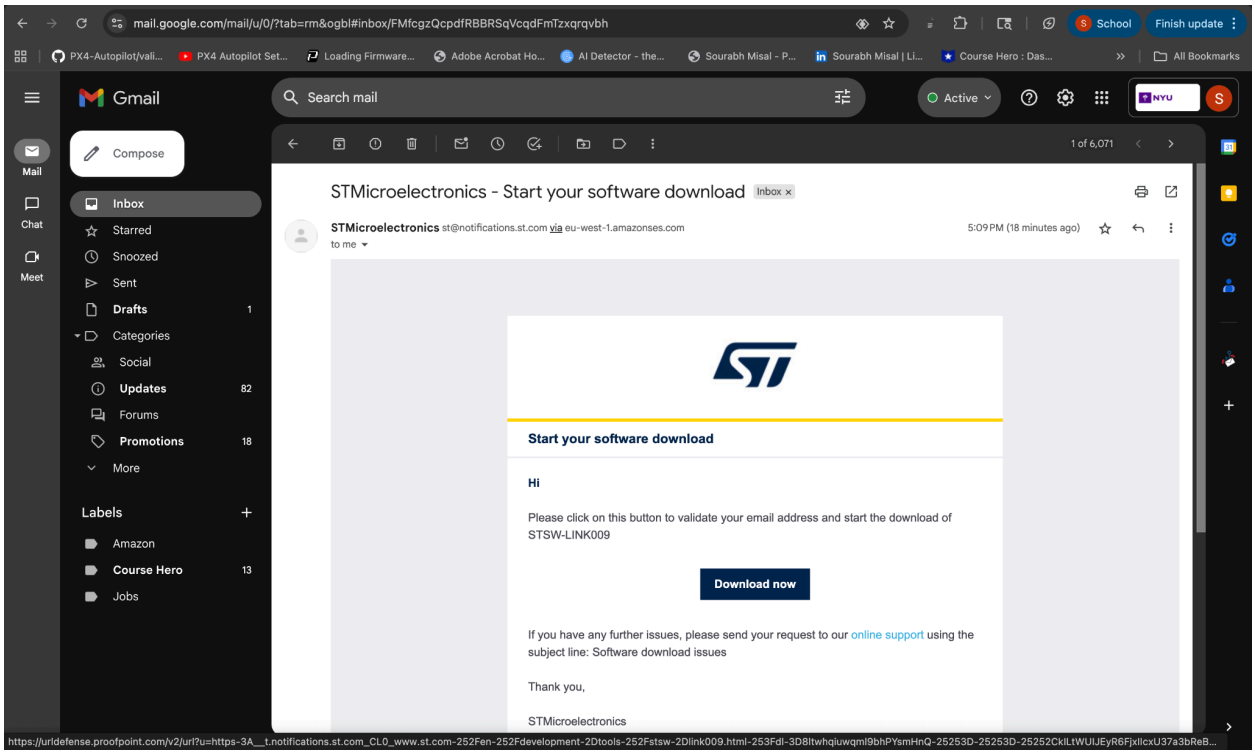
- After the click, a pop-up window appears and click on Download as a guest



- After that, kindly fill in the First Name and Last Name and nyu email id. The download link will be sent to the given email address.

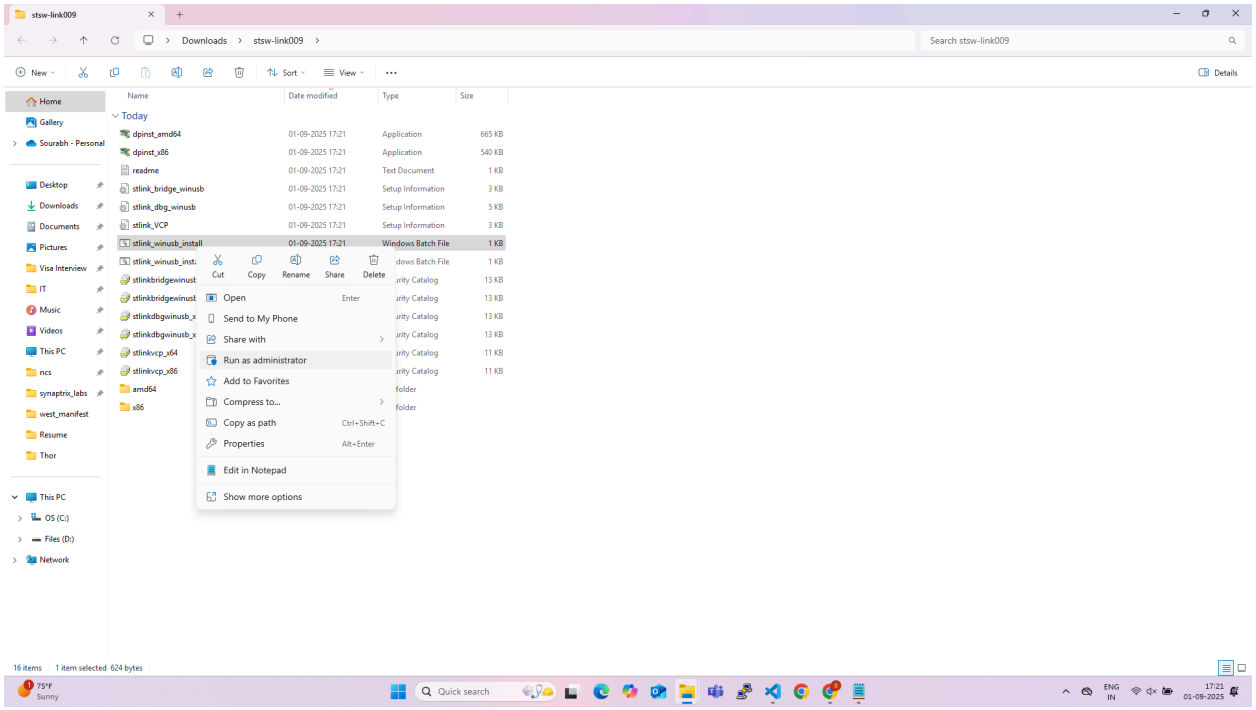


- In the email, under the subject “STMicroelectronics - Start your software download”, click on Download now button. A zip folder named **stsw-link009.zip** will be downloaded.

