

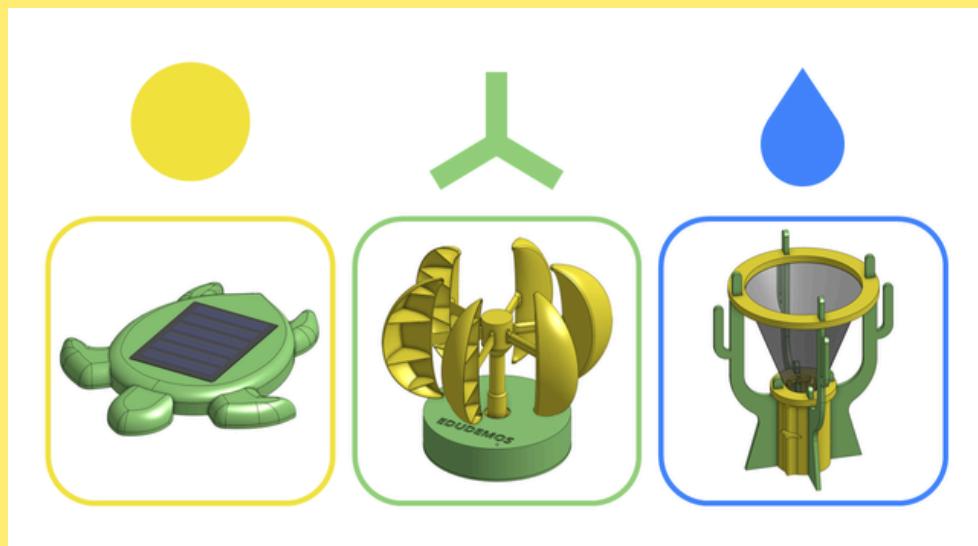


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EDUDEMOS

Solar Demonstrator “Turtle”



RESEARCH PROJECT

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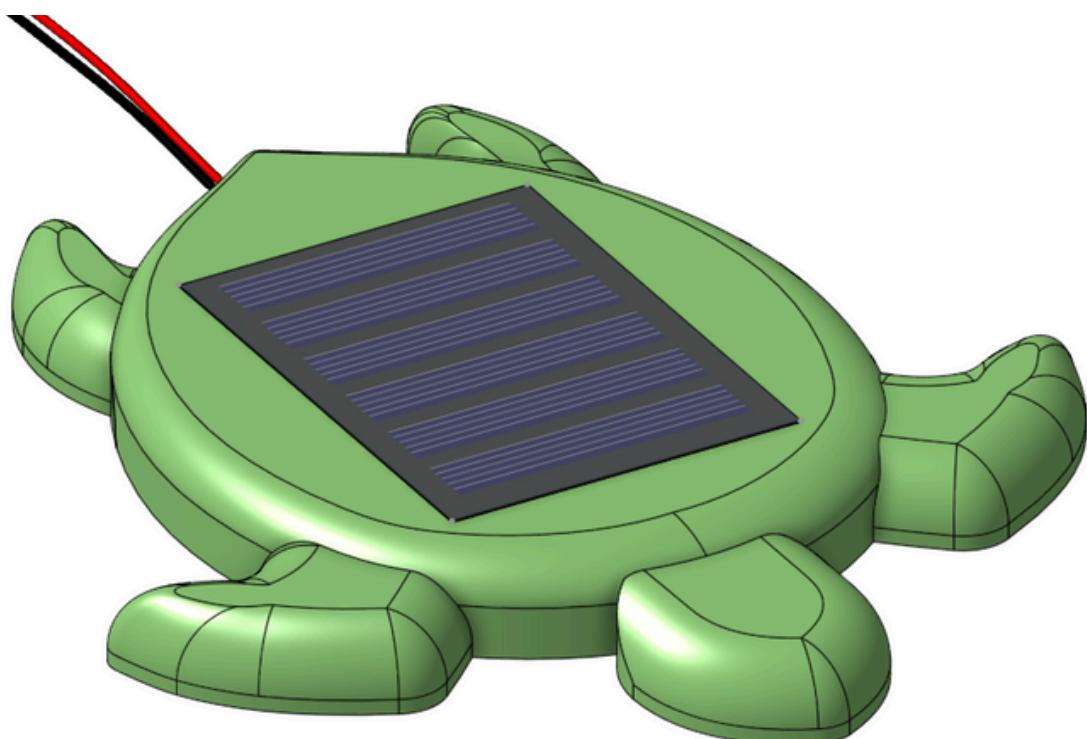
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EDUcating through Sustainable DEMOnstrators

Assembly Guide Solar Demonstrator “Turtle”



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Material

Electrical Components

- ESP 8266 (Microcontroller)
- Voltage Sensor 0-25V
- LCD-Display (I2C 16x2)
- Solar Panel
- Breadboard
- Jumper Wire (x7: F-M & x4: M-M)
- Luster Terminals x2
- USB-C Port

3D-Printer

- 3D-Filament for the Turtle (ca. 45g)

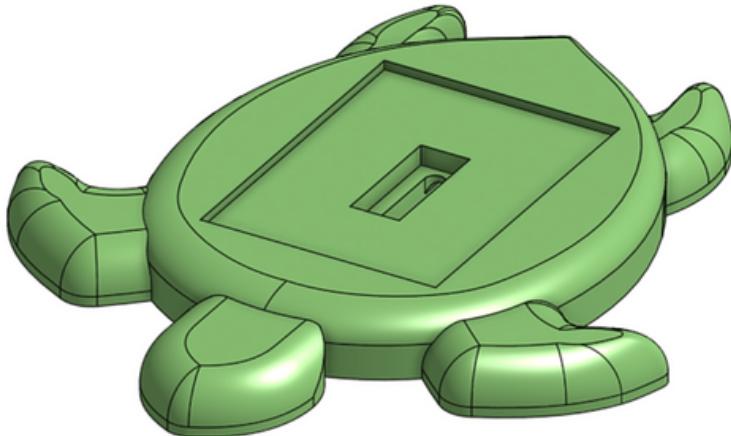
Additional Cables

- USB-C cable for the power supply

Optional:

