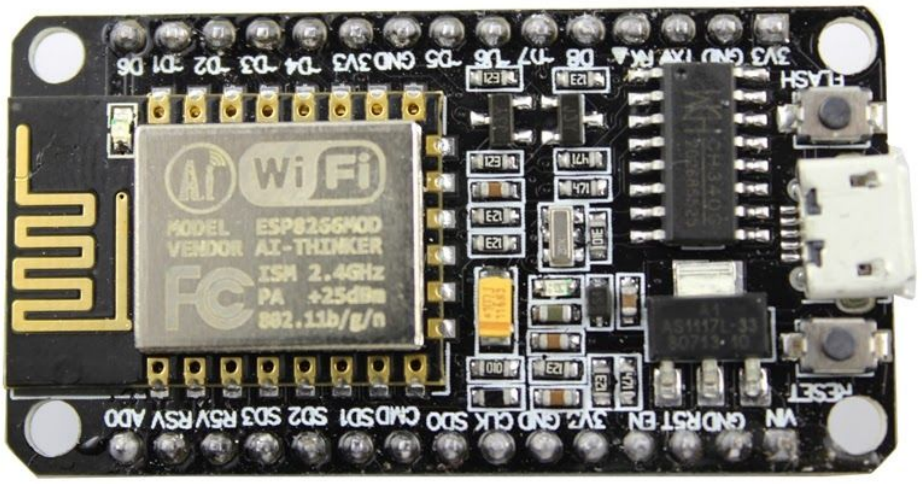
Workshop Overview

Node MCU



The Nodemcu is a development board based upon the esp8266 microcontroller.

-1 analog to digital converter 10bit [a bad one a that]

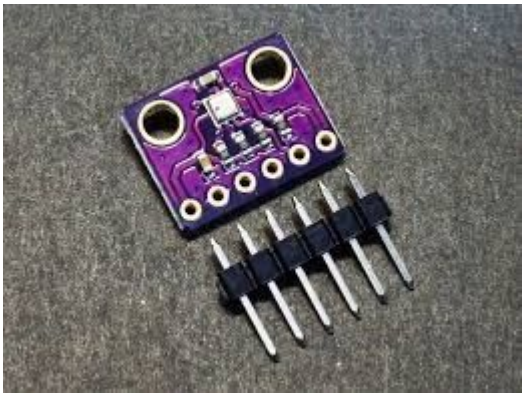
-16 GPIO pins [some of which have extra circuitry connected limiting their use]

-External QSPI flash: 4 MiB [memory]

-IEEE 802.11 b/g/n Wi-Fi

Overall this is a very useful little mcu for prototyping as it is available at an affordable price point, can be programmed via the arduino IDE for fast prototyping, has IOT capabilities that are easy to implement and a lot more permanent memory compared to other similarly priced boards. It has fast become one of the defacto IOT boards for makers and manufacturers.

BME280



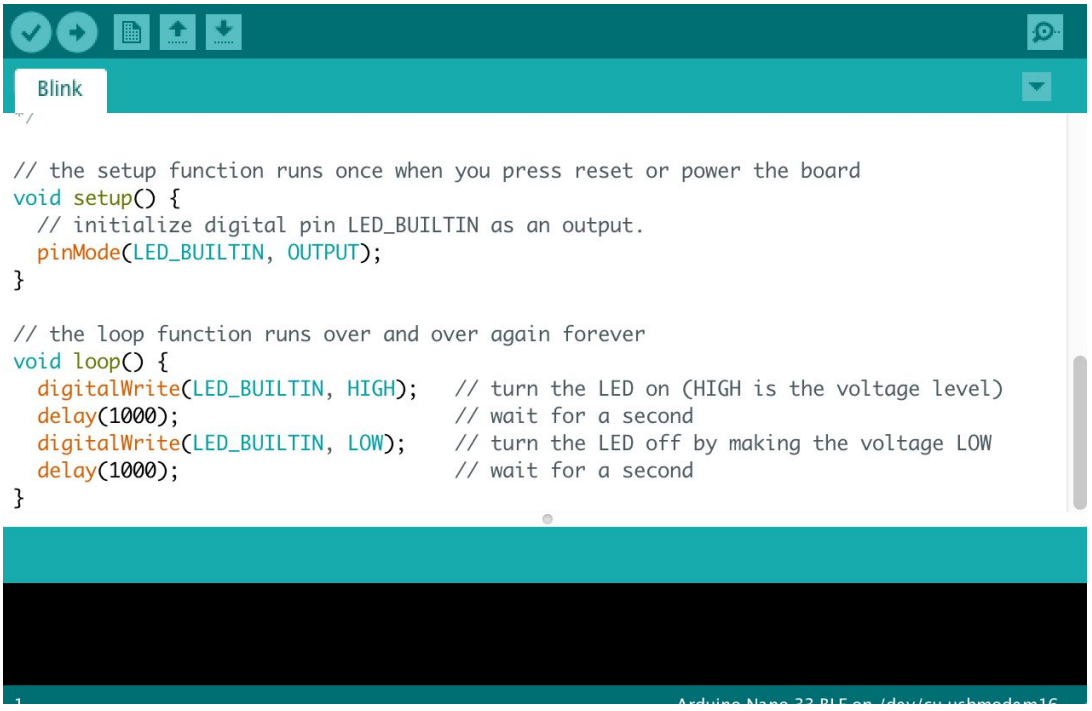
A small packaged air quality sensor, capable of measuring humidity, pressure and air temp. Mainly the I2C communication protocol is implemented making it an easy to use board with many features that can be enabled on a project to project basis.