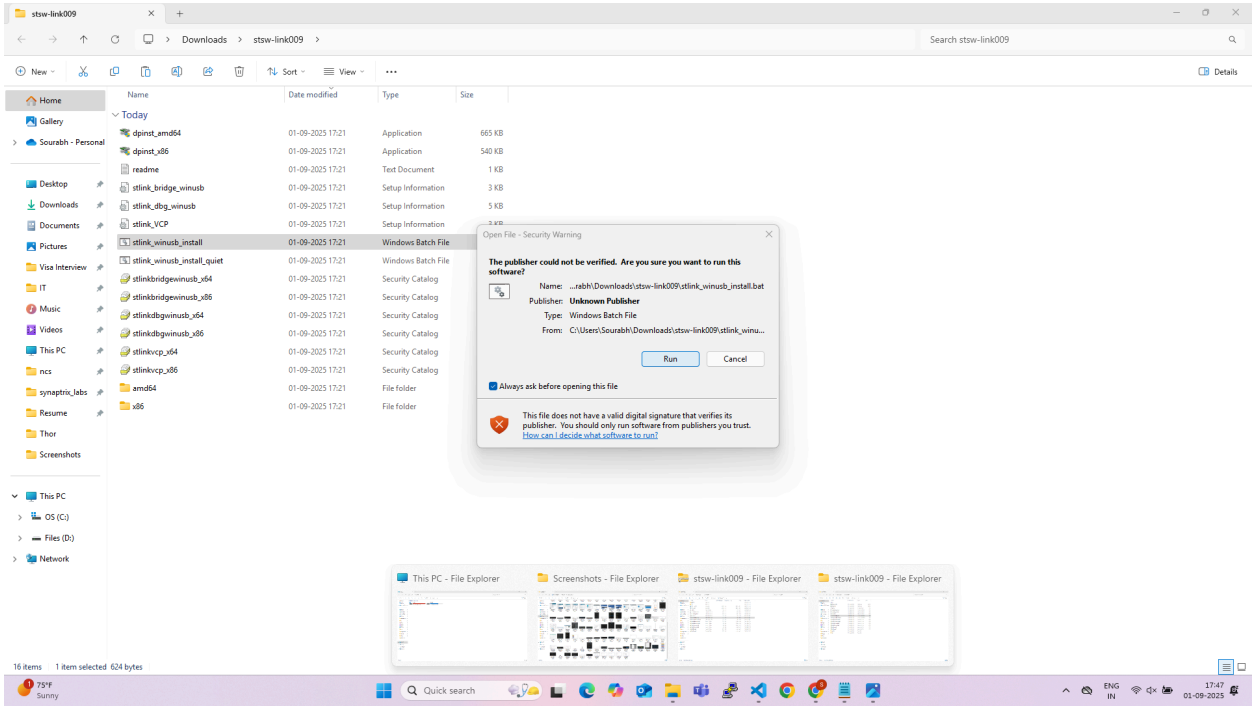


- Unzip the contents of the stsw-link009.zip into a folder named stsw-link009 in Desktop or any other file location of your choice.

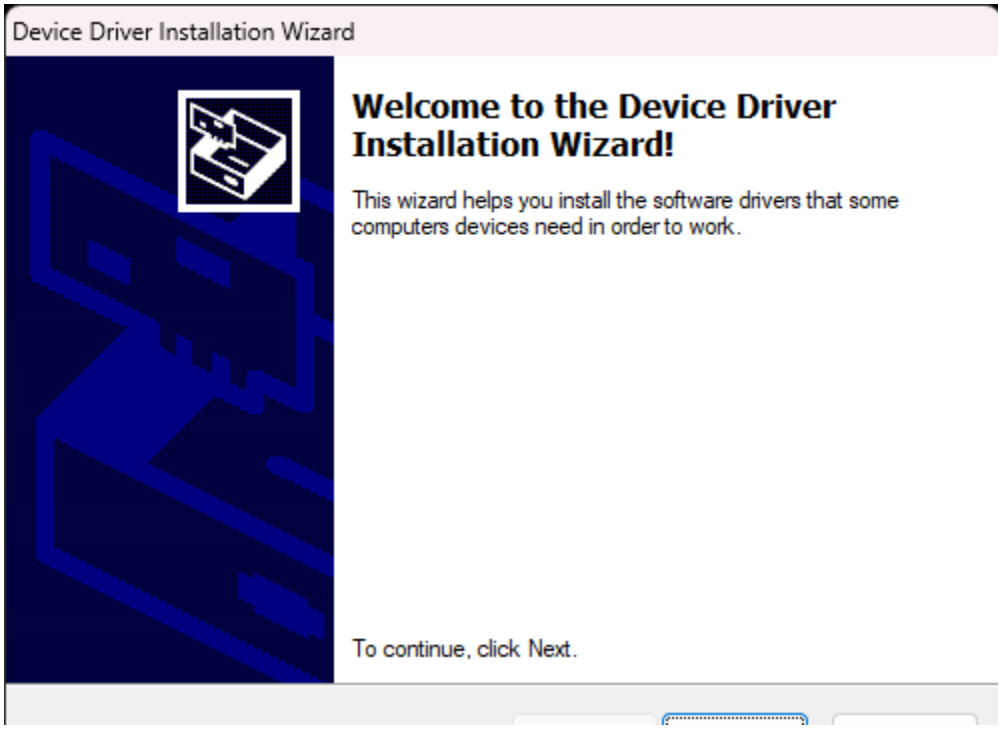
- In the stsw-link009 folder, select the file **stlink_winusb_install** and right-click to select Run as administrator.



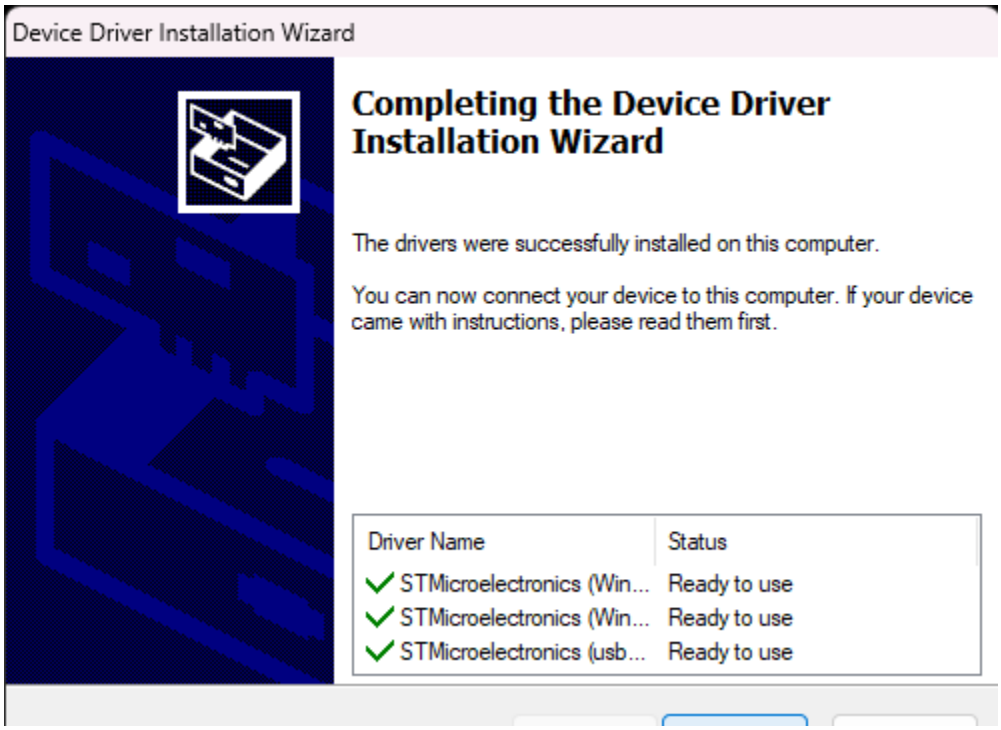
- A “Open File - Security Warning” pop-up window appears. Click on “Run” button.