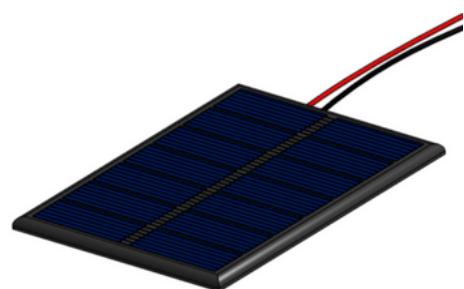
- Micro USB to USB-A, to further alter the solar demonstrator

Solar Demonstrator



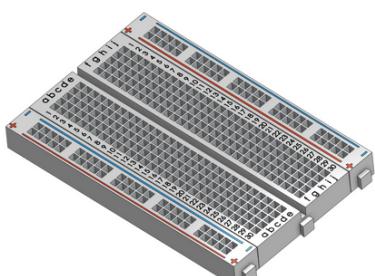
3D Printed Turtle

x1



Solar Panel

x1



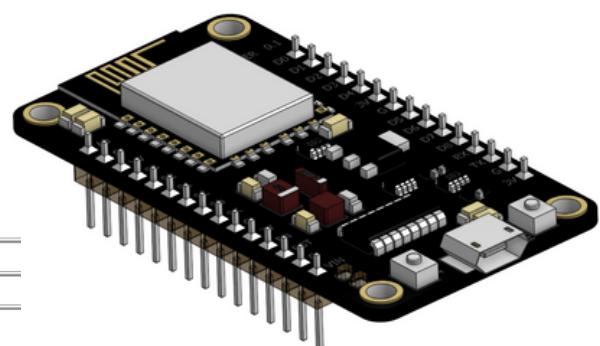
Breadboard

x1



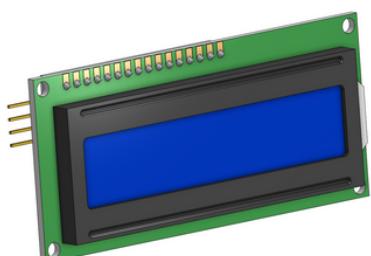
Voltage Sensor

x1



ESP8266 (microcontroller)

x1



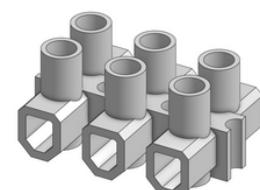
LCD Display (I2C)

x1



USB-C Port

x1



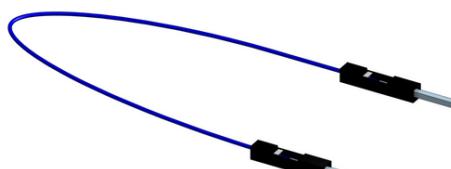
Terminal Block

x1 (two Terminals)



F-M Jumper Wire (Female to Male)

x7



M-M Jumper Wire (Male to Male)

