

Real Time Embedded Systems - Recitation 1

Environment Setup --> Visual Studio Code + PlatformIO

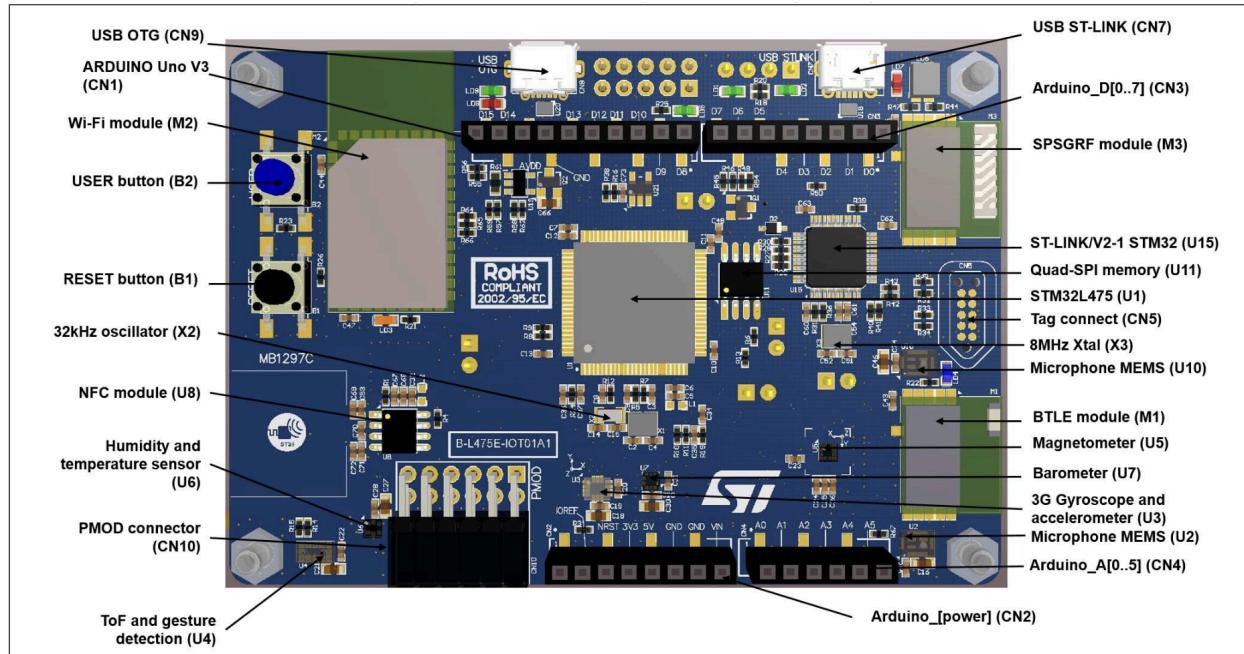
Introduction --> What is Mbed OS?

<https://os.mbed.com/mbed-os/>

- Cortex-M RTOS Kernel (Real Time Core)
- Dev Tools
 - PlatformIO 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](#)

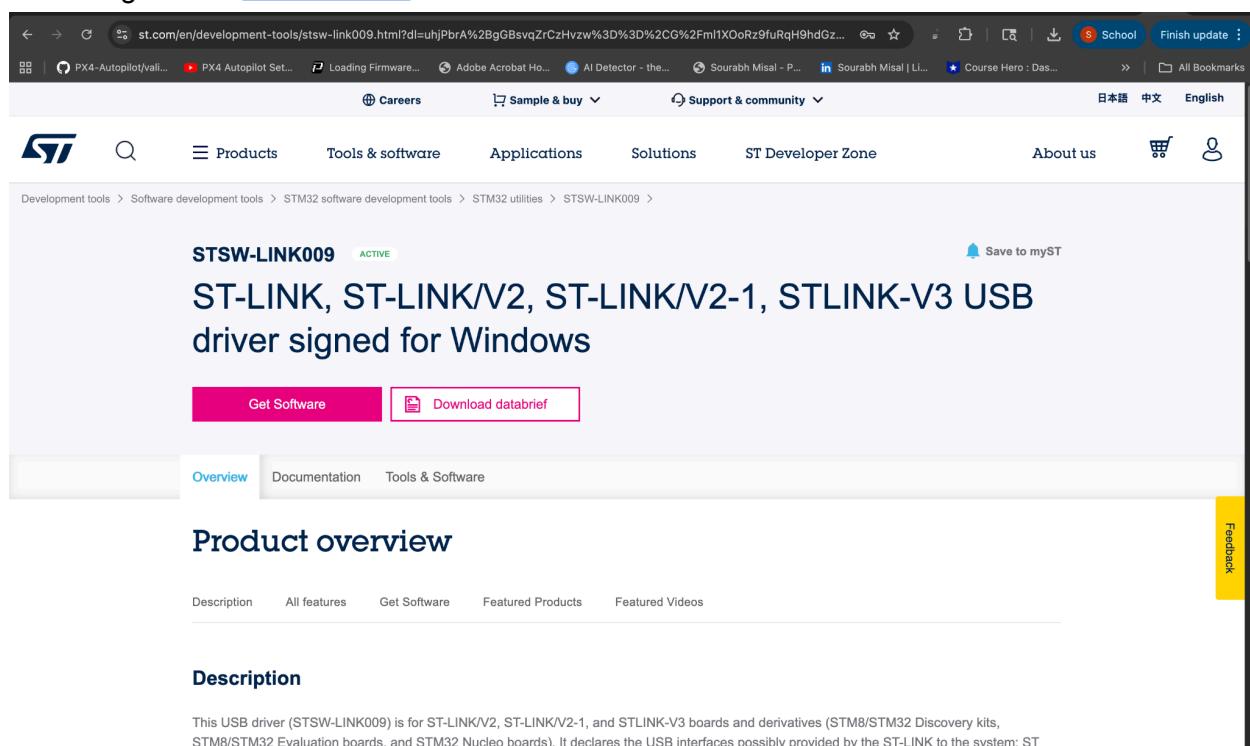
- Cable :

- [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



The screenshot shows the official STMicroelectronics website for the STSW-LINK009 product. At the top, there's a navigation bar with links for 'Careers', 'Sample & buy', 'Support & community', and language options ('日本語', '中文', 'English'). Below the header, the product name 'STSW-LINK009' is displayed with the status 'ACTIVE'. The main content area features a large image of the ST-LINK/V2-1 module, followed by a brief description: 'ST-LINK, ST-LINK/V2, ST-LINK/V2-1, STLINK-V3 USB driver signed for Windows'. Two prominent buttons are visible: 'Get Software' (pink background) and 'Download databrief'. Below these buttons, there are tabs for 'Overview', 'Documentation', and 'Tools & Software'. The 'Overview' tab is currently selected. At the bottom of the page, there's a 'Description' section with a detailed text about the product's purpose and compatibility with various STM32 boards. A 'Feedback' button is located on the right side of the page.

- After click, it takes you to the bottom of the webpage. Then click on [Get latest](#) button.