- After clicking on “Run” button, a pop-up window titled “User Account Control” opens up. Click on “Yes” button. This directs to “Device Driver Installation Wizard” pop-up window.

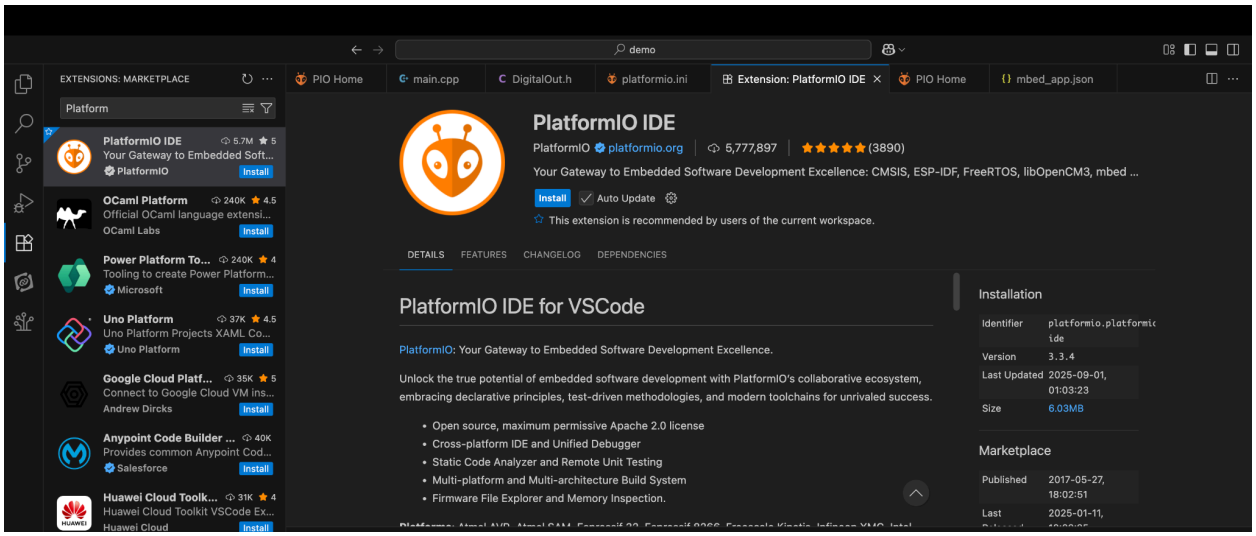


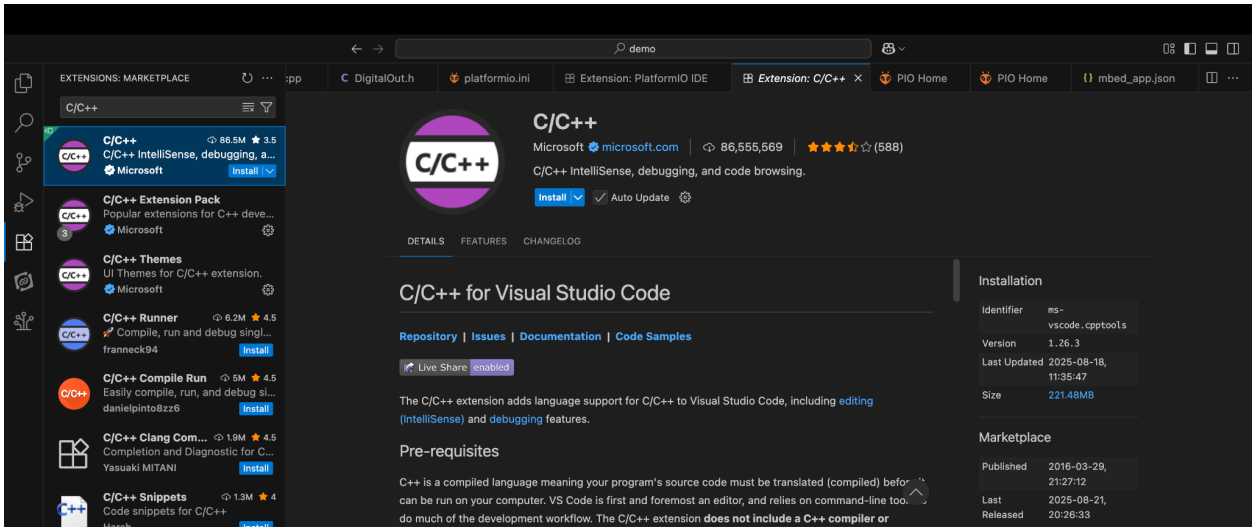
- Click on “Next” button and follow the procedure until the installation process is complete. Click on “Finish” button.

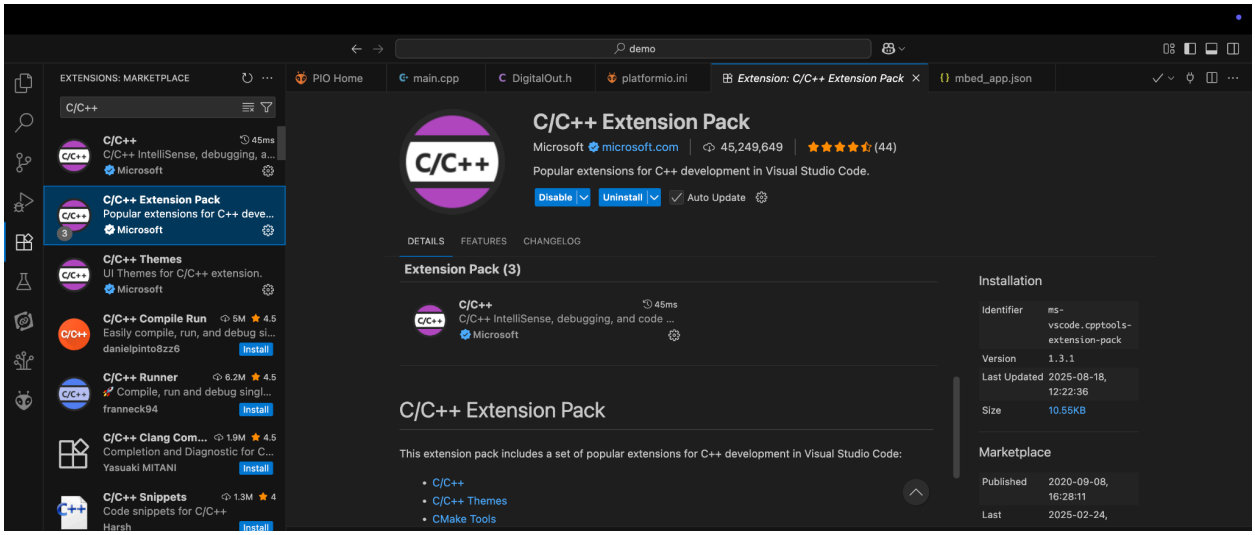


[5] Install PlatformIO extension on VSCode (Generic for all) :