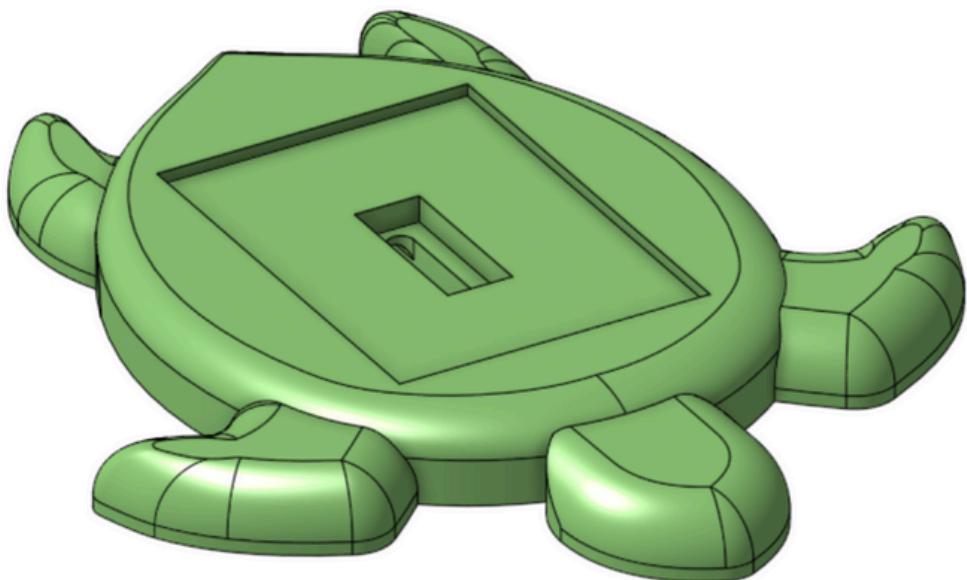
x4

Total 19
elements

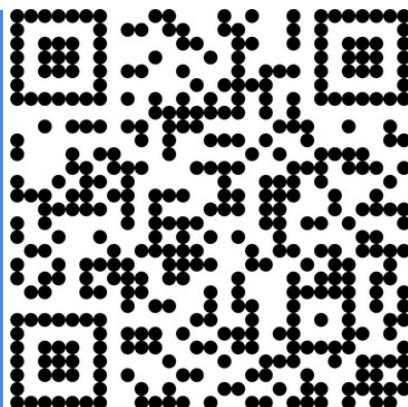
Step By Step

Instructions

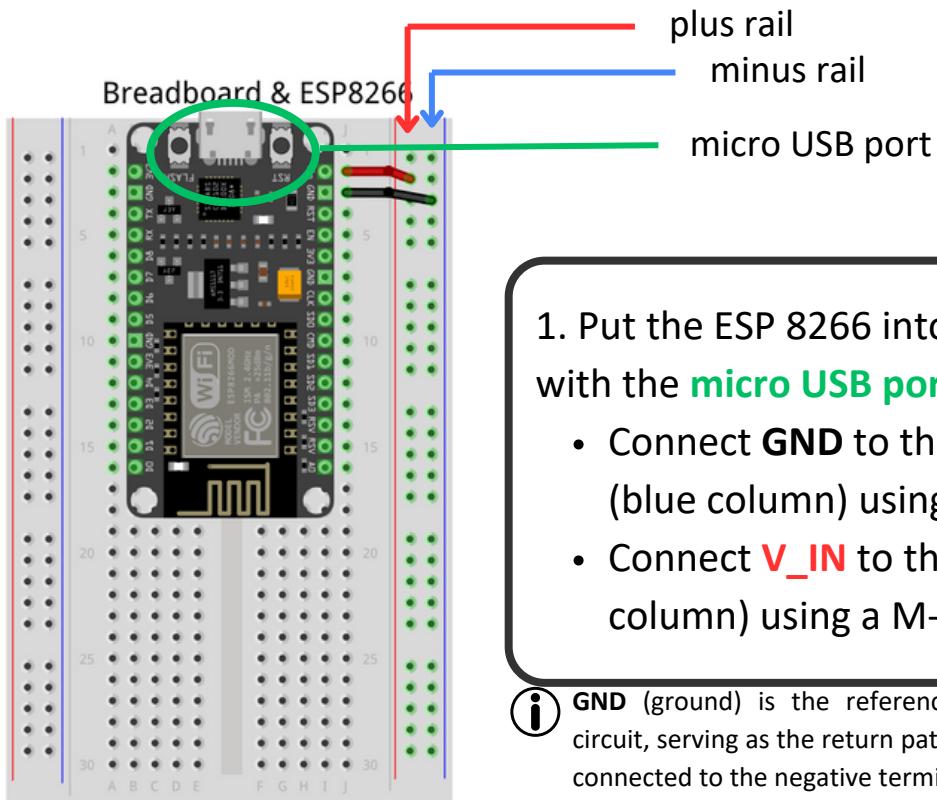
A. Print the corpus of the Turtle on any 3D-Printer



The STL-printfiles
are available on
the EduDemoS
webpage.



B. Building the Solar Demonstrator



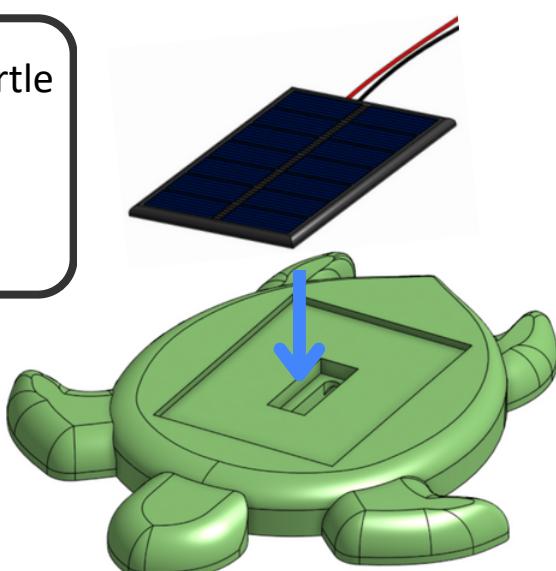
1. Put the ESP 8266 into the Breadboard with the **micro USB port** facing out.

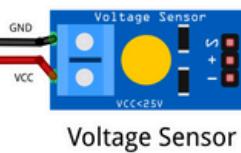
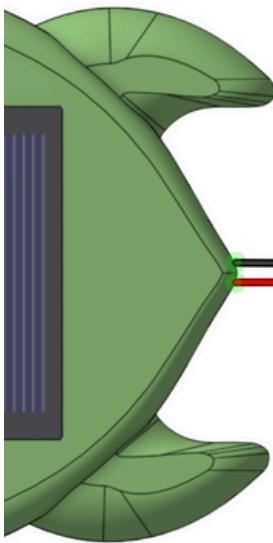
- Connect **GND** to the **minus rail** (blue column) using a M-M wire
- Connect **V_IN** to the **plus rail** (red column) using a M-M wire

i **GND** (ground) is the reference point in an electrical circuit, serving as the return path for current and typically connected to the negative terminal of a power supply
V_in (voltage input) is the pin where the external power supply is connected to provide voltage to the circuit or device.