The screenshot shows a web browser with the URL st.com/en/development-tools/stsw-link009.html?dl=uhjPbrA%2BgGBsvqZrCzHvzw%3D%3D%2CG%2FmI1XOoRz9fuRqH9hdGz.... The page displays the 'All features' section and a table for the 'Get Software' section. The table has columns for Part Number, General Description, Supplier, and Download. A row for 'STSW-LINK009' is shown, with 'ST' listed under Supplier and a 'Get latest' button under Download. The 'Get latest' button is highlighted with a pink border.

- After the click, a pop-up window appears and click on [Download as a guest](#)

A pop-up window titled 'Thank you for your agreement.' is displayed. It contains the text 'Please log in to MyST or create an account to start the download.' Below this, there are two buttons: 'Log in to MyST' and 'Create a MyST Account'. At the bottom of the pop-up, there is a link 'Download as a guest'. The background of the pop-up shows a dark grey overlay of the original website content.

- 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.

The screenshot shows a web browser window with the URL st.com/content/st_com/en/download-as-guest.html. The page title is "Download as a guest". It contains fields for "First Name", "Last Name", and "Professional Email *". Below these fields is a note about the [Privacy Statement](#). A checkbox option allows users to stay informed about future updates. At the bottom, there is a "Get link to download" button and a link to "sign up". A yellow "Feedback" button is visible on the right side.

st.com/content/st_com/en/download-as-guest.html

Download as a guest

by filling this form you will receive an email with the link to download the software.

First Name

Last Name

Professional Email *

Please review our [Privacy Statement](#) that describes how we process your profile information and how to assert your personal data protection rights

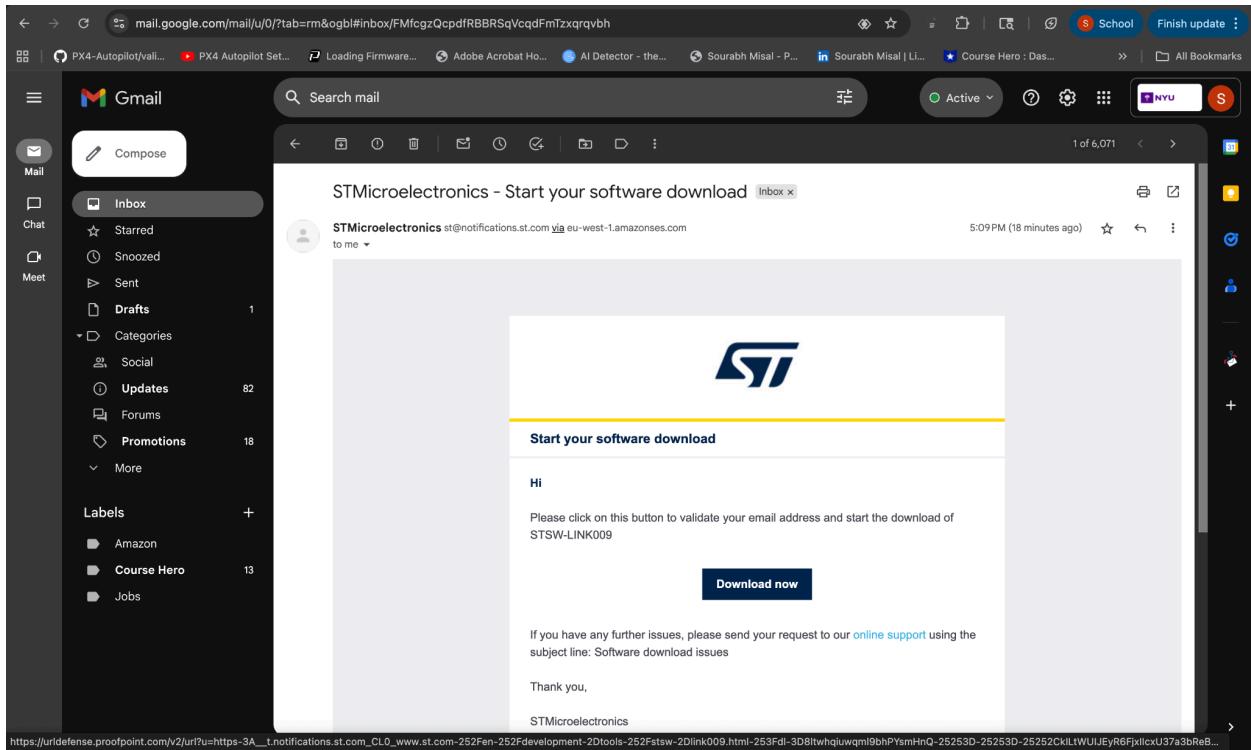
Please keep me informed about future updates for this software or new software in the same category

[Get link to download](#)

Prefer to create an account? [sign up](#)

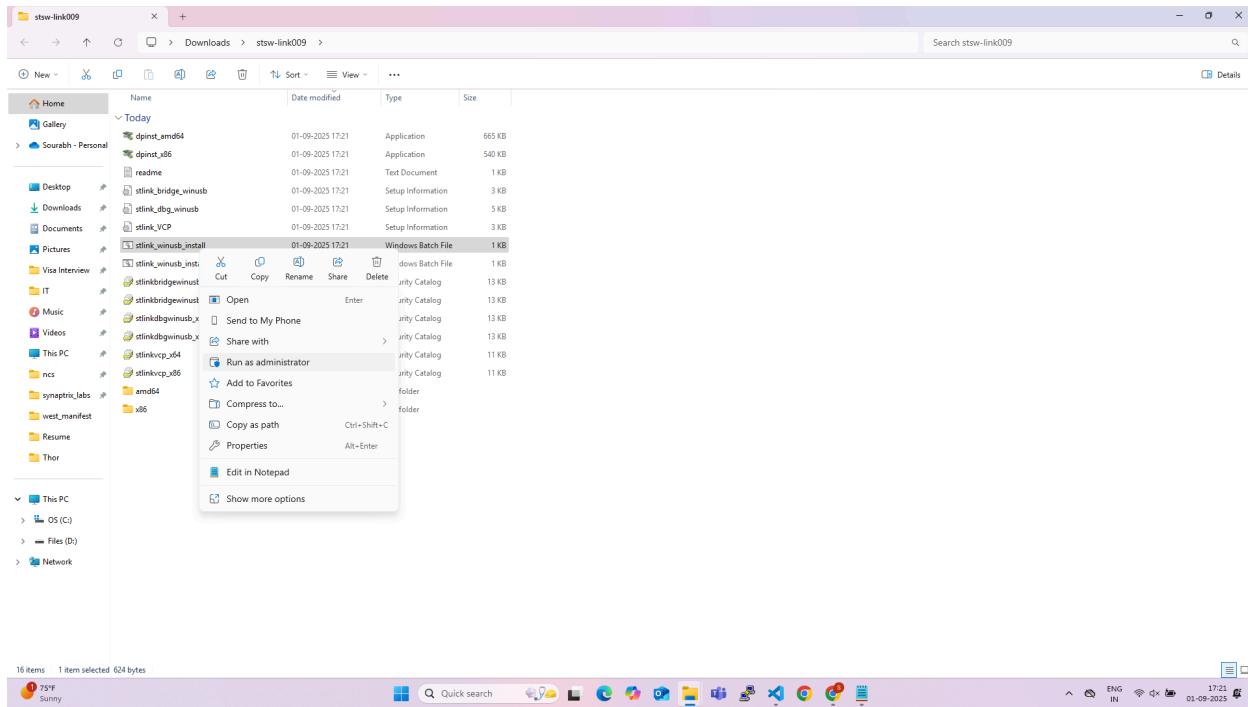
Feedback

- 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.