- Click on extensions icon  and install PlatformIO, C/C++ and C/C++ Extension Pack from the Extensions Marketplace of VSCode



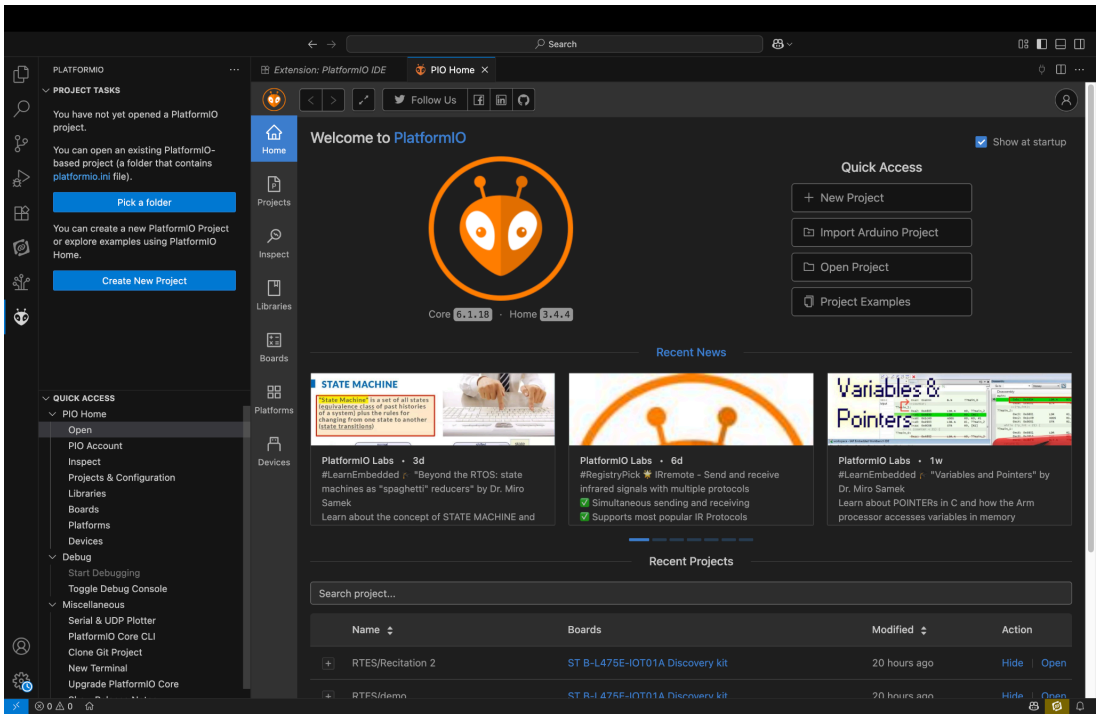




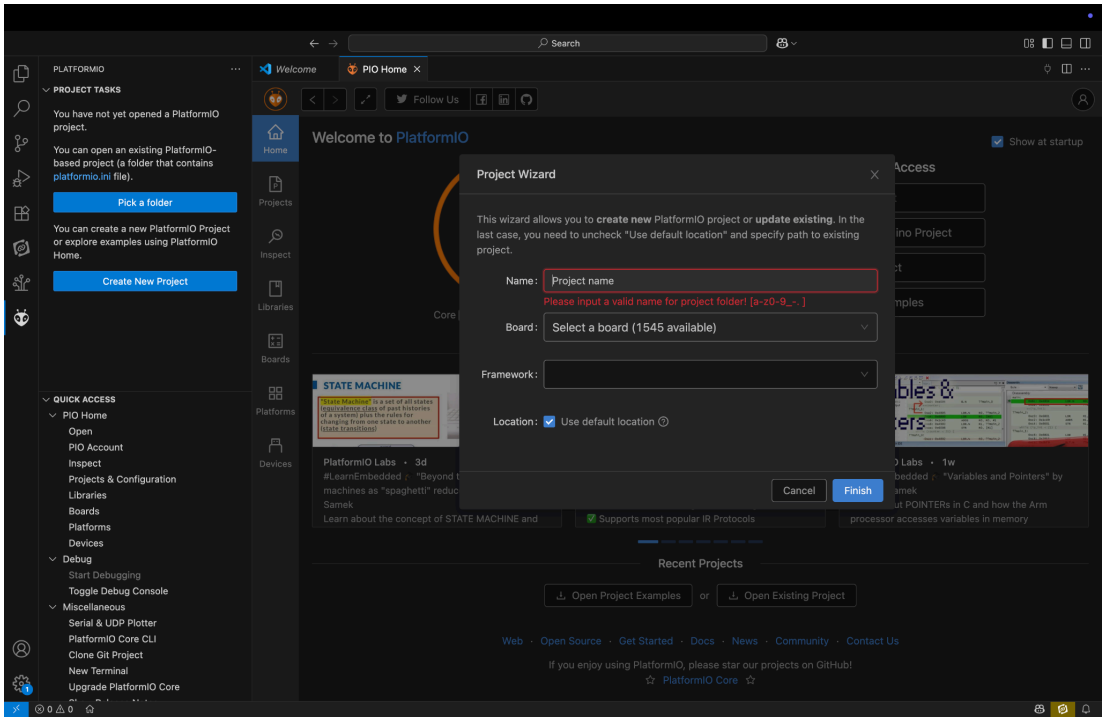
- After the installation, please restart VSCode