2. Place the solar panel on the turtle

- Make sure that the wires are fed through the hole in the turtle



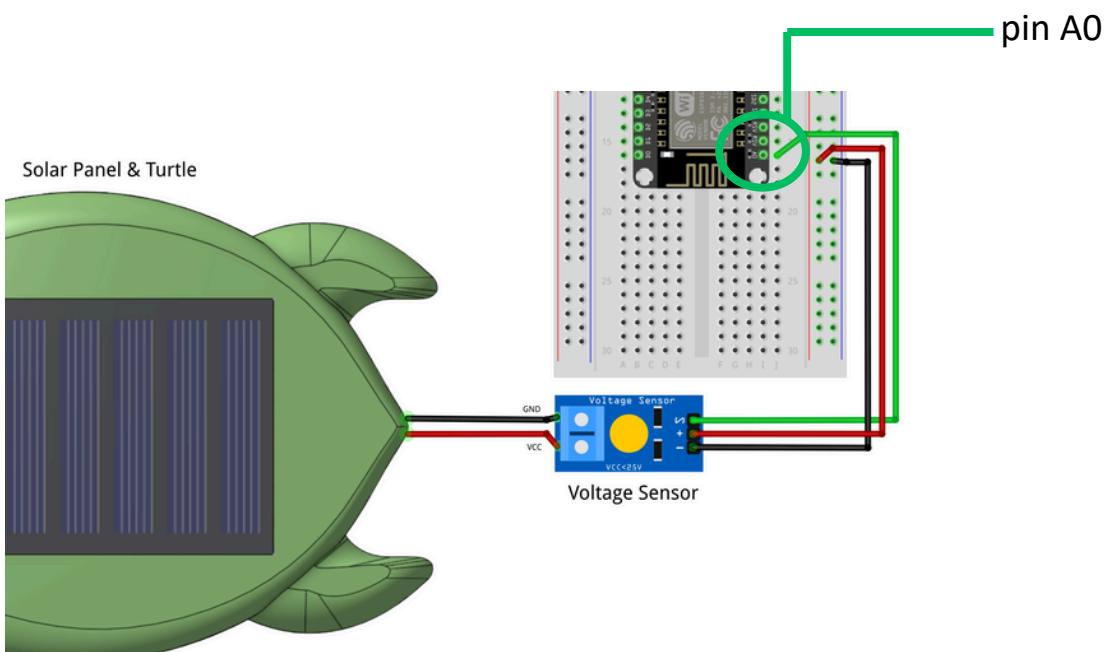


3. Connect the cables from the solar panel to the voltage sensor.
- Connect “+” (red wire) to **Vcc**
 - Connect “-” (black wire) to **GND**

i Use a small double-slot screwdriver to open the clamps on the voltage sensor board, slide the cables in, and then screw them shut again.

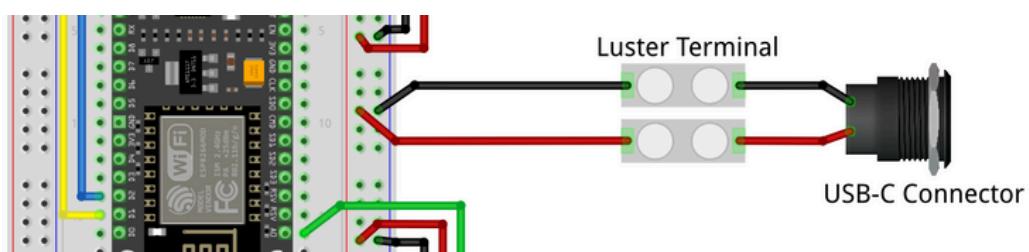
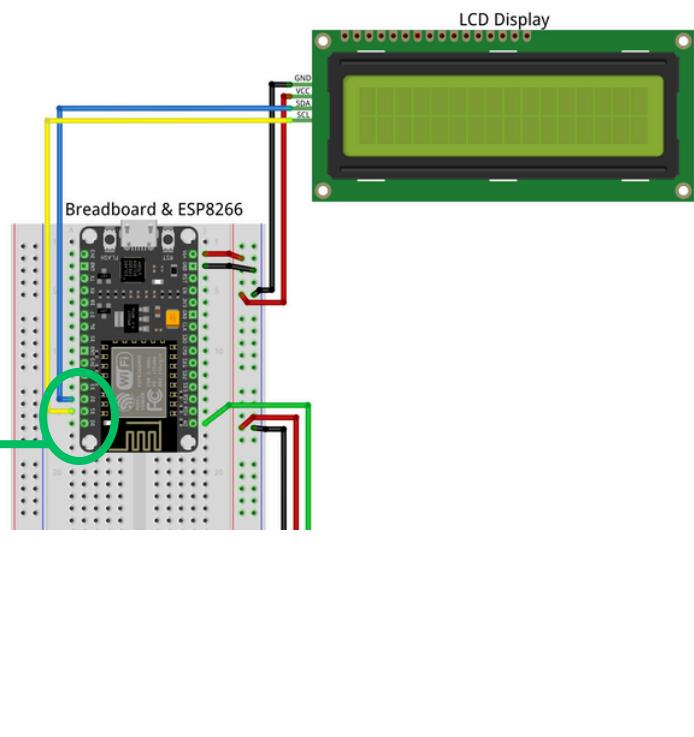
4. Use three of the M-F jumper cables and connect them as follows:

- “S” to the **pin A0** on the ESP8266 board with a F-M wire
- “+” to the **plus rail** with a F-M wire
- “-” to the **minus rail** with a F-M wire



5. For the LCD display:

- **GND** to the **minus rail**
- **Vcc** to the **plus rail**
- **SDA** to **D2**
- **SCL** to **D1**

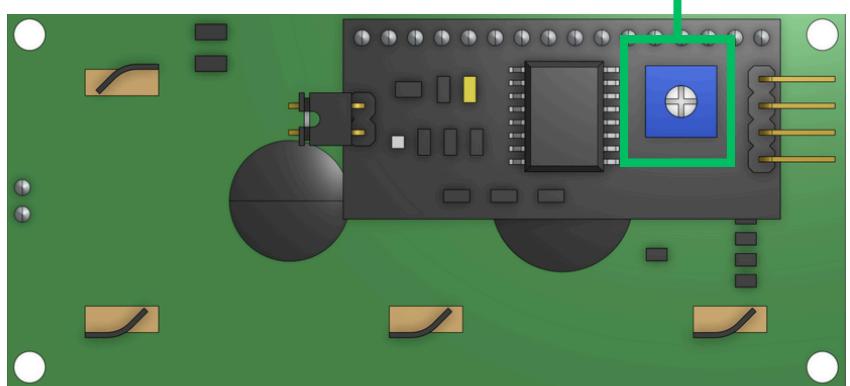


6. For the USB-C port:

- First connect the wires to the terminal blocks from one side
- Connect M-M wires to the other side of the terminal blocks as shown
- Screw the terminals shut
- With the open ends from the M-M wires, connect the **red wire** to the **plus rail** and the **black wire** to the **minus rail**

7. Plug in a standard USB-C cable

If the display is hard to read because it is too bright or too dark, flip it to its back and turn the **potentiometer** until the symbols on the display become readable.