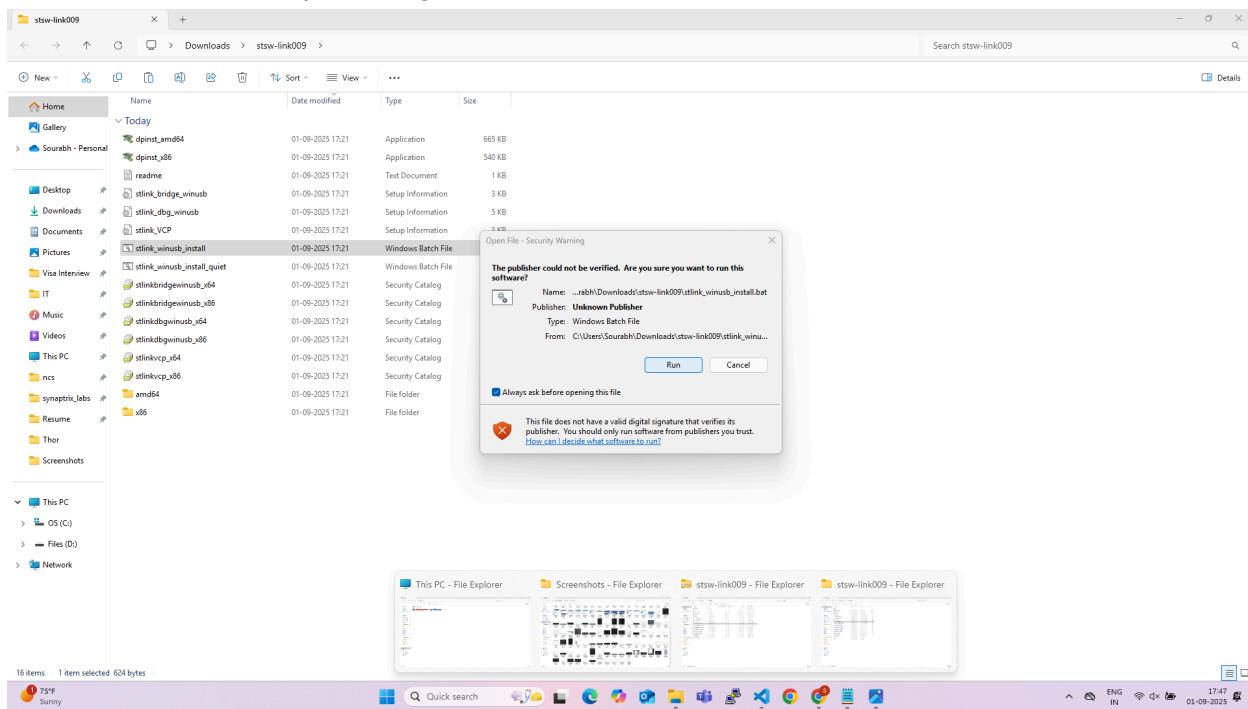


- Unzip the contents of the **stsw-link009.zip** into a folder named **stsw-link009** in Desktop or any other file location of your choice.

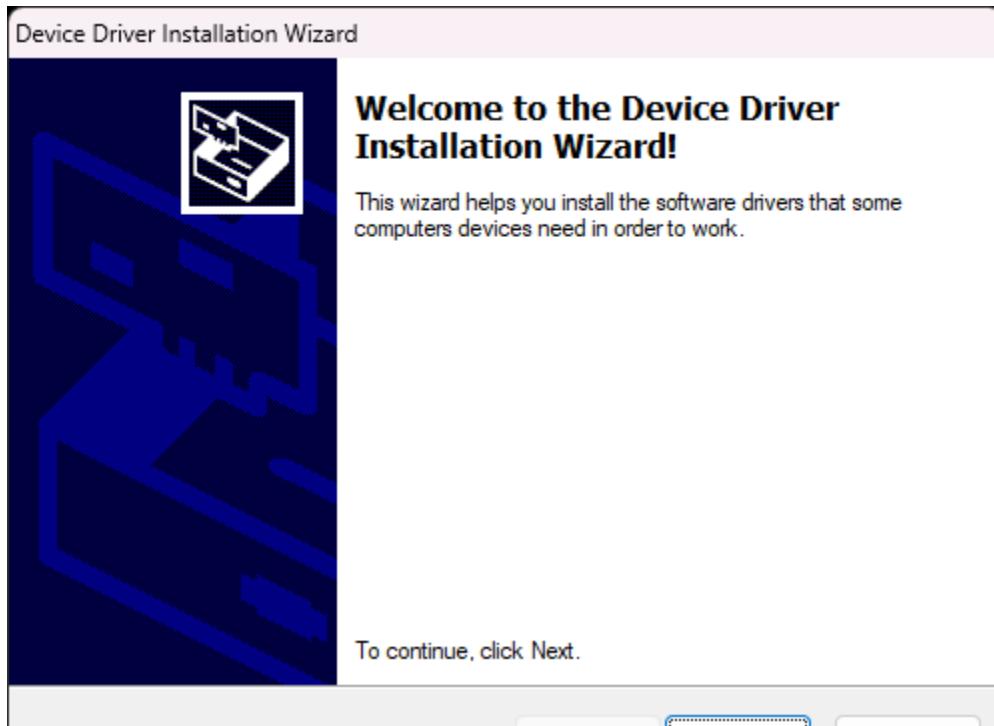
- In the stsw-link009 folder, select the file **stlink_winusb_install** and right-click to select Run as administrator.



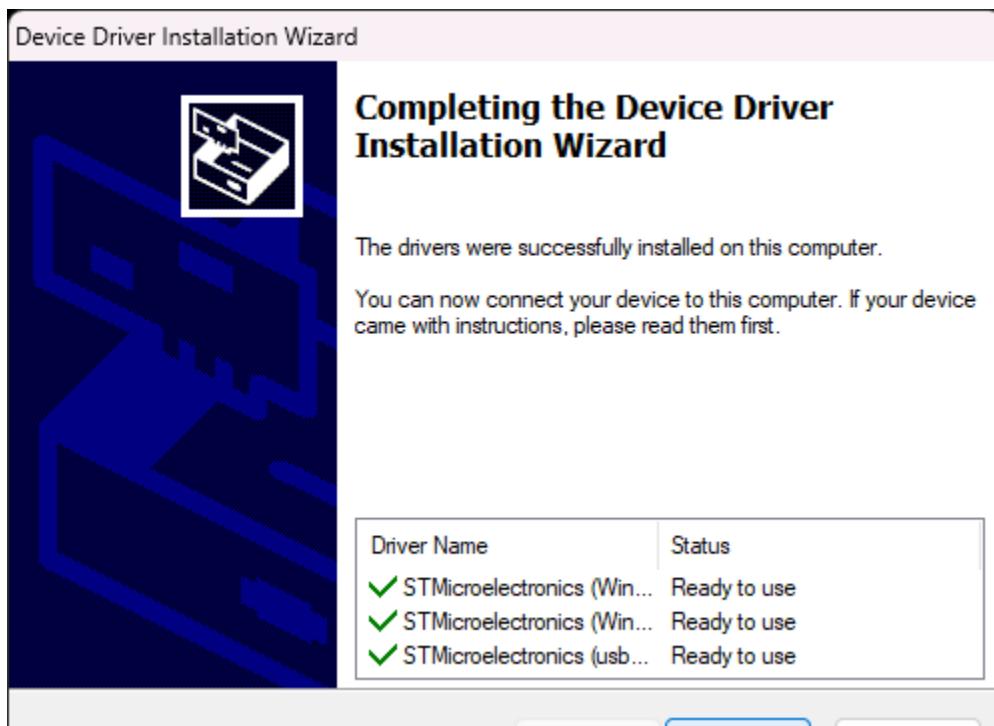
- A “Open File - Security Warning” pop-up window appears. Click on “Run” button.