[6] Build a Sample Project in PlatformIO

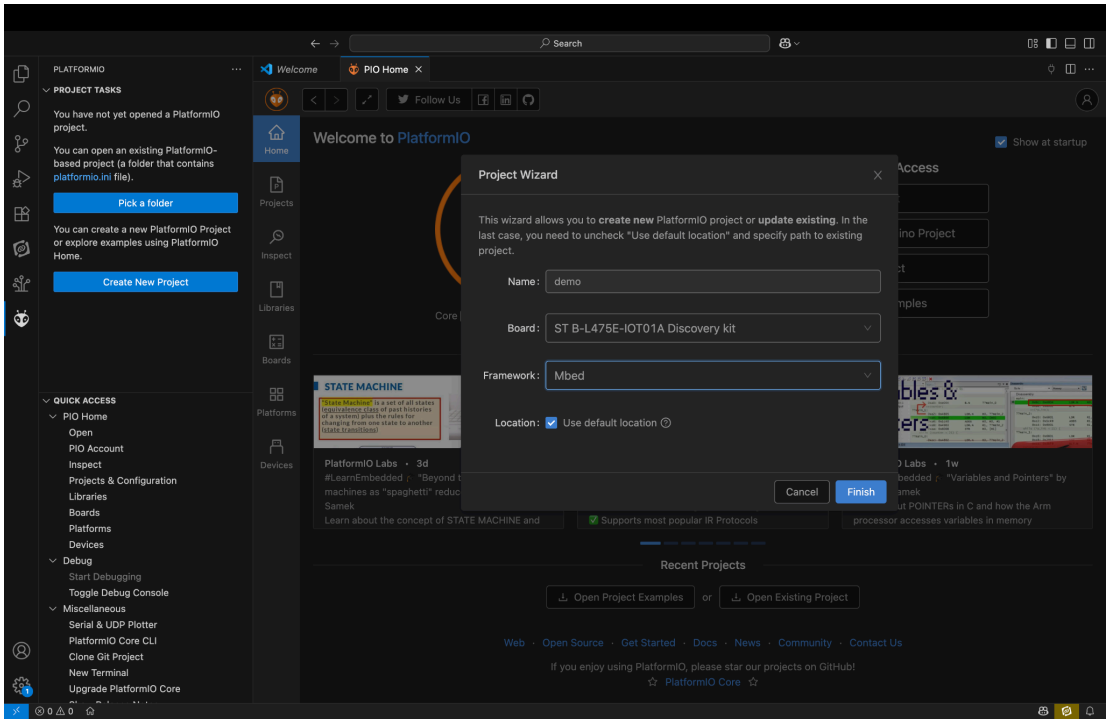
- Click on PlatformIO icon in VSCode 



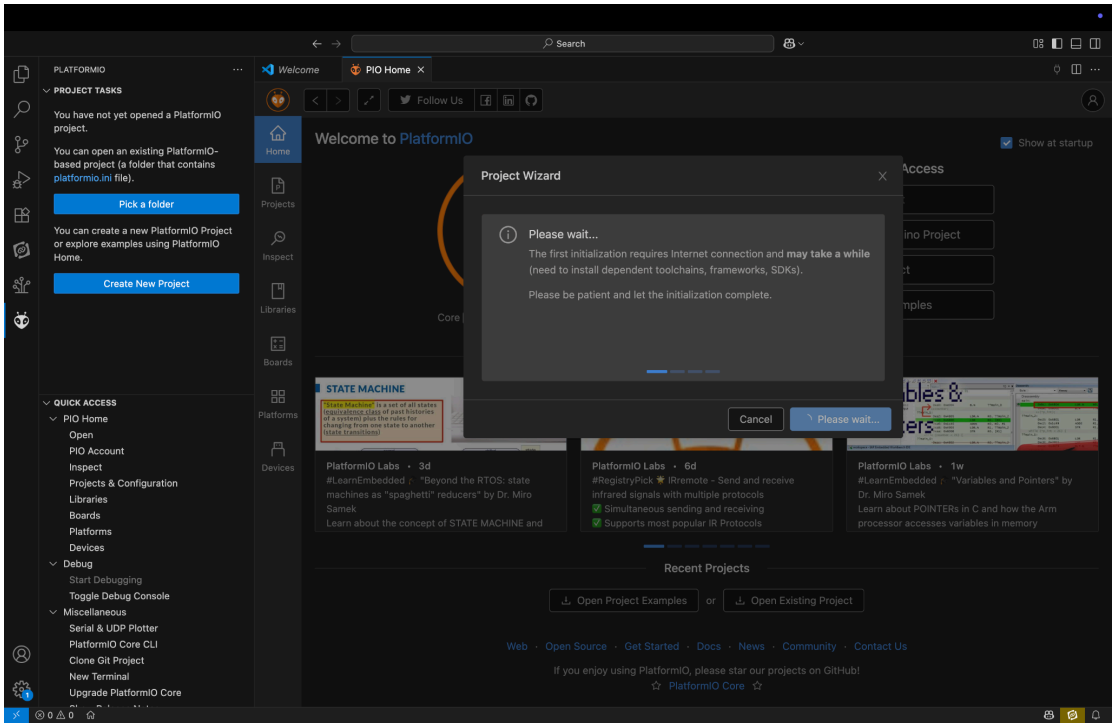
- Click on New Project  under Quick Access. A Project Wizard window pops out.



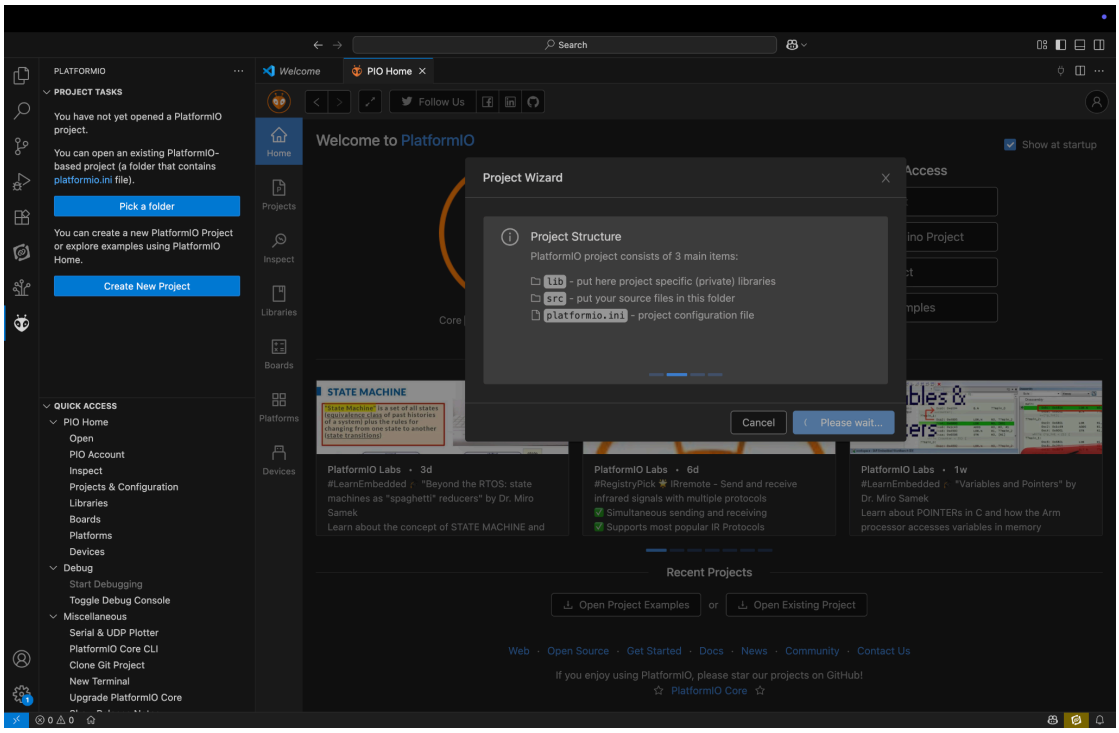
- Give the name as demo, board as ST B-L475E-IOT01A Discovery kit and Framework as Mbed and click on Finish