Backside of the LCD-Display

8. Enjoy.

The display should now show how much voltage the solar panel is generating.

What else can you imagine?

Personalize your own demonstrator,

and share your ideas and feedback

with us at

edudemos@technikmachtspass.org

Installation Guide

What is the Arduino IDE?

The Arduino IDE (Integrated Development Environment) is the software used to write, compile and upload code to your board. (In this case the ESP8266.)

Downloading and installing the Arduino IDE:

Step 1: Go to the Arduino Website

Open your web browser and visit the official Arduino website:

<https://www.arduino.cc/>

Step 2: Navigate to the Download Page

From the homepage, click on “Software” in the top menu, then select “Downloads”

Step 3: Choose Your Operating System

On the Downloads page, select the appropriate version of the Arduino IDE for your operating system (Windows, macOS, or Linux).

Step 4: Download the Installer

Click on the download link, and if prompted, you can choose to contribute or simply download without contributing.

Step 5: Install the Arduino IDE

- For Windows:
 - Run the downloaded .exe file.
 - Follow the installation wizard to install the IDE.
 - Check the option to install the USB driver when prompted.
- For macOS:
 - Open the downloaded .dmg file.
 - Drag the Arduino IDE to the Applications folder.

- **For Linux:**
 - Extract the downloaded .tar.xz file.
 - Run the install.sh script in the terminal.

Step 6: Verify Installation

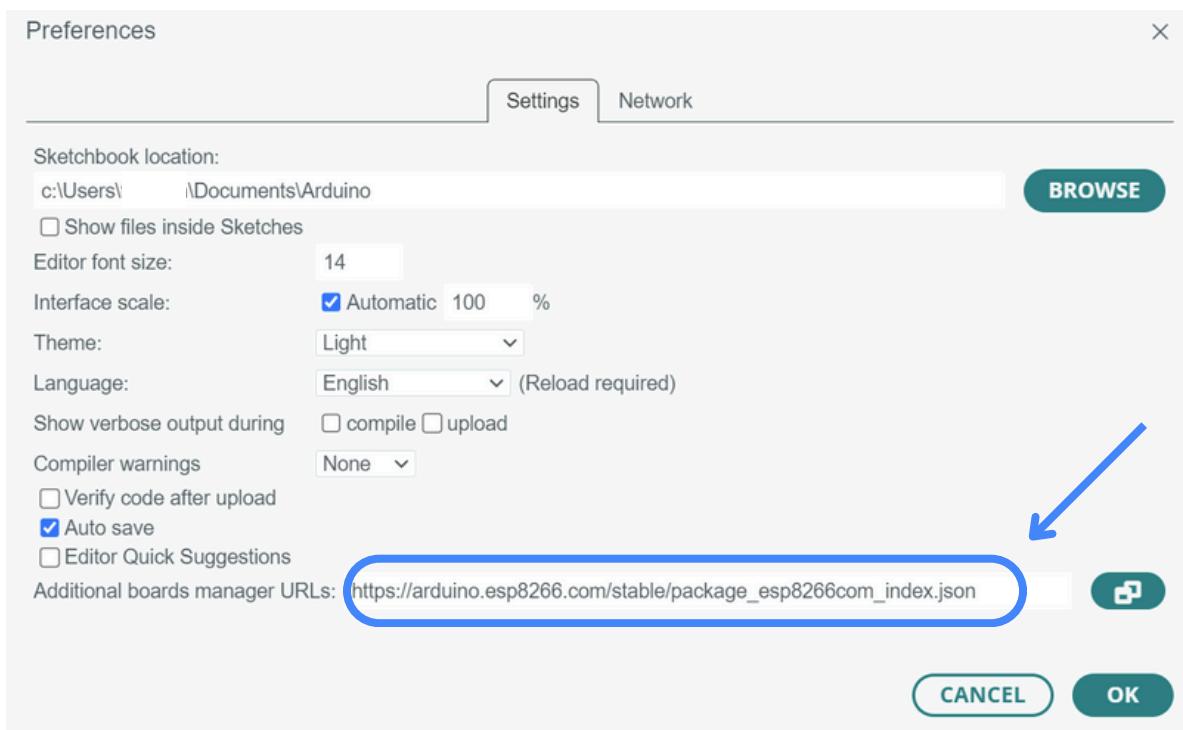
Open the Arduino IDE to ensure it launches correctly.

Configuring the Arduino IDE:

Step 1: Add the ESP8266 Board URL

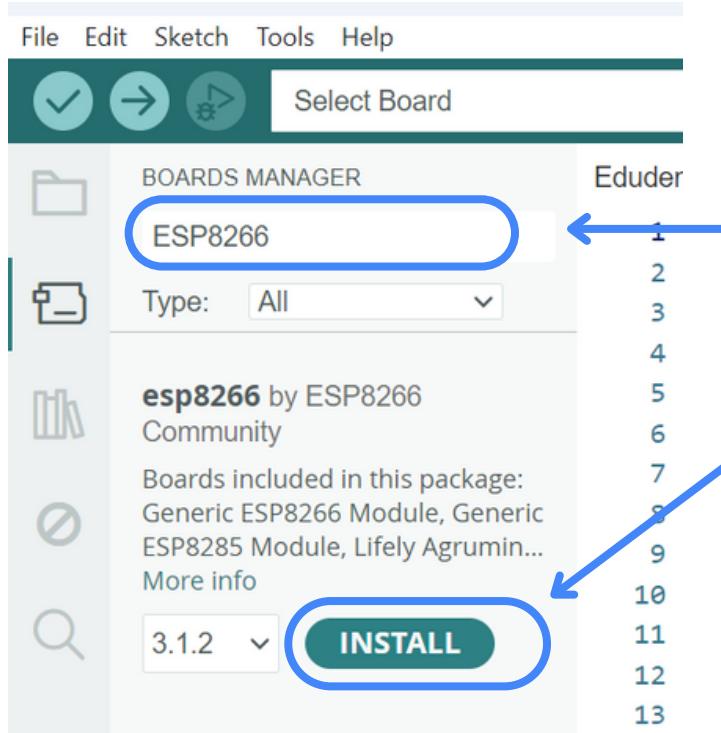
To use the ESP8266 with the Arduino IDE, you need to include the appropriate **URL** in the IDE's preferences:

1. Open the Arduino IDE.
2. Go to **File > Preferences** (on macOS, this might be under **Arduino > Preferences**).
3. In the **Additional Board Manager URLs** field, paste the following URL:
https://arduino.esp8266.com/stable/package_esp8266com_index.json
4. If there are already other URLs listed, separate them with a comma.



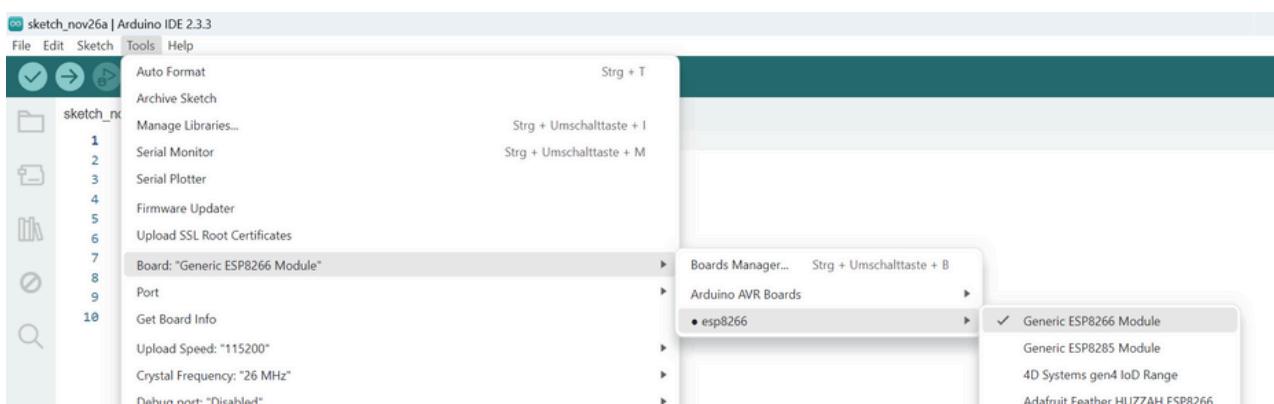
Step 2: Install the ESP8266 Board Package

1. Go to Tools > Board > Boards Manager.
2. In the search bar, type **ESP8266**.
3. Select **esp8266 by ESP8266 Community** and click **Install**.
4. Wait for the installation to complete.



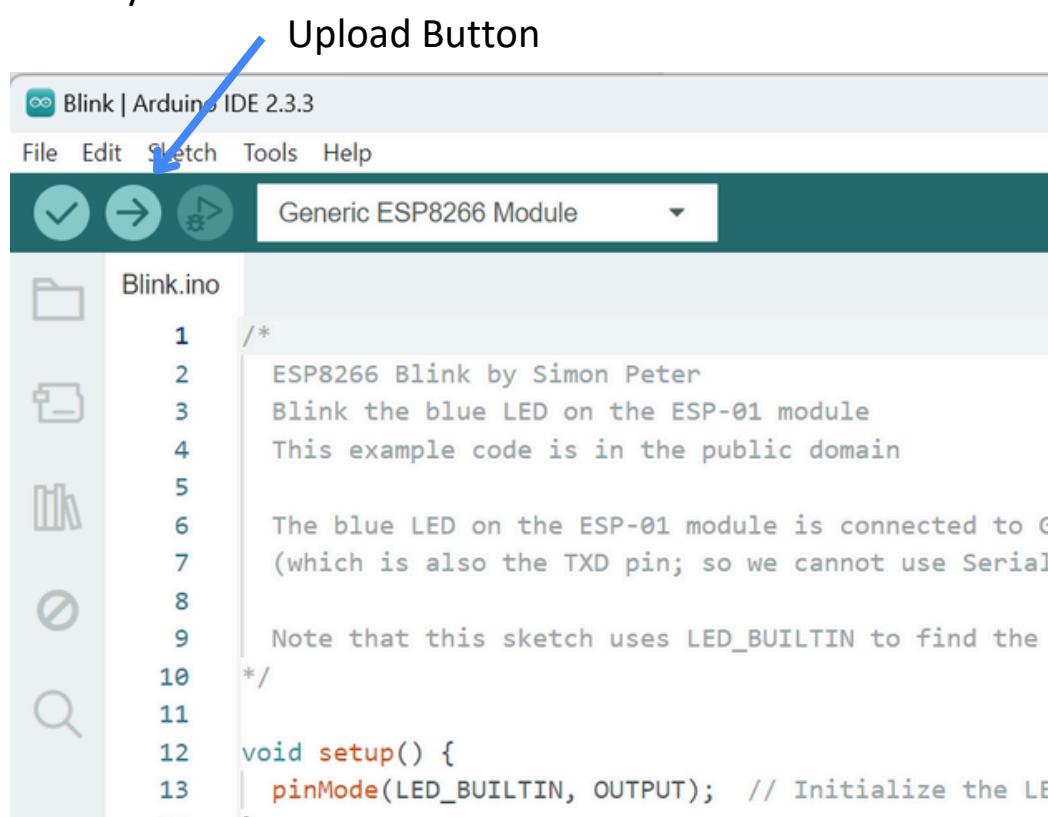
Step 3: Select the ESP8266 Board

1. Connect your **ESP8266** board to your computer using a USB cable.
2. Go to **Tools > Board** and select **Generic ESP8266 Module**.
3. Go to **Tools > Port** and select the correct COM port for your board.



