Making a Luftdaten air quality monitor by Paul Evans W4/VP9KF

UNDER CONSTRUCTION!
This document is intended to make the unit a little easier to build in the USA, using component sources nearer than Europe. The PDF needs to be used with an active browser, as the component URL links are very long. It also clarifies some of the *slightly* 'broken' English in the main build page:

https://luftdaten.info/en/construction-manual/

Part	Full name	Amazon	Aliexpress (USA)
MCU	NodeMCU ESP8266, CPU/WLAN	Link - $5.99 inc. shipping	Link - $2.50
Particle sensor	SDS011 Fine dust sensor (formerly PPD42NS)	Link - $27.00 inc. shipping	Link - $19.50
Temperature and humidity sensor	DHT22, temperature & humidity (optional)	Link - $4.91 + shipping	Link - $2.50
Wires	Interconnects	Link - $.	Link - $.
USB cable	Flat 2m/6' Micro-USB	Link - $.	Link - $.
Power supply USB	Power supply USB	Link - $.	Link - $.
Cable ties	Cable ties x2	$0.02 (hardware)	$0.02 (hardware)
Breathing tube	Flexible tube, if possible not transparent, diameter 6 mm, length approx. 20cm	$0.20 (hardware)	$0.20 (hardware)
PVC pipe		$ (hardware)	$ (hardware)
Approx. Total USD$		$37.90	$24.50

It costs about 50% more using parts from Amazon listings.

The assembly is designed in such a way that anyone can do it. The measuring station consists of only 7 parts and 2 cable ties.

IMPORTANT NOTE

Before assembling install the firmware!
If the firmware does not work on the NodeMCU, you will not have to tear everything apart and put it back together again. It reduces the risk of other connections having to be remade when the USB cable is connected and unplugged.

Introductory words

You do not have to program, don't worry! We already programmed the firmware. You only have to install it on the NodeMCU (ESP8266). It is easy, even for computer beginners.

Install USB2Serial driver

To communicate with the ESP8266, you need usb2serial drivers. The chipset is CH341 for NodeMCUs.

- Linux: no installation required, chip should be supported (verfiy with dmesg)
- MacOS: for Sierra see these successfully tested instructions: https://github.com/adrianmihalko/ch340g-ch34g-ch34x-mac-os-x-driver
- Windows: https://github.com/nodemcu/nodemcu-devkit/tree/master/Drivers (or try the manufacturer's driver)
- Raspberry Pi: https://github.com/aperepel/raspberrypi-ch340-driver

Import firmware

Hint: Just follow the instructions.

Having problems please look in the FAQ's. There is a video tutorial (in German).

Install Arduino software, import firmware

OS independant steps

- Download & install Arduino IDE software on your computer: https://www.arduino.cc/en/Main/Software
- In the settings look for the field "Additional Board Manager URLs" and insert this URL: http://arduino.esp8266.com/stable/package_esp8266com_index.json
- Under "Tools -> Board … -> Board Administrator" search for "esp8266" and install "esp8266 by ESP8266 Community"
- Quit Arduino IDE (before flashing)
- Download the English firmware https://www.madavi.de/sensor/update/data/latest_en.bin

  other languages:
  - Bulgarian: https://www.madavi.de/sensor/update/data/latest_bg.bin
  - French: https://www.madavi.de/sensor/update/data/latest_fr.bin
  - German: https://www.madavi.de/sensor/update/data/latest_de.bin
  - Italian: https://www.madavi.de/sensor/update/data/latest_it.bin
  - Spanish: https://www.madavi.de/sensor/update/data/latest_es.bin
  - Portuguese: https://www.madavi.de/sensor/update/data/latest_pt.bin
  - Dutch: https://www.madavi.de/sensor/update/data/latest_nl.bin
- Connect the NodeMCU with your computer. If possible, connect a USB2.0 cable to a USB2.0 port, so the NodeMCU can be used. Otherwise it may not be recognized under Windows.

Attention: When copying the firmware to the NodeMCU, use a USB cable not more than 1m in length.

Windows

- Open the command line (cmd.exe) under Windows
- Windows: "% USERPROFILE%\AppData\Local\Arduino15\packages\esp8266\tools\esptool\ 0.4.9\esptool.exe" -vv -cd nodemcu -cb 57600 -ca 0x00000 -cp COM11 -cf "_path_to the_downloaded_firmware_file" (the port behind, '-cp' may need to be adjusted)
- The appropriate port can be found, for example, by connecting the NodeMCU to the desired port (see note above) and then starting the Arduino IDE. Under, Tools -> Port 'are the available port to see, usually quite easily the port with the NodeMCU recognizable. Or select a port and then run Tools – Get Board Information. If the correct port is selected, codes will appear at VID and PID. Close the IDE afterwards, otherwise this port is blocked.