Servo

In control engineering a **servomechanism**, sometimes shortened to **servo**, is an automatic device that uses error-sensing negative feedback to correct the action of a mechanism.

For our purpose this is a low cost high torque motor that can be commanded via PPM [Pulse position modulation] to move to a certain angle and stay there until instructed otherwise. It contains in the blue housing a DC motor, gearbox, microcontroller and a potentiometer to achieve this.

The arduino IDE



The arduino programming environment is based upon c++, but it is tailor made for the programming of microcontrollers and has simplified much of the heavy lifting by the use of common functions that work across a wide range of boards [Novel/complex code can still be written in the IDE in c++ where needed]. We will be using this to code out greenhouse.

We have all we need to control a greenhouse,albeit a small greenhouse. A microcontroller and programming environment, to read a temperature sensor and open a window via the servo motor to control air quality.

Brief overview of workshop

We will run through the programming of the microcontroller and slowly build up each sub system to test its functioning.

0- Setting up the arduino IDE

1-Basic_Sketch_L1: Fixing communications issues with the controller and limiting the ability of the motor to foul the housing. We can have a more stable communication if we reduce the serial speed, reduce the motor current draw by slowing it down, and add a delay between motor movement and serial usage. Change baud rate to 9600, limit motor movement speed, add half a second delay before serial output, add min/max limits to servo position

2-Basic_Sketch_L2: Now that we all have a working unit that is moving the servo, reading the air quality sensor and transmitting data via serial. We will calibrate the servo position for open and closed

3-Basic_Sketch_L3: Now we are starting to implement things that the client cares about: Automation of temp control. Passing sensor readings into variables not just serial. Implementing a basic hysteresis control for temp, too hot open the window

4-Basic_Sketch_L4: Air temp and humidity is nice to know, but a good greenhouse controls the vapor pressure deficit, a way to quantify how well the plant is breathing

5-Basic_Sketch_L5: The esp8266 has iot capabilities lets have a web based readout

6-Basic_Sketch_L6: The esp8266 also has 4mb of internal Non-volatile memory, we can use this to store data locally in the form of a sensor data log and html files to make the gui more

Setting up the arduino IDE

In order to use the arduino ide with the nodemcu, we need to do the following:
-Download the arduino IDE
-Give the IDE aces to MCU via usb [permissions issues for linux]
-Install a definitions file for the board we are using [what port is what pin etc]
-Install a separate file that allows us to access the memory on tip [its on board but external to the main mcu].
-Install some libraries that make using I2C and websockets simple

Please go to https://bit.ly/3ivdT60 and download workshop demo codes

Download the arduino programming environment
https://www.arduino.cc/en/main/software

If your on Linux you will need to allow the IDE access to your usb:
https://www.arduino.cc/en/guide/linux [Half way down the page]

Install the definitions for the board we are using [NodeMCU 1.0]
Download https://github.com/esp8266/Arduino

In the arduino IDE Files >Preferences
add the following line to the Additional board managers URL:
https://arduino.esp8266.com/stable/package_esp8266com_index.json

Open Boards Manager from Tools > Board menu and install *esp8266* platform (and don't forget to select your ESP8266 board from Tools > Board menu after installation).

Install add-on for writing to memory

To upload files to the ESP8266 SPI Flash Filesystem (SPIFFS), we'll use the Filesystem Uploader Plugin. Install the plugin in your Arduino IDE:

Install ESP8266 Filesystem Uploader in Arduino IDE

Install Library for BME280
Humidity/Pressure/Temp Sensor
In the arduino IDE go to Sketch>> Include Library>> Manage Library> In search bar enter:
Adafruit_BME280_Library

Install Websockets lib:
Download https://github.com/Links2004/arduinoWebSockets

-Download Zip from git.
-In arduino IDE Sketch >Include library >Add .zip library
-Navigate to the zip file in your downloads