- 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.

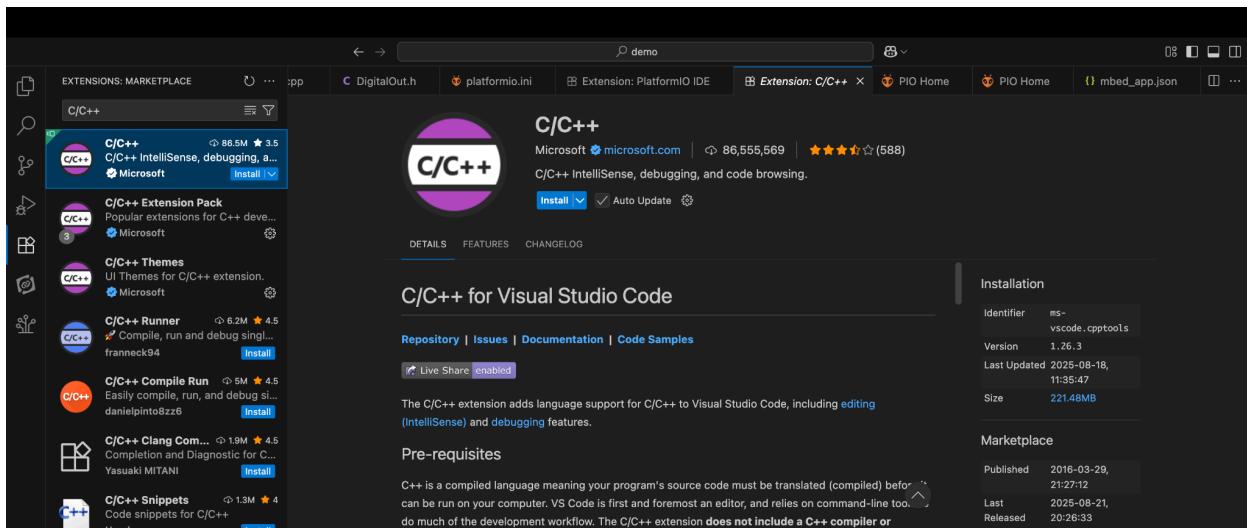
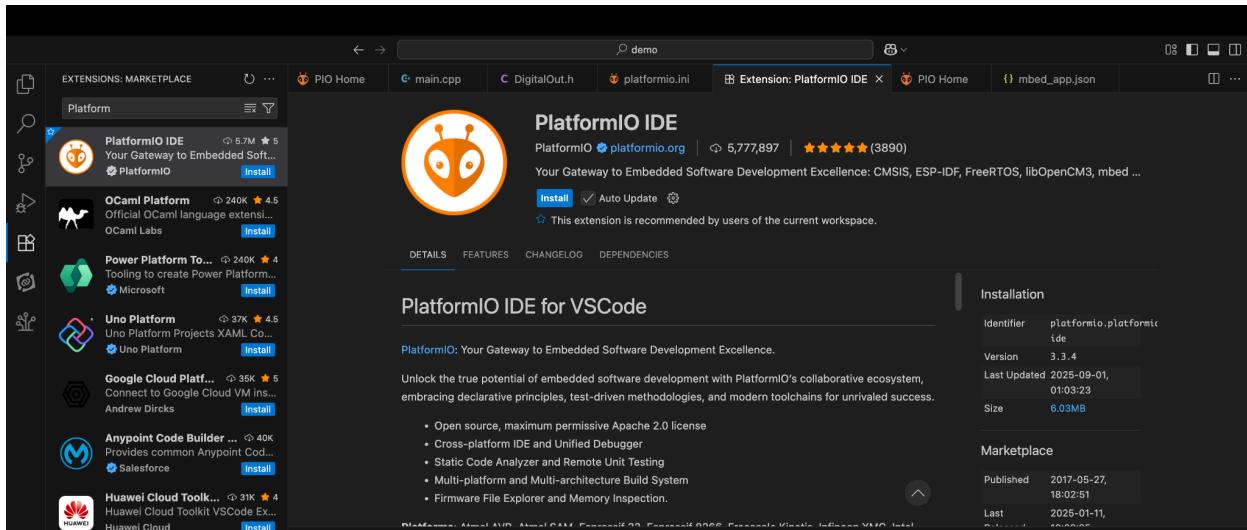


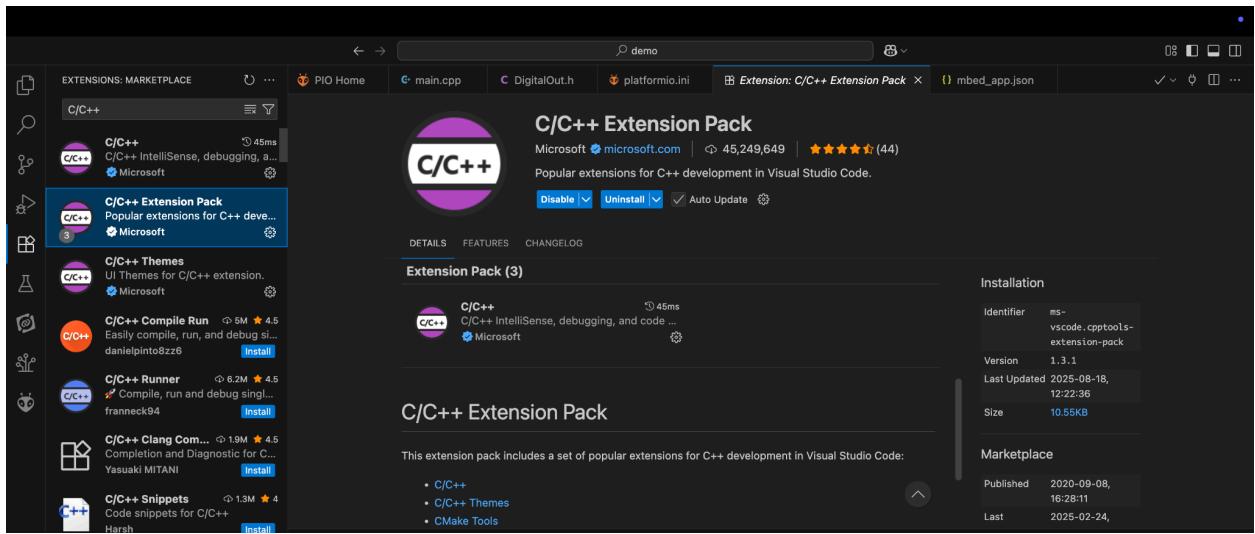
- Click on “Next” button and follow the procedure until the installation process is complete. Click on “Finish” button.



