Introduction To IoT

Spring 2023

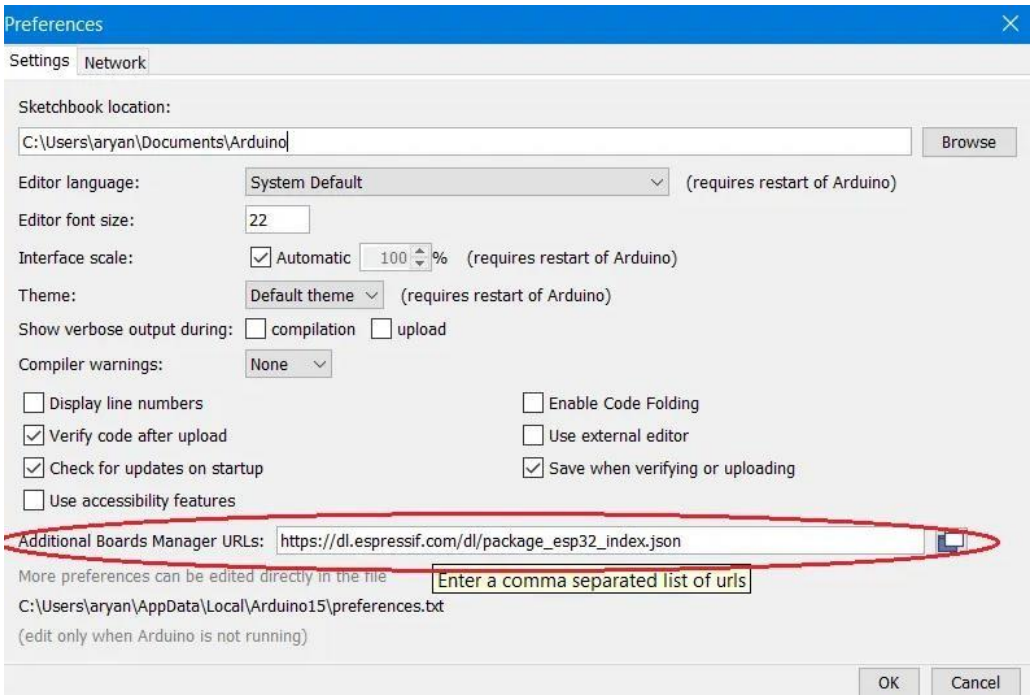
LAB-1

Introduction

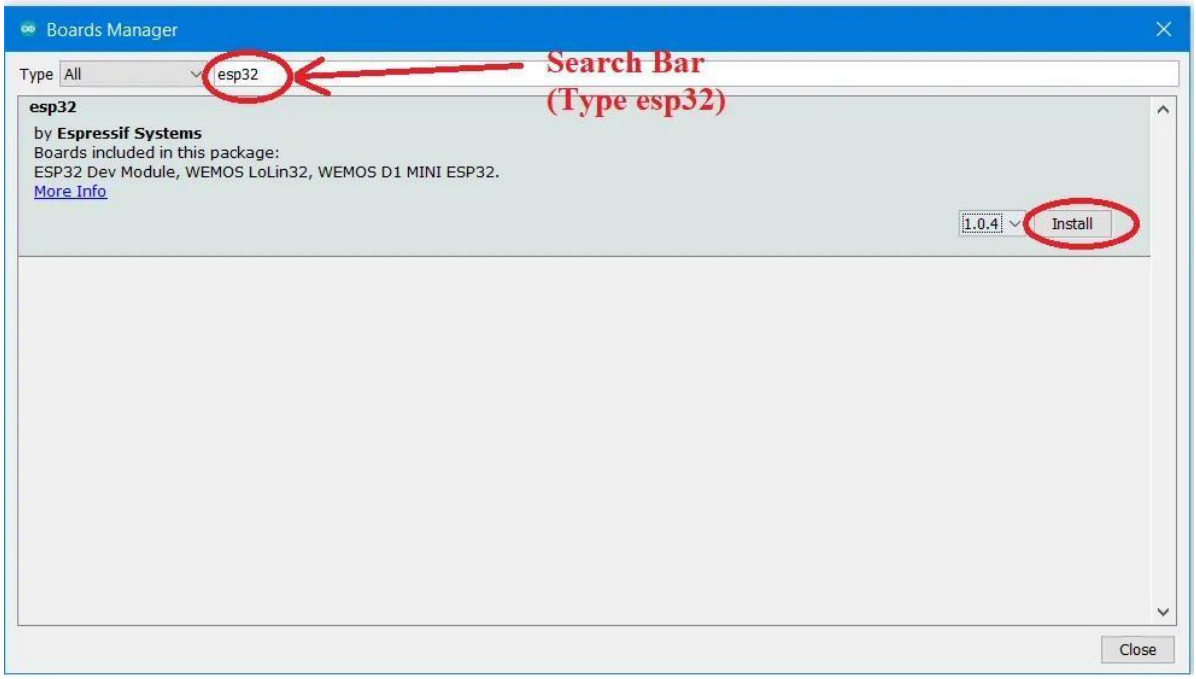
ESP32 is a highly integrated solution for Wi-Fi and Bluetooth IoT applications, with around 20 external components. ESP32 integrates an antenna switch, power amplifier, low noise receive amplifier, filters, and power management modules. The ESP32 boards can be programmed using many different programming languages. For example, you can program your ESP32 board in C++ language (like the Arduino) or MicroPython. And to make use of all the ESP32 features Espressif has officially provided the Espressif IoT Development Framework, or ESP-IDF (tutorial link). And usingArduino IDE is the easiest way to get started in programming the ESP32 board.