4-Basic_Sketch_L4

https://en.wikipedia.org/wiki/Vapour-pressure_deficit

DimLuxLighting.com

Recommended Leaf VPD

Leaf cooler than room temp by: 0 °F ≈ 0 °C

Propagation / Early Veg Stage 0.4 - 0.8 kPa

Late Veg / Early Flower Stage 0.8 - 1.2 kPa

Mid / Late Flower Stage 1.2 - 1.6 kPa

Danger Zone Below 0.4 / Over 1.6

Room Temp		Relative Humidity																	
C	F	90%	85%	80%	75%	70%	65%	60%	55%	50%	45%	40%	35%	30%	25%	20%	15%	10%	5%	0%
15	59	0.17	0.26	0.34	0.43	0.51	0.60	0.68	0.77	0.85	0.94	1.02	1.11	1.19	1.28	1.36	1.45	1.53	1.62	1.71
16	61	0.18	0.27	0.36	0.45	0.55	0.64	0.73	0.82	0.91	1.00	1.09	1.18	1.27	1.36	1.45	1.55	1.64	1.73	1.82
17	63	0.19	0.29	0.39	0.48	0.58	0.68	0.78	0.87	0.97	1.07	1.16	1.26	1.36	1.45	1.55	1.65	1.74	1.84	1.94
18	64	0.21	0.31	0.41	0.52	0.62	0.72	0.83	0.93	1.03	1.14	1.24	1.34	1.44	1.55	1.65	1.75	1.86	1.96	2.06
19	66	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.10	1.21	1.32	1.43	1.54	1.65	1.76	1.87	1.98	2.09	2.20
20	68	0.23	0.35	0.47	0.58	0.70	0.82	0.94	1.05	1.17	1.29	1.40	1.52	1.64	1.75	1.87	1.99	2.10	2.22	2.34
21	70	0.25	0.37	0.50	0.62	0.75	0.87	0.99	1.12	1.24	1.37	1.49	1.62	1.74	1.87	1.99	2.11	2.24	2.36	2.49
22	72	0.26	0.40	0.53	0.66	0.79	0.93	1.06	1.19	1.32	1.45	1.59	1.72	1.85	1.98	2.11	2.25	2.38	2.51	2.64
23	73	0.28	0.42	0.56	0.70	0.84	0.98	1.12	1.26	1.40	1.55	1.69	1.83	1.97	2.11	2.25	2.39	2.53	2.67	2.81
24	75	0.30	0.45	0.60	0.75	0.90	1.04	1.19	1.34	1.49	1.64	1.79	1.94	2.09	2.24	2.39	2.54	2.69	2.83	2.98
25	77	0.32	0.48	0.63	0.79	0.95	1.11	1.27	1.43	1.58	1.74	1.90	2.06	2.22	2.38	2.53	2.69	2.85	3.01	3.17
26	79	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	1.85	2.02	2.18	2.35	2.52	2.69	2.86	3.03	3.19	3.36
27	81	0.36	0.53	0.71	0.89	1.07	1.25	1.43	1.60	1.78	1.96	2.14	2.32	2.50	2.67	2.85	3.03	3.21	3.39	3.57
28	82	0.38	0.57	0.76	0.94	1.13	1.32	1.51	1.70	1.89	2.08	2.27	2.46	2.65	2.83	3.02	3.21	3.40	3.59	3.78
29	84	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00	3.20	3.40	3.60	3.81	4.01
30	86	0.42	0.64	0.85	1.06	1.27	1.48	1.70	1.91	2.12	2.33	2.55	2.76	2.97	3.18	3.39	3.61	3.82	4.03	4.24
31	88	0.45	0.67	0.90	1.12	1.35	1.57	1.80	2.02	2.25	2.47	2.70	2.92	3.14	3.37	3.59	3.82	4.04	4.27	4.49
32	90	0.48	0.71	0.95	1.19	1.43	1.66	1.90	2.14	2.38	2.61	2.85	3.09	3.33	3.57	3.80	4.04	4.28	4.52	4.75
33	91	0.50	0.75	1.01	1.26	1.51	1.76	2.01	2.26	2.51	2.77	3.02	3.27	3.52	3.77	4.02	4.28	4.53	4.78	5.03
34	93	0.53	0.80	1.06	1.33	1.60	1.86	2.13	2.39	2.66	2.93	3.19	3.46	3.72	3.99	4.25	4.52	4.79	5.05	5.32
35	95	0.56	0.84	1.12	1.41	1.69	1.97	2.25	2.53	2.81	3.09	3.37	3.65	3.94	4.22	4.50	4.78	5.06	5.34	5.62

*Pressure has many different measurements!

1 hPa = 1 mb = 0.1 kPa ≈ 2.09 lb/ft2 ≈ 0.03 inHg ≈ 0.001 bar