[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

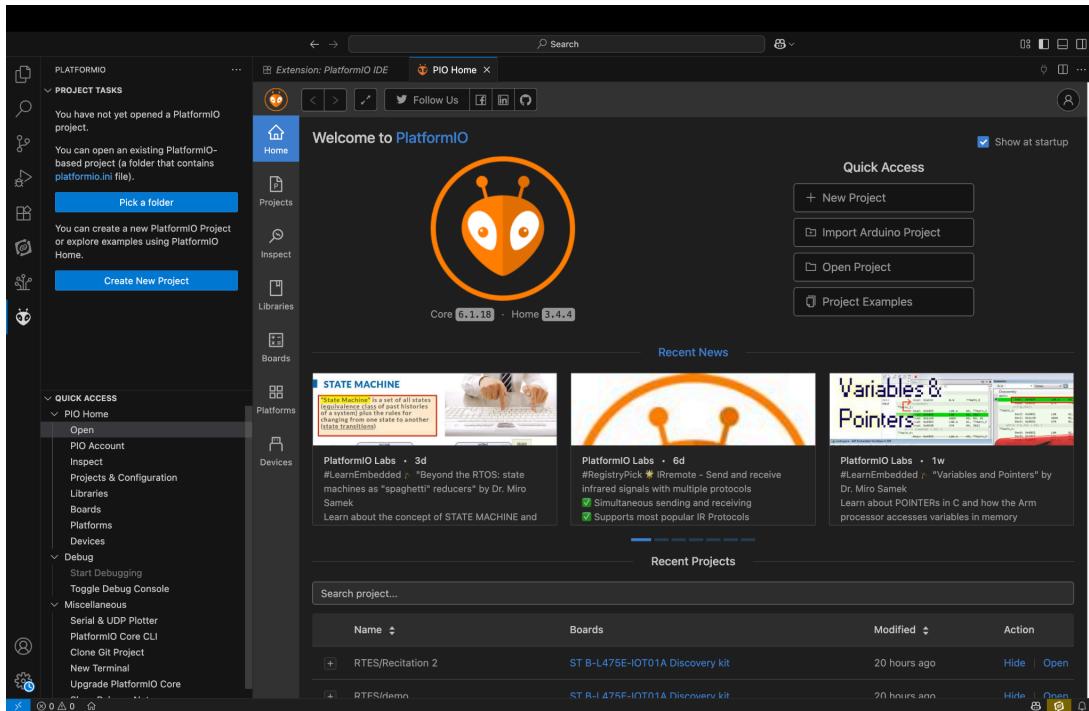




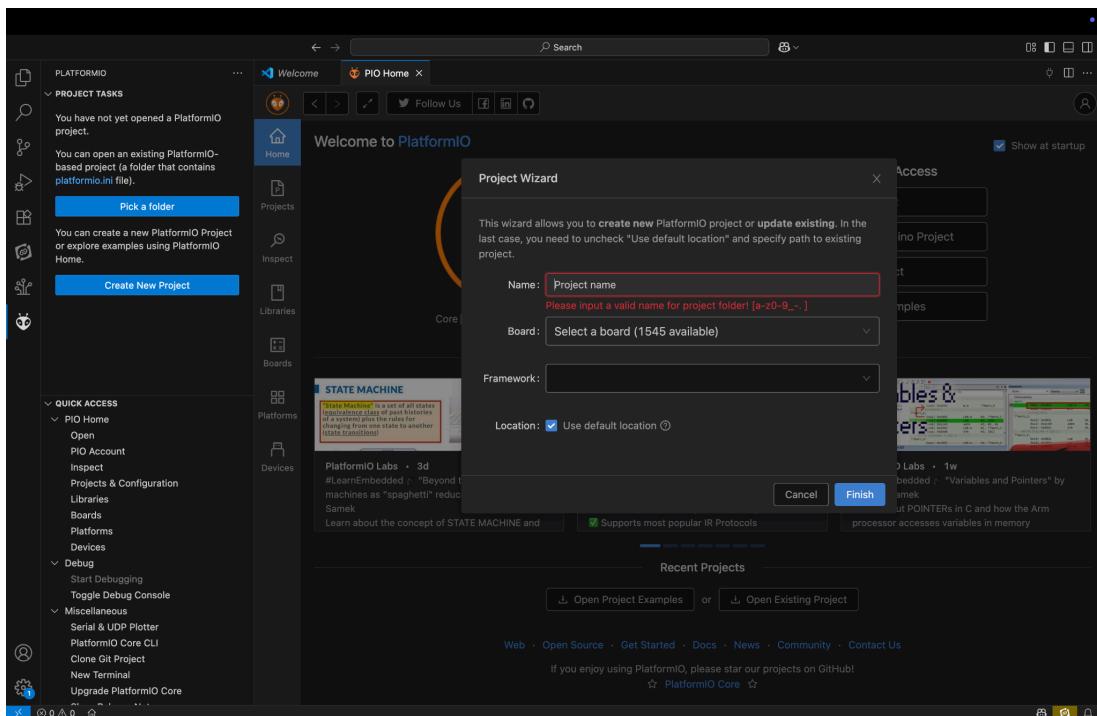
- After the installation, please restart VSCode