Setup for LAB experiments:

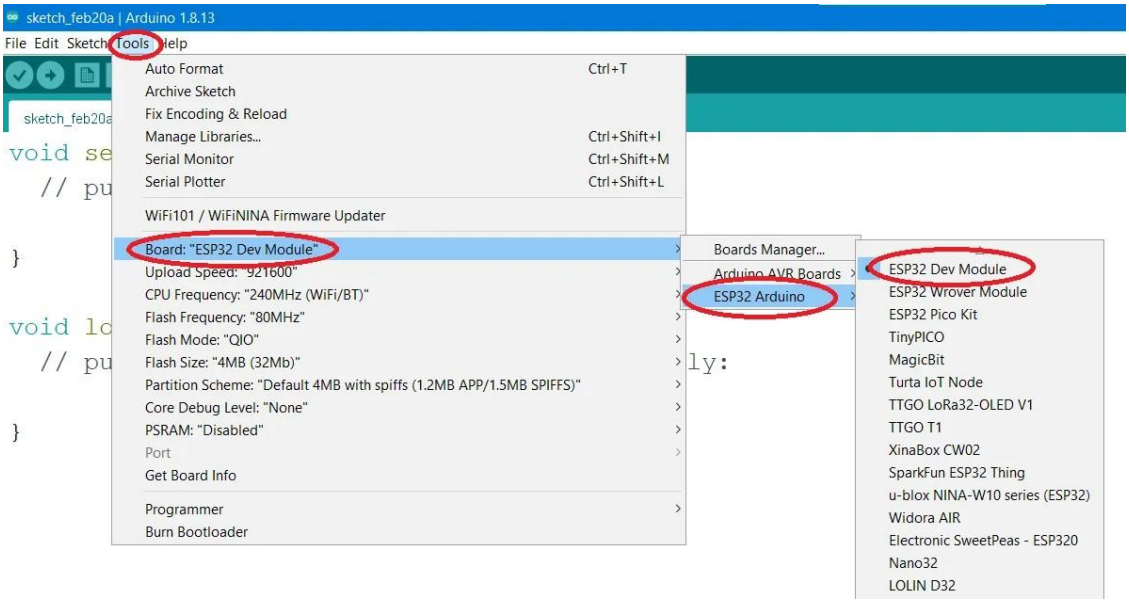
- Install the COM/Serial port driver
  ○ The new version ESP32(we use this) comes with the CP2102 serial chip, you can downloadand install the driver here.
- Download the Arduino IDE from the official website of Arduino. You can download thesoftware for Windows, Mac, and Linux 32 bit, 64 bit.
- Install the ESP32 Board Package
  ○ Enter Paste the URL: "**https://dl.espressif.com/dl/package_esp32_index.json"** into the"Additional Board Manager URLs" box as shown in the figure below. Then, click the "OK" button:
  Note: In case there are already some links present in the Additional Board Manager URL, youcan add new URLs by using a comma to separate them.



- Now open board manager from **Tools>Board>Board Manager to install ESP32 package.**
- In the board manager dialog box, click on the search bar. Then type “ESP32” and hit enter. Now select and click on the install button for **“ESP32 by Espressif systems”**



- Now after the installation, in the **Tools> Board menu** a new option should appear **“ESP32 Arduino”** as shown in the figure below. Click on this option and select the version of yourESP32 board.