Step 4: Test the Setup

1. Open the **Examples** menu in the Arduino IDE:
2. **File > Examples > ESP8266 > Blink.**
3. Verify and upload the sketch to your ESP8266.
4. The onboard LED on the ESP8266 should blink if everything is set up correctly.



Code

Download the Missing Library to Run the Code

Step 1: Download the Library:

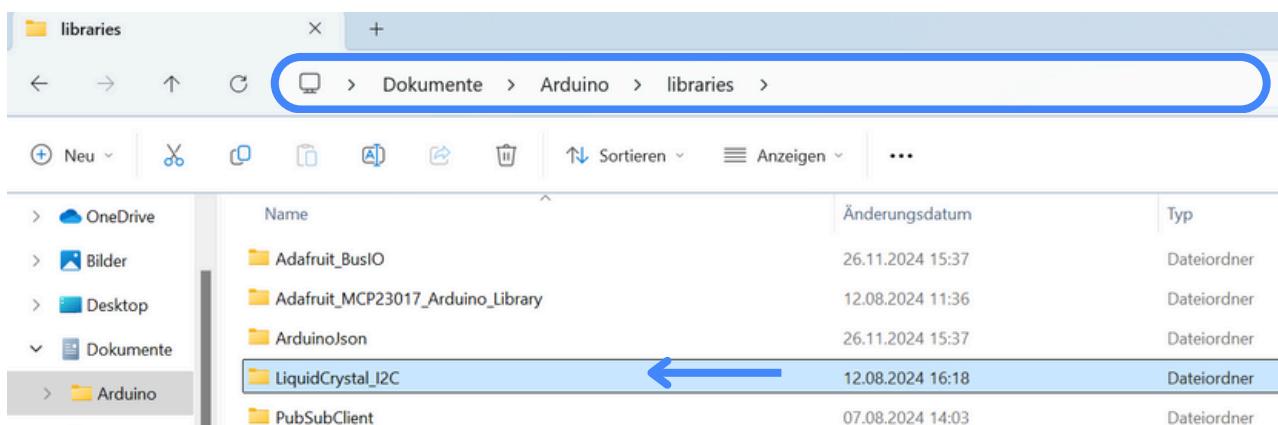
Go to the EduDemoS website <https://edudemos.eu/en/demonstrators/> and click on the **Programming** button. Download the ZIP folder called “**libraries.zip**”.

Step 2: Extract the ZIP File

Extract the downloaded ZIP file on your computer using a ZIP extractor such as WinRAR, 7-Zip, or the default extractor of your operating system.

Step 3: Move the Library to the Correct Folder:

- Navigate to the folder where your Arduino sketches are stored (e.g., *Documents/Arduino/libraries* on Windows or *~/Documents/Arduino/libraries* on macOS/Linux).
- Create a new folder in the *libraries* directory with the same name as the library (e.g., *LiquidCrystal_I2C*).
- Move the extracted library folder into this newly created folder.



Once the library is in the correct folder, it will be available for use in your Arduino IDE.

Where to Find the Code

The code for the Turtle is available on the EduDemoS website under the **Programming** button.

<https://edudemos.eu/en/demonstrators/>

Running the Code

Open the **Arduino IDE** and load the code into a new sketch. Finally you can upload the code to your ESP8266.

You should now see on the LCD Display how much current voltage is being generated by the solar panel.

Troubleshooting

General Issues

- Restart the Arduino IDE if changes don't take effect.
- Open the **Serial Monitor** (**Tools > Serial Monitor**) to check for error messages.
- Double-check your wiring, especially the I2C connections and power.
- If nothing works, try disconnecting and reconnecting the ESP8266, then press the **RST (Reset)** button to restart the board.

Installation Issues

Arduino IDE Won't Install:

- Ensure your computer meets the minimum requirements for the Arduino IDE.
- Download the correct version for your operating system from <https://www.arduino.cc/en/software>.
- On Windows, run the installer as an administrator.

Code Upload Errors

- Use a good-quality USB cable (some cables are for power only, not data).

Common Upload Error Messages:

- *Failed to connect to ESP8266:*
 - Hold the **BOOT/FLASH button** on the ESP8266 while uploading the code.
 - After the upload is complete, press the RST (Reset) button to reboot the board and run the code.
- *Serial port not found:*
 - Check the USB connection and ensure the right port is selected in **Tools > Port**.

It could also be a **Driver Issue** (read next section).

USB Driver Issues

If your ESP8266 or its port is not recognized by your computer, you may need to install the appropriate USB-to-Serial driver. ESP8266 boards use the CP210x chip:

Download the Driver

- Go to the official Silicon Labs website:
 - <https://www.silabs.com/developer-tools/usb-to-uart-bridge-vcp-drivers?tab=downloads>
- Download the appropriate version for your operating system (Windows Universal Driver for Windows 10 and 11)

Still Not Detected?

Try a different USB cable (some cables are power-only and don't support data).

Ensure no other devices are interfering with the USB ports.

Restart your computer after installing the driver.

I2C Display Not Working

No Display Output:

- Verify **SDA** and **SCL** pins are correctly connected:
 - Default ESP8266 pins: **SDA = GPIO4 (D2)**, **SCL = GPIO5 (D1)**.
- Ensure the I2C address in the code matches the display's address. Use an I2C scanner sketch to confirm the address.
- If you can't see anything or you have trouble reading the Display, make sure that you put everything properly together. If everything is correctly assembled, try adjusting the potentiometer on the back of the Display.

