IoT workshop at ASP-2024

Most physics experiments today use electronics and a computer readout to get at the measurement results.

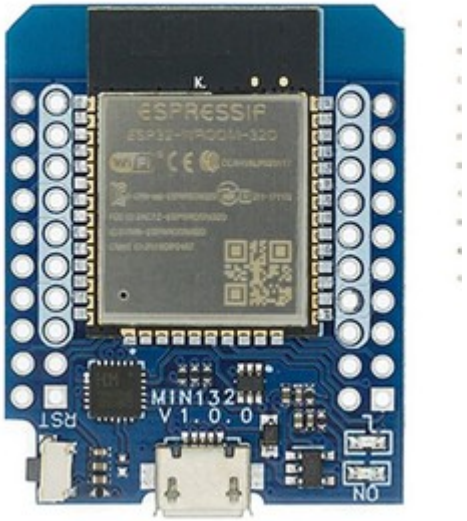
The IoT workshop uses very low cost equipment to demonstrate how such an experiment can be conducted

The equipment we had in 2022

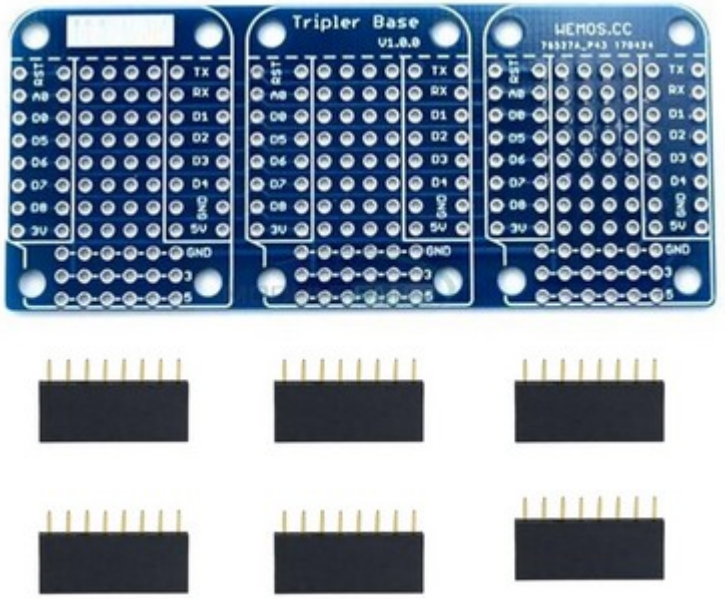
- CPU card
- back plane bus
- 7 rgb LED ring
- push button
- linear potentiometer
- micro USB cable for flash programming and serial connection
- Total cost for 17 kits: 222.10 Euros