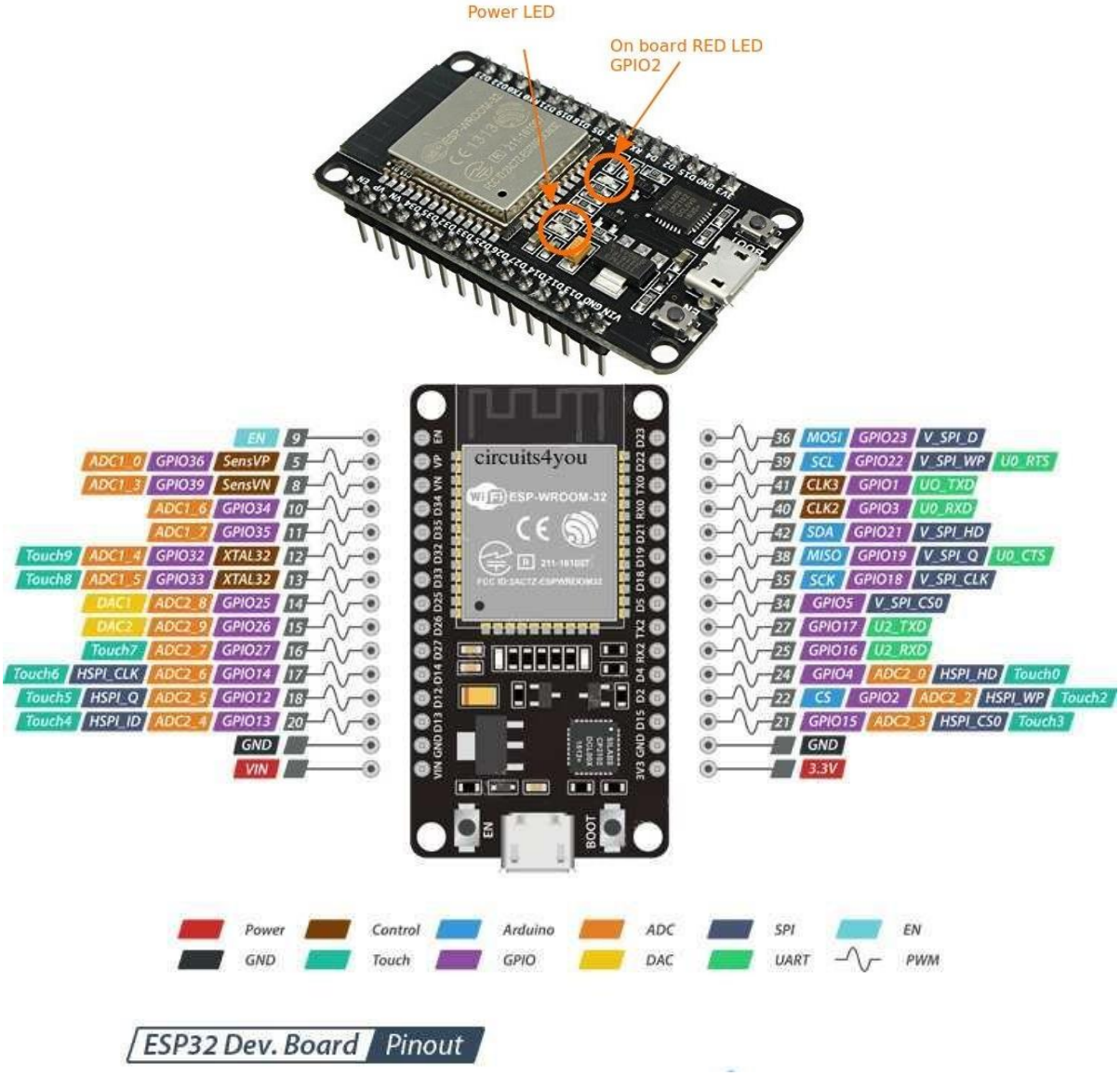


- Note: You’d better close the Arduino IDE and restart it again.
- Config the Board menu and choose the right Port for your device.
  - CPU Frequency：80MHz,
  - Flash Size：4M（3M SPIFFS）,
  - Upload Speed：115200

LAB EXPERIMENT- 1a (Blinking the Built-In LED)

In this lab session, we will introduce how to control the built-in LED on ESP32.