Mac/Linux

- open the terminal
- Linux: ~/.arduino15/packages/esp8266/tools/esptool/0.4.9/esptool -vv -cd nodemcu -cb 57600 - ca 0x00000 -cp /dev/cu.wchusbserial1410 -cf /path/to/firmware/file (the port behind, -cp ' may need to be adjusted)
- MacOS: ~/Library/Arduino15/packages/esp8266/tools/esptool/0.4.9/esptool -vv -cd nodemcu - cb 57600 -ca 0x00000 -cp /dev/cu.wchusbserial1410 -cf /path/to/firmware/file (the port behind, -cp may need to be adjusted)
- In case of problems you should try to execute the above command as root. Then in the path, ~/'must be replaced by the home directory.
- The appropriate port can be found, for example, by connecting the NodeMCU to the desired port (see note above) and then starting the Arduino IDE. Under, Tools -> Port 'are the available port to see. Select a port and then run Tools -> Get Board Information. If the correct port is selected, codes will appear at VID and PID. Close the IDE afterwards, otherwise this port is blocked.
- For Linux there is a script in the repository sensors-software/utils/flash, which can also delete an existing configuration:https://github.com/opendata-stuttgart/sensors-software/tree/master/ utils/flash

Plugging together (after firmware installation)

Our instructions refer to version 3 of the NodeMCU. This can be recognized by the connections VU and G (see drawing). The older versions have RSV at these ports. In these versions, the VIN ports can be used instead of VU and GND instead of G (next to the MicroUSB port).

NodeMCU+SDS011+DHT22
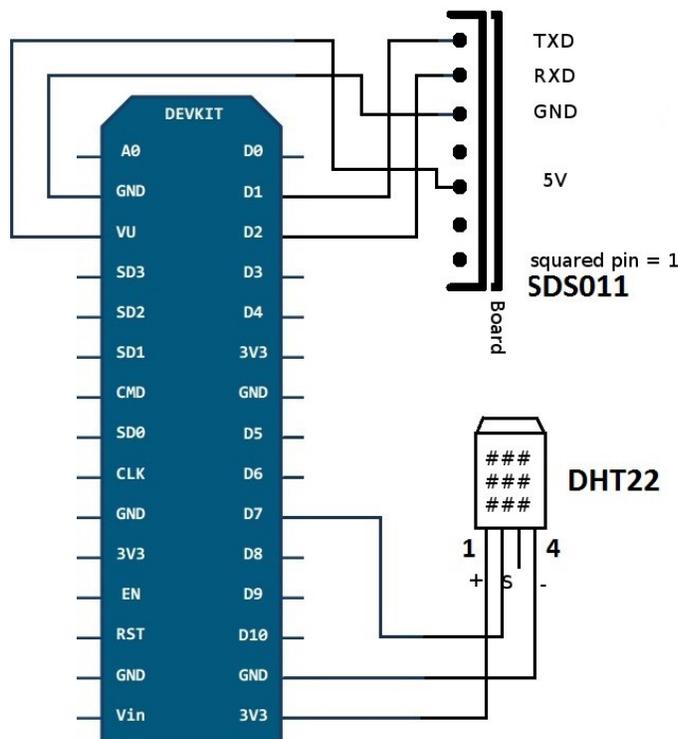
Connecting the SDS011

Pins are numbered from RIGHT to LEFT, make sure when connecting that the cables are sitting on the pins, as most Dupont cables also fit in between the pins.
SDS011 Pin 1 -> Pin D1 / GPIO5
SDS011 Pin 2 -> Pin D2 / GPIO4
SDS011 Pin 3 -> GND
SDS011 Pin 4 -> unused
SDS011 Pin 5 -> VU (NodeMCU v3) / VIN (NodeMCU v1,v2)
SDS011 Pin 6 -> unused
SDS011 Pin 7 -> unused

Connecting the DHT22

Pins are numbered from LEFT to RIGHT.
DHT22 Pin 1 -> Pin 3V3 (3.3V)
DHT22 Pin 2 -> Pin D7 (GPIO13)
DHT22 Pin 3 -> unused
DHT22 Pin 4 -> Pin GND

Connecting displays and other sensors

In the FAQ, (NO English version) under 'Connecting other sensors', there is a list of supported sensors (such as BME280) and displays. It is also describes how to connect those. This is expanded here in English:

Displays
Displays with the driver chip SSD1306 are connected via I2C (serial bus, several components share the same connection pins, description on Wikipedia)

```
VCC  -> Pin 3V3
GND  -> Pin GND
SCL  -> Pin D4 (GPIO2)
SDA  -> Pin D3 (GPIO0)
```

After plug-in, the display must still be activated in the configuration. After that, a reboot is necessary, since the display must be initialized appropriately at startup.

LCDs (LCD1602) with I2C connection are connected and configured in the same way. Depending on the version only the connection VCC must be connected to 5v or 3v. If the display does not show anything, the I2C address of the LCD display should be checked first. After that, you can still try to change the contrast so that the text will be visible by turning the contrast potentiometer.

Other Sensors
Additional sensors can be connected. Currently, the sensor software supports the following sensors:

PPD42NS (particulate matter, the first sensor we used)

SDS011, SDS018, SDS021 (particulate matter, the SDS011 is our current sensor)

BMP180/BMP280 (temperature, pressure)

BME280 (temperature, RH, pressure)

DHT22 (temperature, RH)

BMP180, BMP280 and BME280 are connected via I2C (serial bus, several components share the same connection pins, description on Wikipedia):

```
VCC  -> Pin 3V3
GND  -> Pin GND
SCL  -> Pin D4 (GPIO2)
SDA  -> Pin D3 (GPIO0)
```

After connecting, the sensors must still be activated in the configuration. After that, a reboot is necessary, since the sensors must be initialized appropriately at startup.