[6] Build a Sample Project in PlatformIO

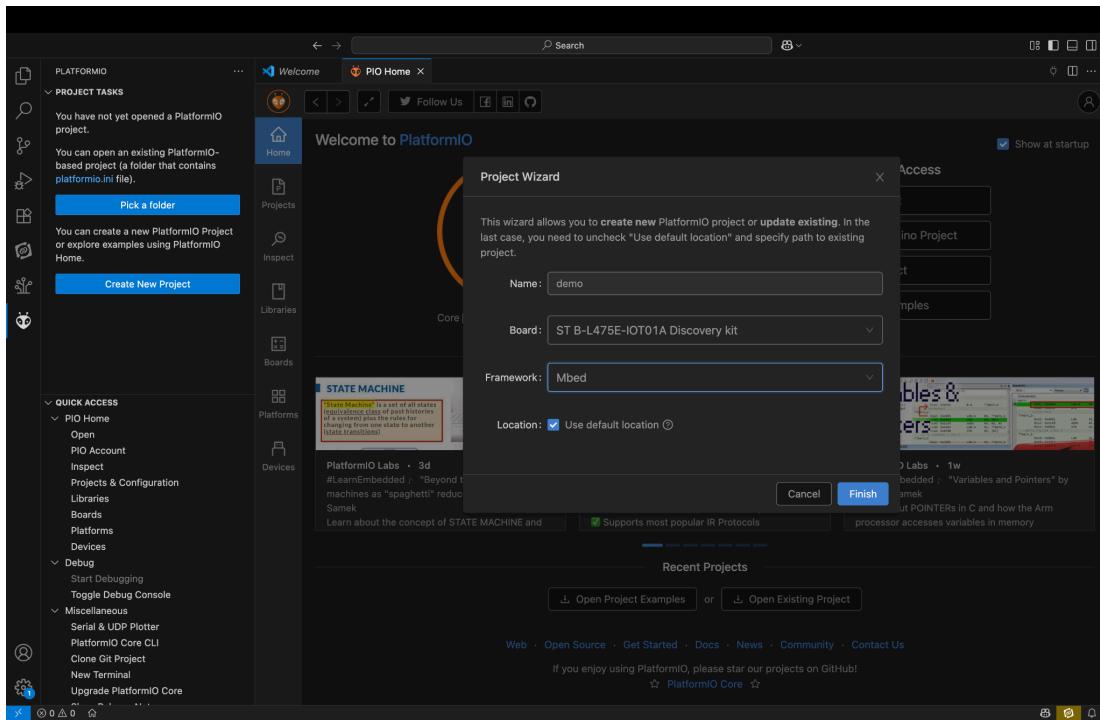
- Click on PlatformIO icon in VSCode



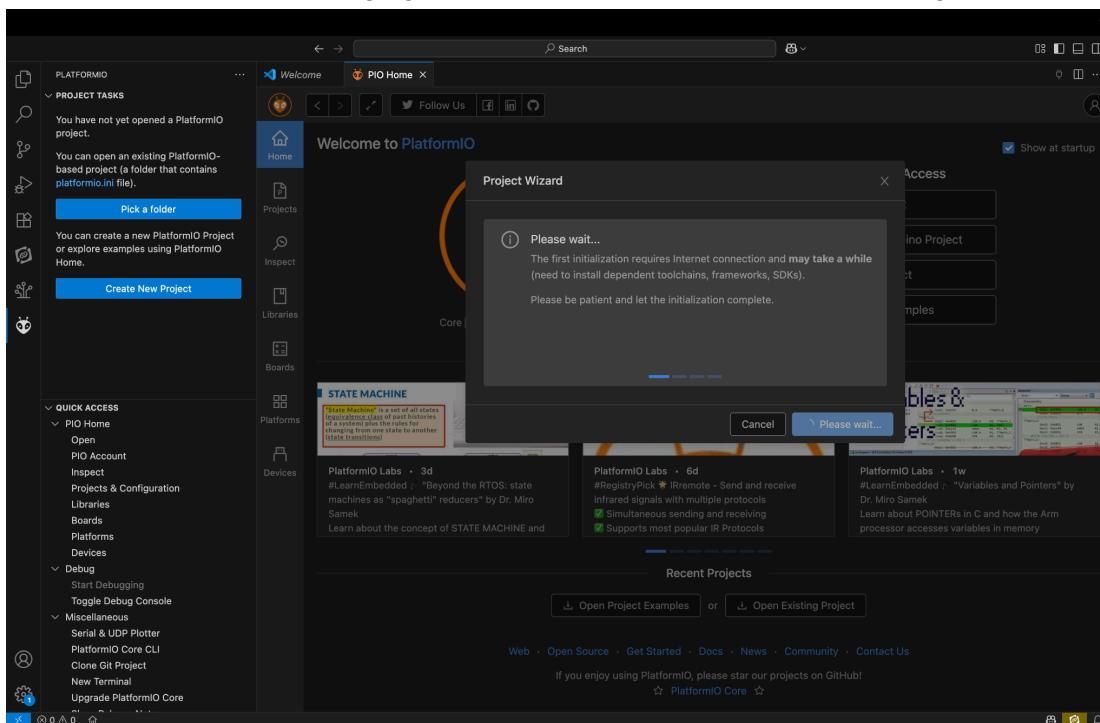
- Click on **New Project** under Quick Access. A Project Wizard window pops out.



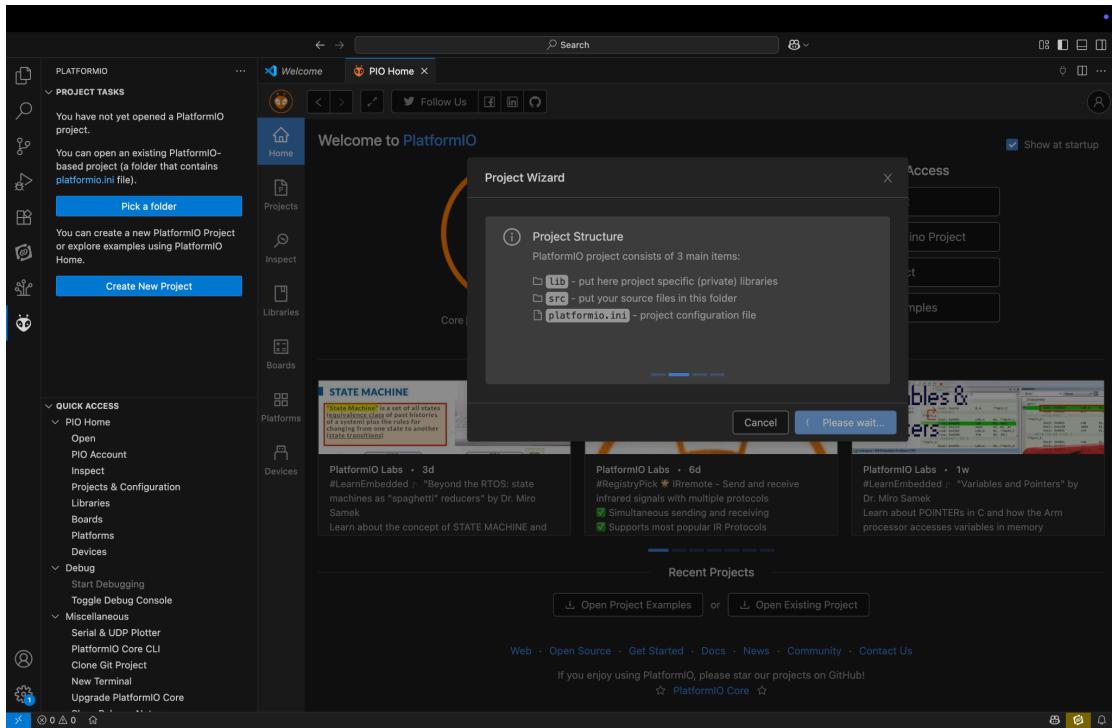
- Give the name as demo, board as ST B-L475E-IOT01A Discovery kit and Framework as Mbed and click on Finish