- **Hardware Required**
    - ESP32x 1
    - Micro USB cable x 1
    - PC x 1
- Blink the onboard LED connected to pin 2 on theESP32 .
- Follow the above-mentioned board config to use ESP32 from Tools->Board dropdown
- Use the below given PINOUT diagram of the ESP32



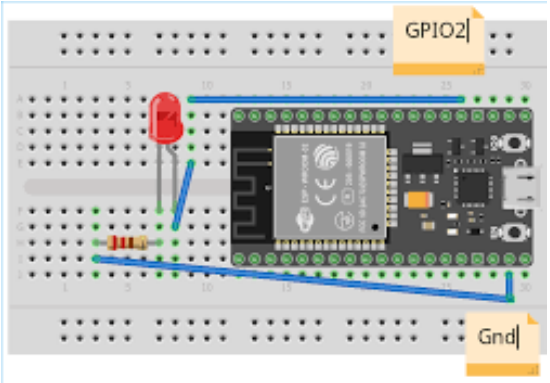
- **Pseudocode**:
  - Setup block
    - Declare the LED Pin 2 as the output using PinMode(<pin number>, <pin type>) function
  - Loop block
    - Make the LED Blink using the functions digitalWrite(<ping number>, <output>) and delay(<time in milliseconds>) with appropriate delay in milliseconds.

LAB EXPERIMENT- 1b (Blinking an external LED)

In this lab session, we will introduce how to control an external device like LED using the pins on ESP32.

- **Hardware Required**
  - ESP32x 1
  - LED x 1
  - 200 ohm resistor x 1
  - Micro USB cable x 1
  - PC x 1

- **Blink an external LED**
  - Connect one end of the resistor 200 ohms to D1(or any digital pin) and the other end to LED long leg (positive leg / anode). Connect the short leg (negative leg/cathode) to GND.
  - The value of the resistor in series with the LED may be of a different value than 200 ohm; the LED will lit up also with values up to 1K ohm.



Your task is to glow the LED in an incremental order of delay and then in a decremental order. So, initially, the duration between 2 consecutive glows of an LED should be 1 sec, then increase to 2 sec, then 3 sec and so on until the delay reaches 5 seconds. At this point, we will start decreasing the delay by 1 second in an iterative fashion. That is the LED will glow with a delay of 5 sec, then 4 sec and so on, until the delay reaches 0 sec.

- **Pseudocode**
  - Same as internal LED except for LED pin now is D1(or any other digital pin).

LAB EXPERIMENT- 1c (Printing on the Serial Monitor)

In this lab session,we will introduce how to print the output of the sensor data on to serial monitor using the micro USB cable.

- **Hardware Required**
  - ESP32x 1
  - Micro-USB cable x 1
  - PC x1
- Connect your ESP32 to the PC and put below code to your Arduino IDE
- PseudoCode:
  - Use Serial.begin(<baud rate>) to begin the serial communication.
  - Use Serial.println(<data>) to print on the serial monitor in a new line.
  - The data in the experiment can be randomly generated number using
    random(<min>, <max>)
- Modify the provided pseudocode to output one randomly generated number in an erative order where the min-limit and max-limit are varying.
  Consider the initial min value to be 0 and max value to be 10. In this case, the random number generated will lie between 0 and 9. Now, in the second iteration the min value=10 and max value = 20, in the third iteration min value=20, max value = 30 and so on.

  Perform the above-mentioned task of random number generation and display them on the serial monitor for 20 iterations.

LAB EXPERIMENT- 1d (Reading inputs from the Serial Monitor)

In this lab session, we will introduce how to read the inputs using Serial.read from the serial monitor and controlling the buzzer's frequency using the tone function.

- Hardware Required
  - ESP32 x 1
  - Micro USB cable x1
  - PC x1
  - Passive Buzzer MH-FMD
- Difference between active and passive buzzer:
  - An active buzzer generates a tone using an internal oscillator so all that is needed is a DC voltage. A passive buzzer requires an AC signal to make a sound.
    It is like an electromagnetic speaker where a changing input signal produces the sound, rather than producing a tine automatically.

  - With a "passive" device or speaker, you must send it an AC "sound signal" and you can control the sound. The Arduino needs to generate the "tone". WIth enough hardware and software you could make it play music etc. The only down-side (besides a bit of extra programming) is that it takes processor-time to generate the sound.