Simulating an experiment

To simulate an experiment we have
an ESP32 micro-controller



a bus system
to connect the sensor to the uC

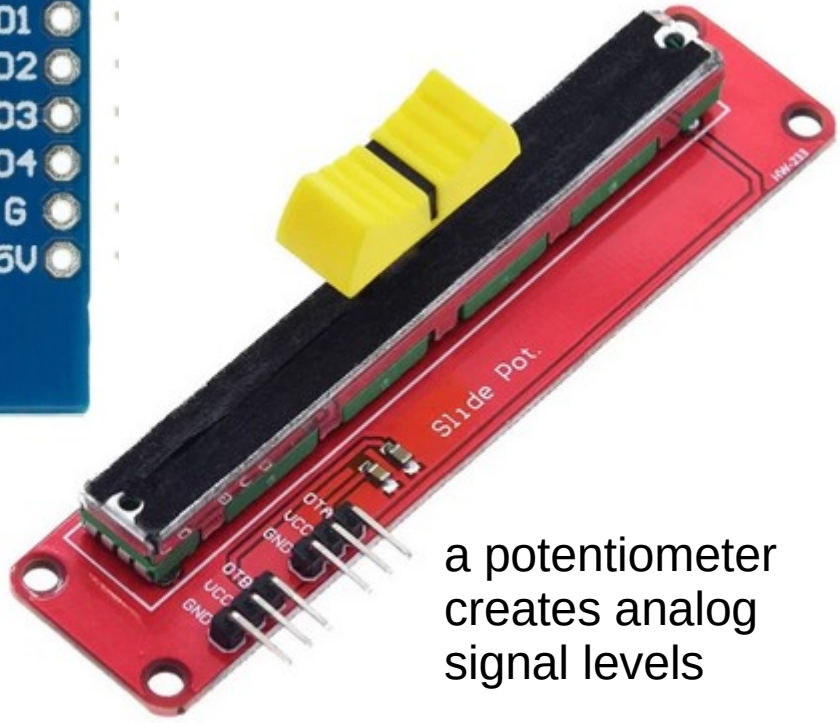


The CPU card has a user programmable LED
and an USB to serial interface

Sensor and actuator

a simple display with
7 rgb LEDs

a pushbutton allows
to generate digital
signals



a potentiometer
creates analog
signal levels

ESP32 specifications

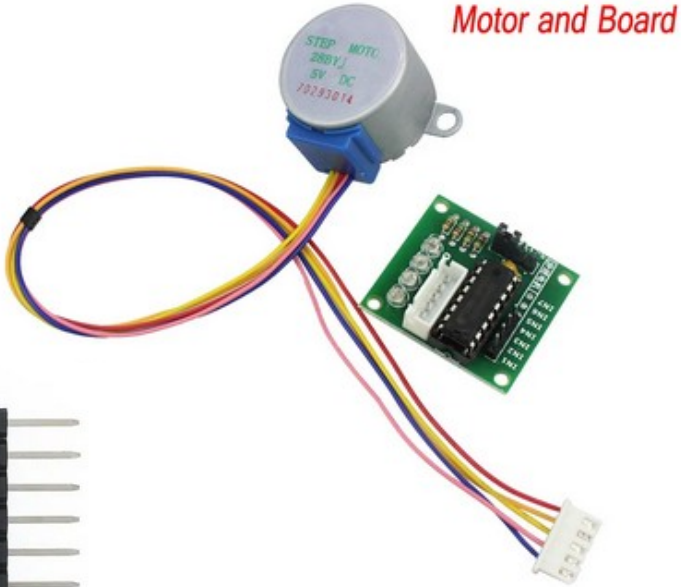
ESP32-WROOM-32 (ESP-WROOM-32) Technical features

Microprocessor	Tensilica Xtensa LX6
Maximum Operating Frequency	240MHz
Operating Voltage	3.3V
Analog Input Pins	12-bit, 18 Channel
DAC Pins	8-bit, 2 Channel
Digital I/O Pins	39 (of which 34 is normal GPIO pin)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
SRAM	520 KB
Communication	SPI(4), I2C(2), I2S(2), CAN, UART(3)
Wi-Fi	802.11 b/g/n
Bluetooth	V4.2 – Supports BLE and Classic Bluetooth

All this for 4 US$

New devices for ASP 2024

- Stepping motor and controller
- SHT30 temperature ar humidity sensor
- BMP180 barometric pressure sensor



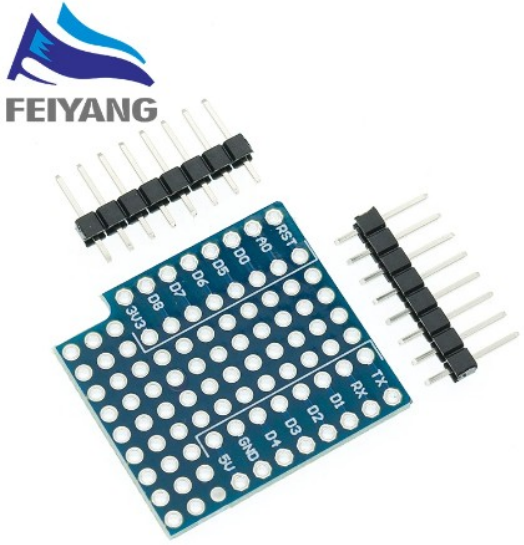
Replacement of phased out module

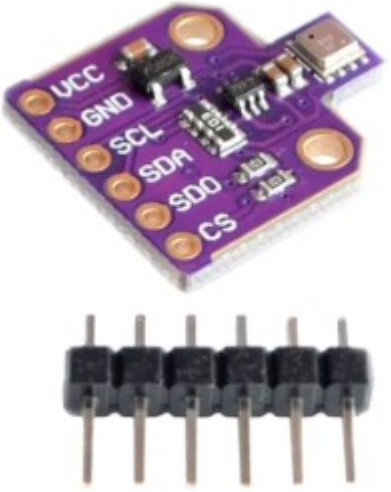
Replacement of the
7 rgb LED ring

Total cost of all devices including
solder wire & shipping: ~400 Euros

The alternatives

These need to be adapted with a prototype board





Additional requirements

- The boards come which pins, not soldered. If I get them to my home, I will have to solder them all (several thousand solder points), flash the Python interpreter onto the ESP32 CPU and test all sets
- The total price of all sets exceeds the limit where I can import them without customs declaration (~ 350 – 400 Euros)
- 1 PC per student is needed for software development, preferably with USB port to connect the ESP32 to the PC. (USB-2 is sufficient)