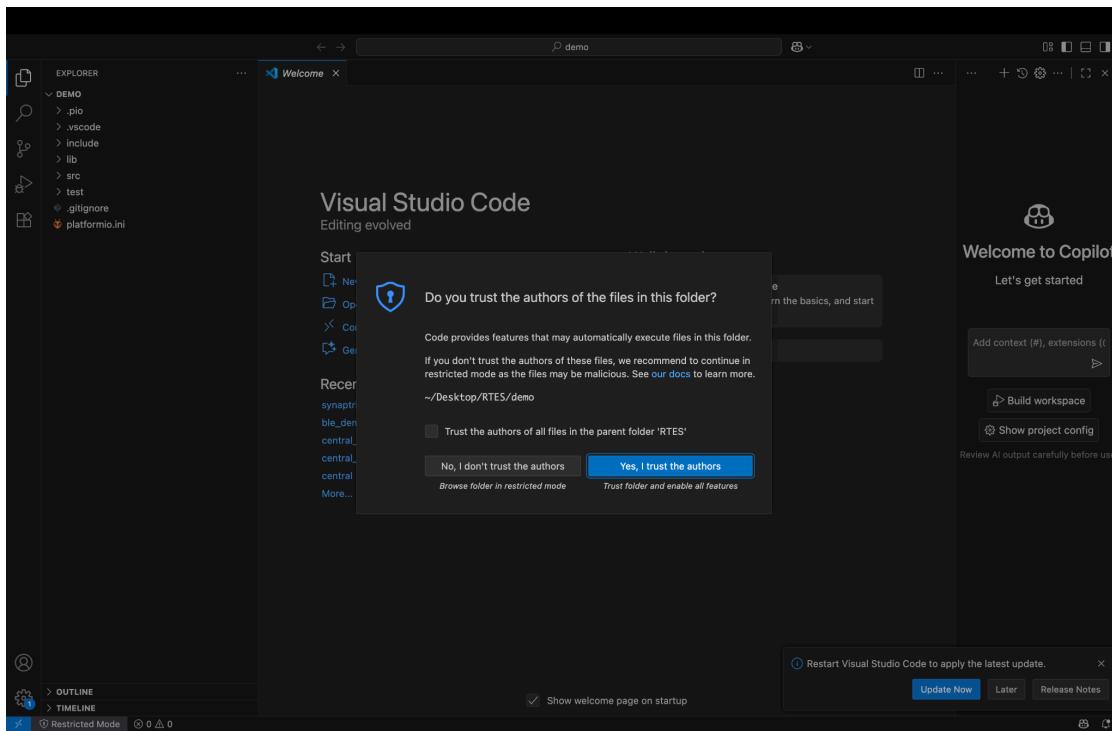
- Please wait for a while ranging from 2 minutes to 10 minutes depending on the machine.



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



- A new project directory called demo is created. Click on **Yes, I trust the authors** in the following window after the project directory is created.



- This is the platformio.ini file

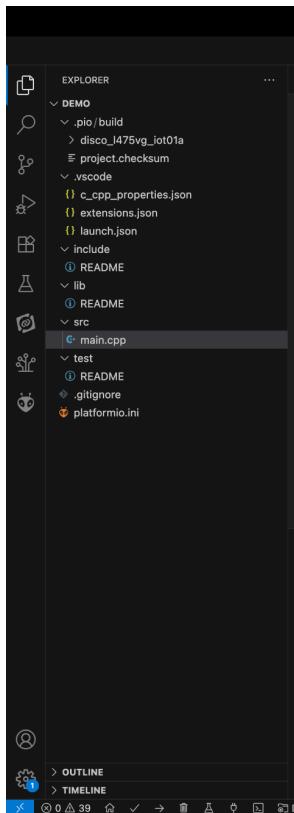
The screenshot shows the Visual Studio Code interface with the following details:

- Explorer View:** Shows a project structure with a folder named "DEMO". Inside "DEMO" are ".pio", ".vscode", "include", "src", and ".gitignore". A file named "platformio.ini" is selected and highlighted.
- Editor View:** The "platformio.ini" file is open in the main editor area. Its content is as follows:

```
1 ; PlatformIO Project Configuration File
2 ;
3 ; Build options: build flags, source filter
4 ; Upload options: custom upload port, speed and extra flags
5 ; Library options: dependencies, extra library storages
6 ; Advanced options: extra scripting
7 ;
8 ; Please visit documentation for the other options and examples
9 ; https://docs.platformio.org/page/projectconf.html
10 [env:disco_l475vg_iot01a]
11 platform = ststm32
12 board = disco_l475vg_iot01a
13 framework = mbed
14
15
```

- Right Panel:** The "Welcome to Copilot" panel is visible, featuring a "Welcome" icon, the text "Welcome to Copilot", and a "Let's get started" button. It also includes buttons for "Add context (#, extensions)", "Build workspace", and "Show project config". A note at the bottom says "Review AI output carefully before use".
- Bottom Status Bar:** Shows "Ln 1, Col 1" and "Spaces: 4" and "UTF-8". There are also buttons for "Update Now", "Later", and "Release Notes".

- Under src folder, create a main.cpp file



- Paste this demo code in the main.cpp

```
#include <mbed.h>

DigitalOut led(LED1);

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

    float value = 3.14159f;

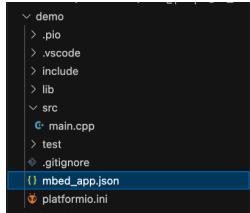
    while (1) {

        // 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);
    }
}
```

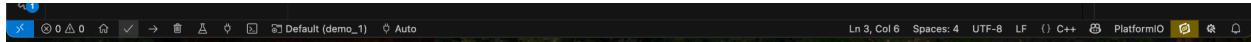
- Create a file named mbed_app.json in the project directory