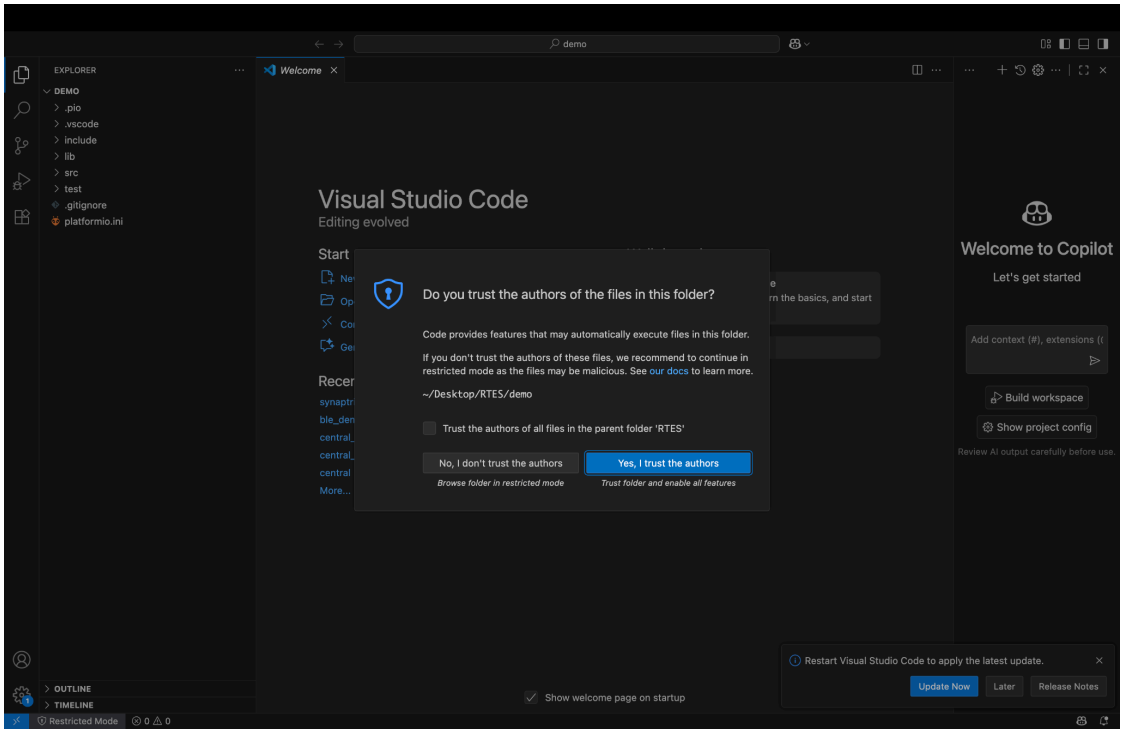
- Please wait for a while ranging from 2 minutes to 10 minutes depending on the machine.



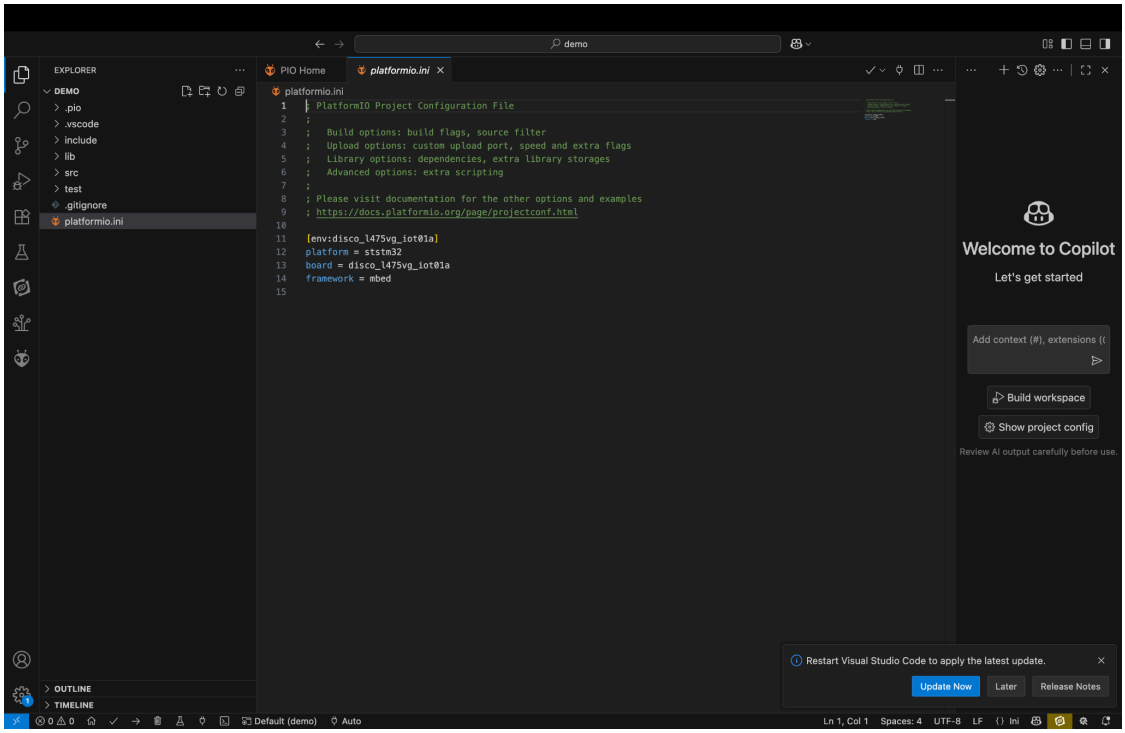
- Please wait for a while till the installation and setup finishes. The installation and setup time depends on the machine it is runnning on.