Display Flickers or Shows Garbage Data:

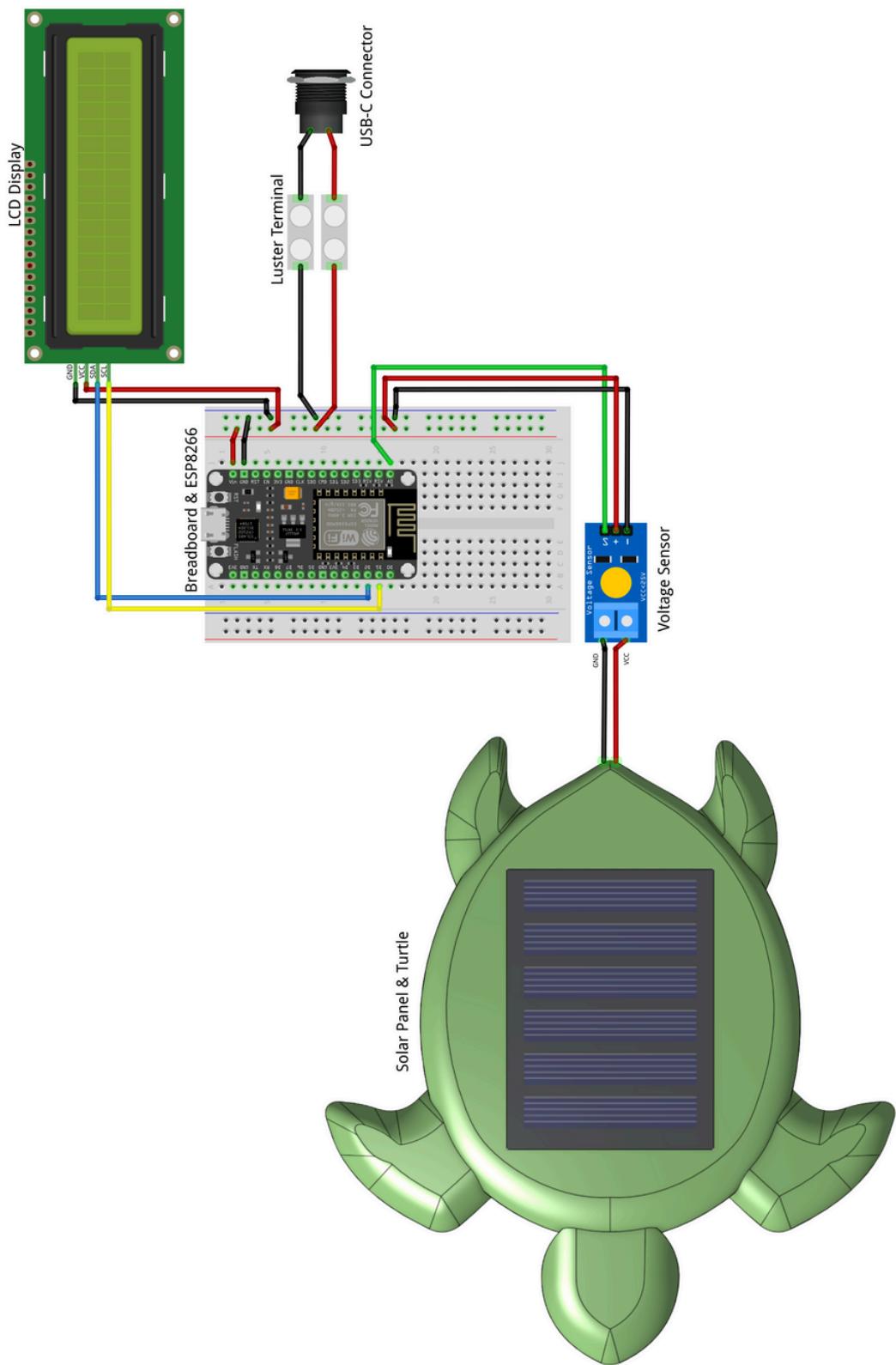
- Use pull-up resistors ($4.7\text{k}\Omega$) on SDA and SCL lines if not already present.
- Ensure the power supply is stable (ESP8266 and display both get sufficient power).

Appendix

Components with Example Link

Quantity	Name	Specification	Size	Example Link	Last Update
1	ESP8266	NodeMCU Board Amica V2	48x26x13 mm	https://amzn.eu/d/gnZ5Kst	28.11.2024
1	LCD Display	I2C 16x2 (pre-soldered)		https://amzn.eu/d/0KgODal	28.11.2024
1	Voltage Sensor	0-25V		<a href="https://www.roboter-
bausatz.de/p/spannung-
sensor-modul-dc0-25v">https://www.roboter- bausatz.de/p/spannung- sensor-modul-dc0-25v	28.11.2024
1	Solar Panel	3V, 0.3W	65x48m m	https://amzn.eu/d/hDaVRu9	28.11.2024
1	Bread- board	Mini	400 Pin	https://amzn.eu/d/gEZwM3o	28.11.2024
7	Jumper Wire	F-M	20cm	https://amzn.eu/d/cPTe2WY	28.11.2024
4	Jumper Wire	M-M	20cm	https://amzn.eu/d/0WQP3MI	28.11.2024
1x2	Luster Terminal			https://amzn.eu/d/jf2sQKD	28.11.2024
1	USB-C Port	Female, 5V		https://amzn.eu/d/bjhGCws	28.11.2024

Wiring Diagram



Licensing

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All Circuits were created with [Fritzing](#).

Some images are based on modules from [GrabCAD Library](#).



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edudemos@technikmachtspass.org