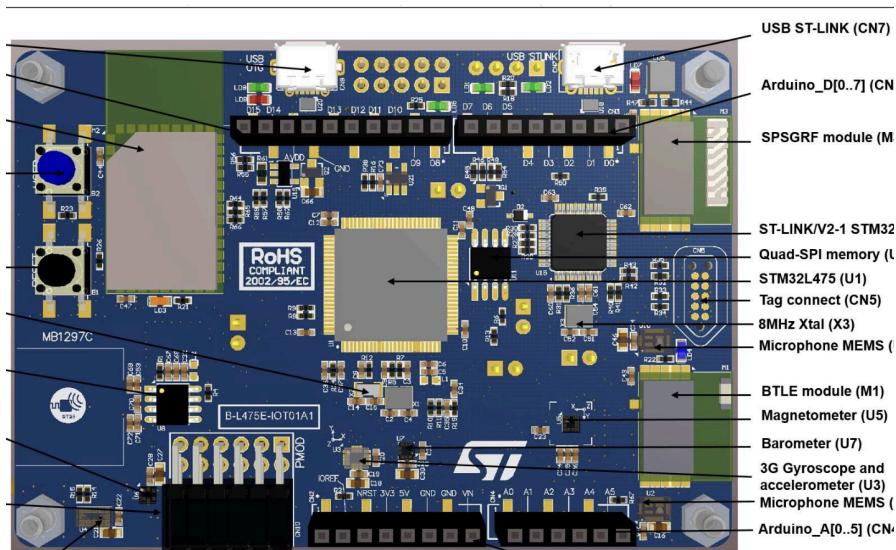
- Paste the following code in mbed_app.json

```
{
    "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:

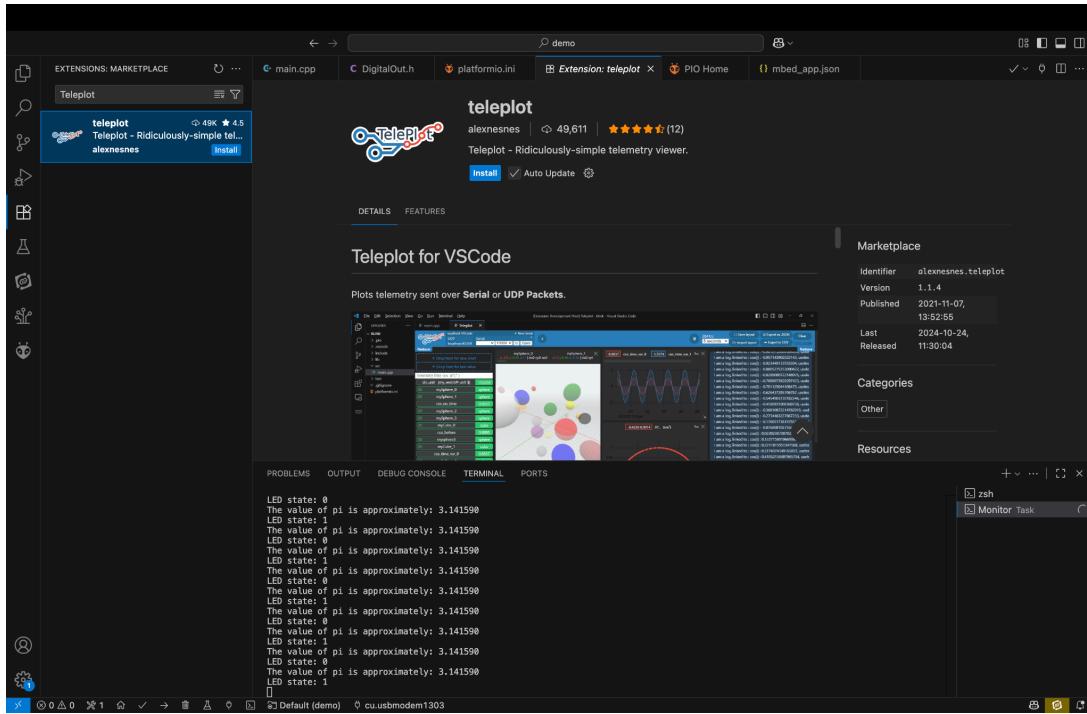
- During installation, the setup might get redirected to
 - Install python3
 - Install gcc or clang

[7] Starter Templates:

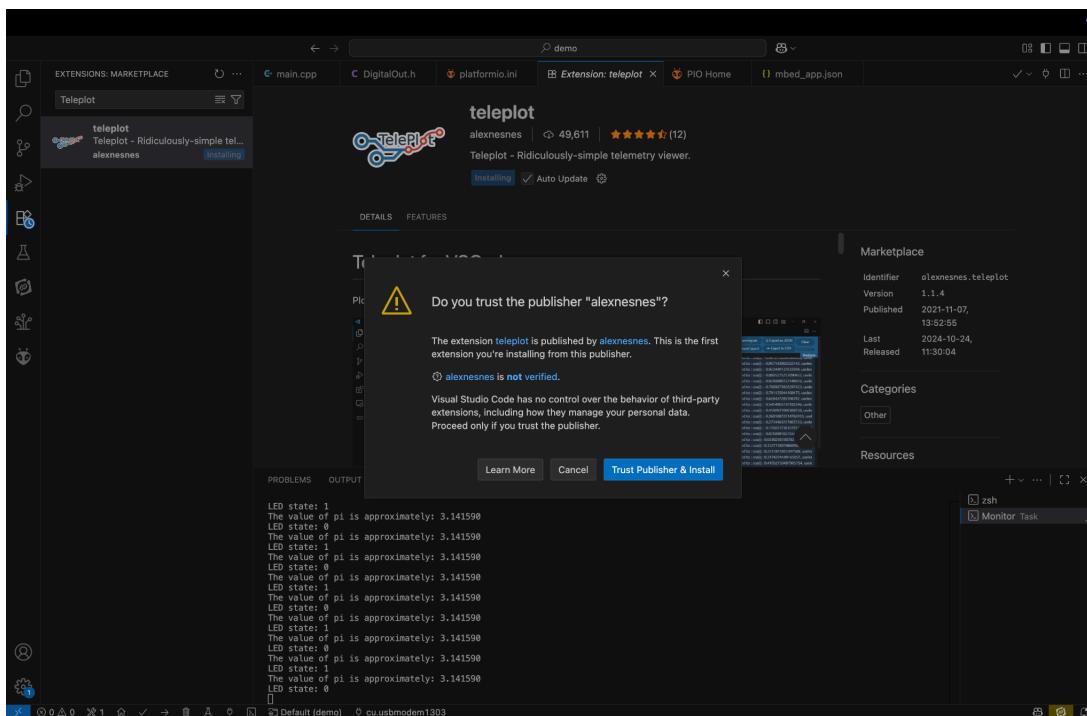
- Provided in the recitations Folder on Brightspace
- 2 versions given, check the How to Use the Templates folder!
- Try using both and check out their configuration files (platformio.ini)

[8] Extras/Optional:

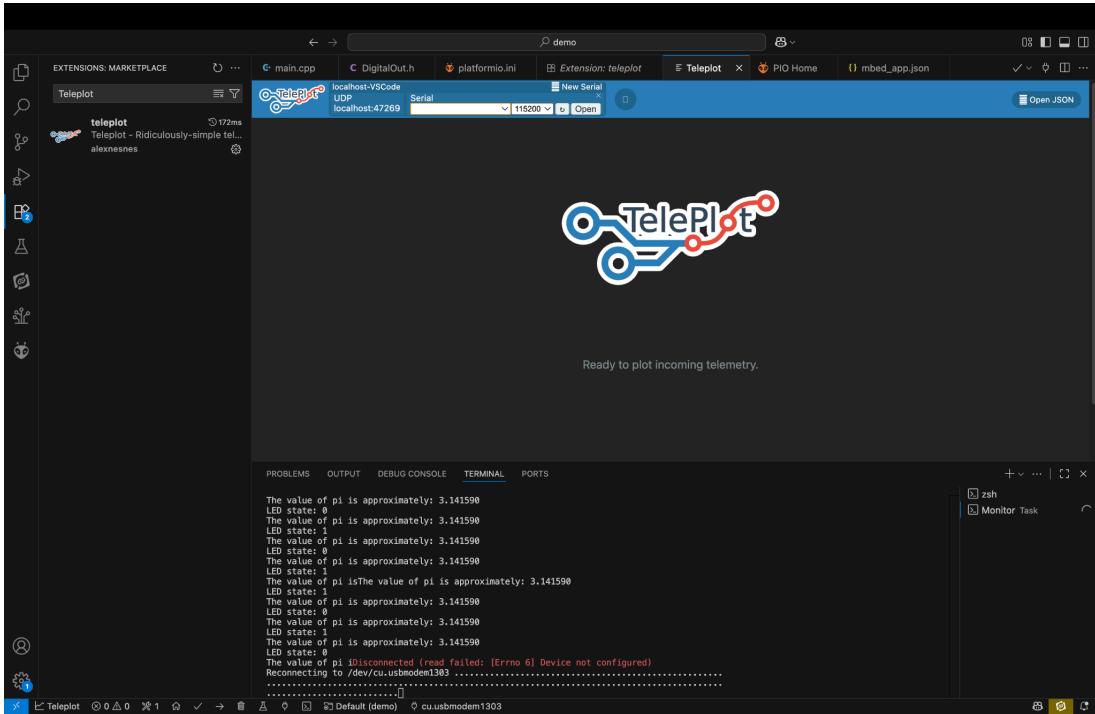
- Teleplot --> Install this VSCode extension



- 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 version:
 - 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