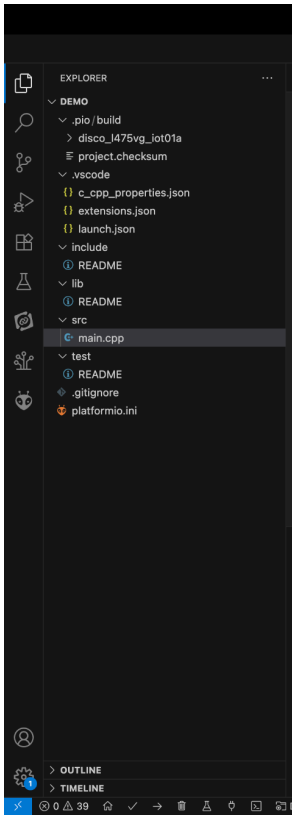
- A new project directory called demo is created. Click on  in the following window after the project directory is created.



- This is the platformio.ini file



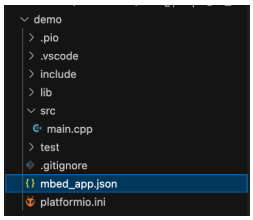
- Under src folder, create a main.cpp file



- Paste this demo code in the main.cpp

```cpp
#include <mbed.h>

DigitalOut led(LED1);

int main() {
   printf("MbedOS demo starting...\n");

   float value = 3.14159f;

   while (1) {

       // Toggle LED
       led = !led;
       printf("LED state: %d\n", led.read());

       // Print a float with 2 decimal places
       printf("The value of pi is approximately: %f\n", value);

       // 1 second delay
       thread_sleep_for(1000);
   }
}
```

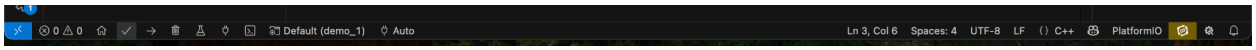
- Create a file named mbed_app.json in the project directory



- Paste the following code in mbed_app.json

```json
{
   "target_overrides":{
       "*": {
           "platform.minimal-printf-enable-floating-point": true
       }
   }
}
```

- This is the PlatformIO bar found at the bottom of the PlatformIO window where the building, uploading and observing the logs and print statements of the codebase can be accessed and controlled



- This symbol  represents **PlatformIO: Build** where the code gets compiled to binary

- This symbol  represents **PlatformIO: Upload** where the executable code (binary or hex or elf) gets put on the microcontroller

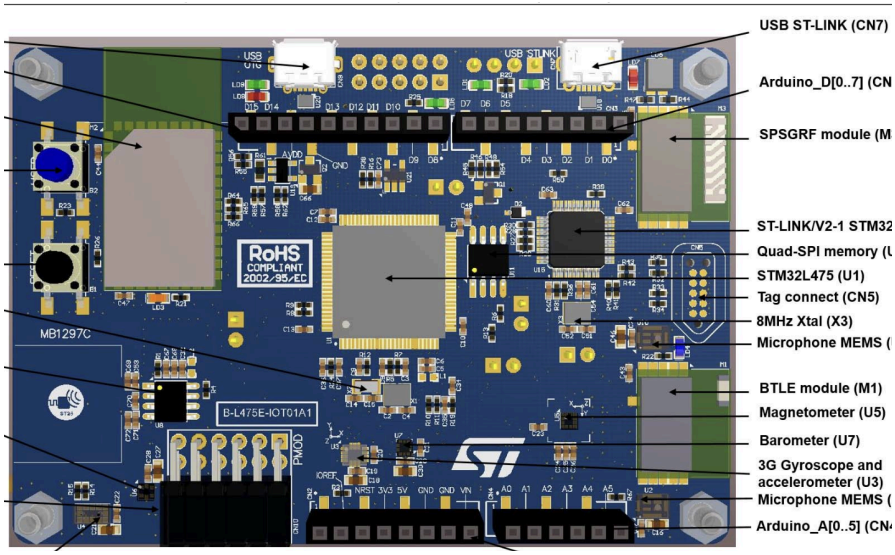
- This symbol  represents **PlatformIO: Serial Monitor** where the logging and printf statements and streams of the codebase from the microcontroller are visible

- This symbol  represents **PlatformIO: Clean** where the built codebase gets removed prior to rebuilding the code

- This symbol  **Set upload/monitor/test port** is for selecting the serial port or auto-detecting the serial port (USB cable)

- Click on the **PlatformIO: Build** and it will take a good amount of time to compile the files to machine executable code.

- Connect the USB cable from the laptop to the board's USB ST-LINK (CN7) . Kindly orient the board in this manner and the USB ST-LINK of the development kit will be in the top left side .



- Click on the **PlatformIO: Upload** to upload the code on the microcontroller via USB cable attached to it

- Click on the **PlatformIO: Serial Monitor** to see the print statements from the microcontroller

- Flow: Source Code (.c/.cpp)--> Preprocessing --> Compilation (.S/Machine Code) --> Assembly (object file) --> Linking (.elf/.bin) --> Flashing/Upload (STLink)

Miscellaneous issues:

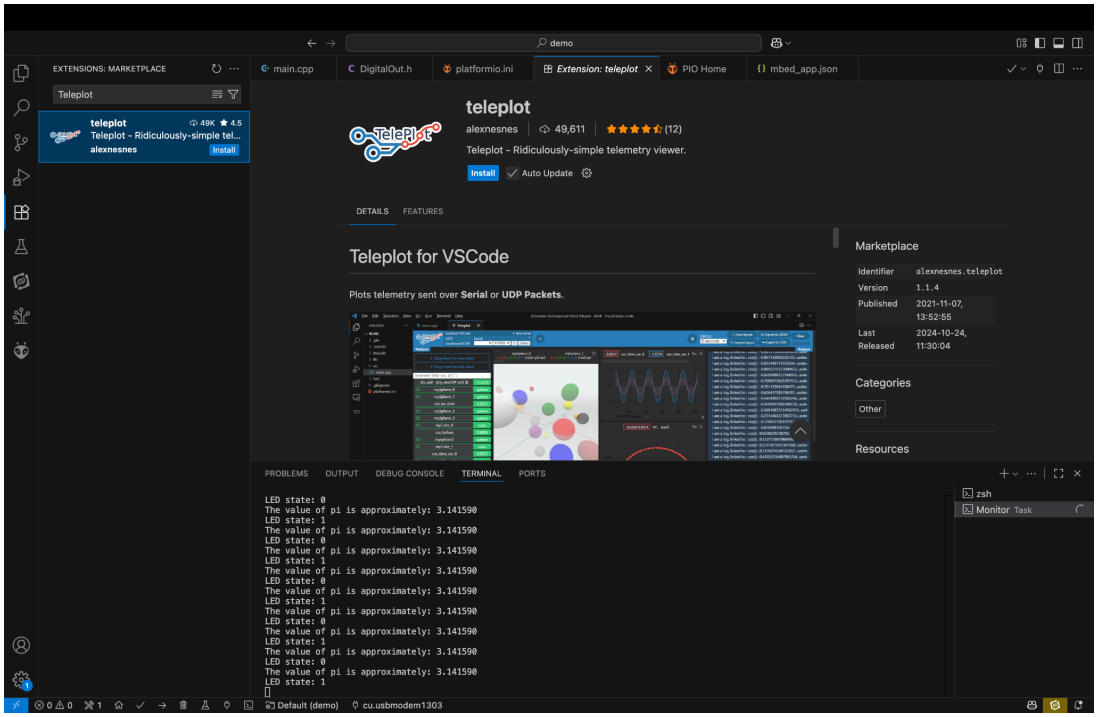
- During installation, the setup might get redirected to
  - Install python3
  - Install gcc or clang

[7] Starter Templates:

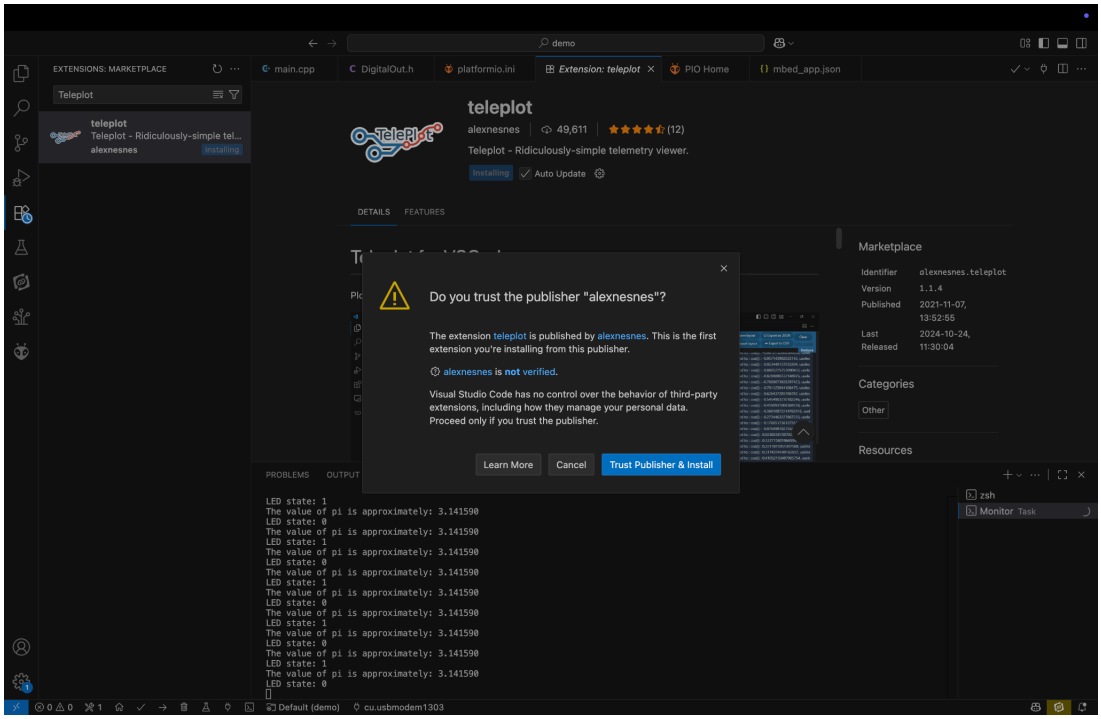
- Provided in the recitations Folder on Brightspace
- 2 versions given, check the How to Use the Templates folder!
- Try using both and check out their configuration files (platformio.ini)

[8] Extras/Optional:

- Teleplot --> Install this VSCode extension

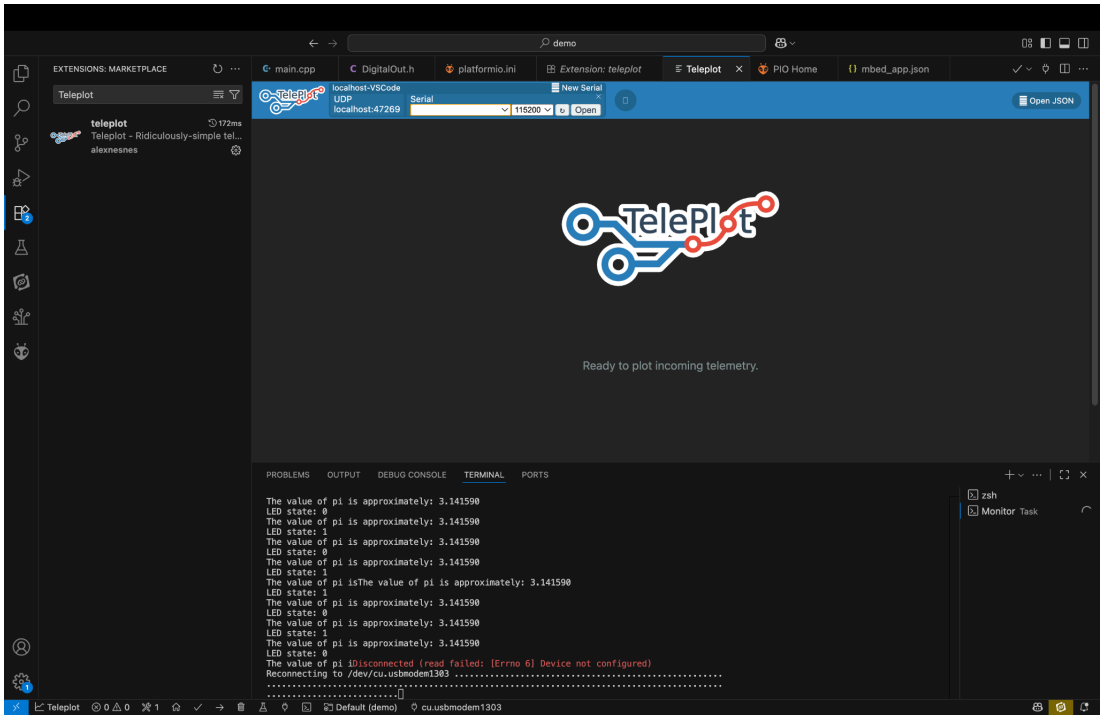


- Click on Trust Publisher & Install button 



- After installation, at the bottom of VSCode window, a 

button appears. When clicked on it, this window appears, which verifies the installation of Teleplot.



[7] Extras :

- PlatformIO Core --> PIO CLI
  - Ensure that PlatformIO is properly installed and added to your system's PATH variables.
  - Following commands will allow capturing the serial monitor data into an output file:
    - Install or check pio verion:
      - pio upgrade
      - pio --version
    - Access the serial monitor --> pio device monitor
    - Capture in an Output file --> pio device monitor --baud 9600 > output.txt
    - Appending --> pio device monitor --baud 9600 >> output.txt