Prototyping embedded solutions

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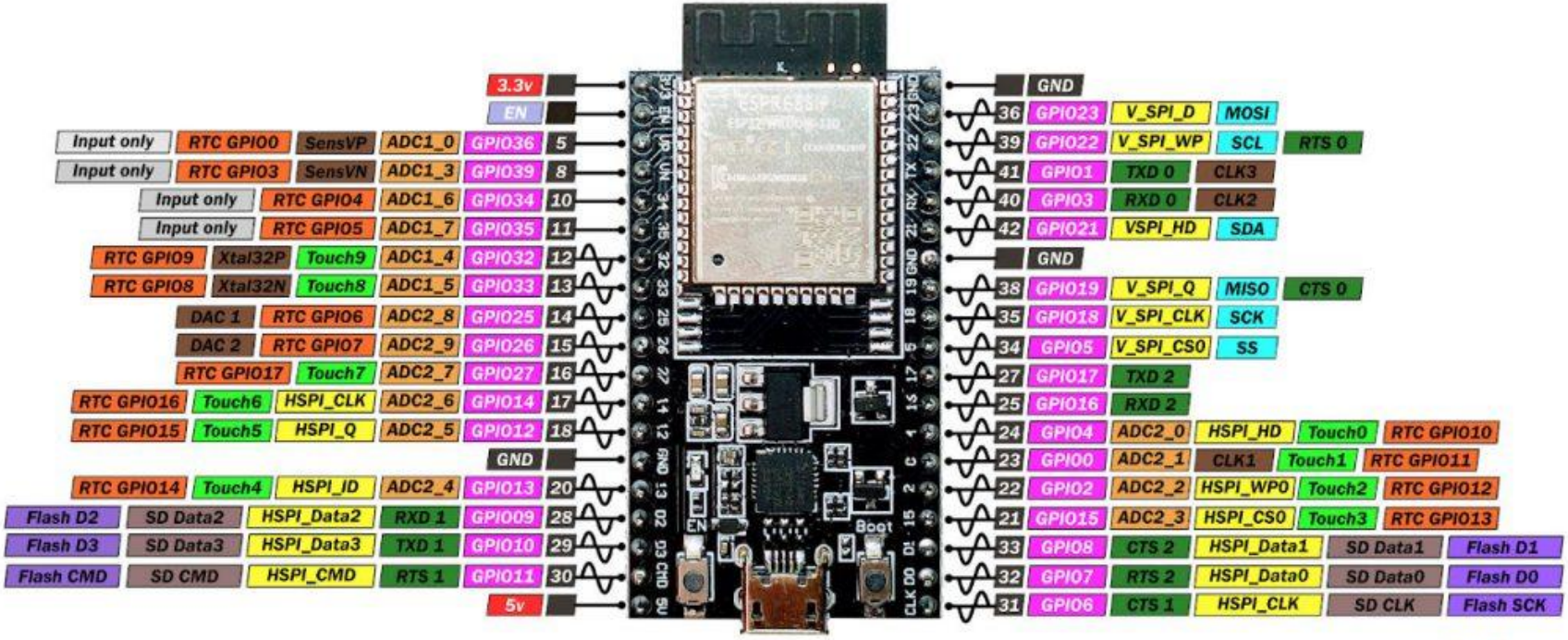
ESP32 microcontroller

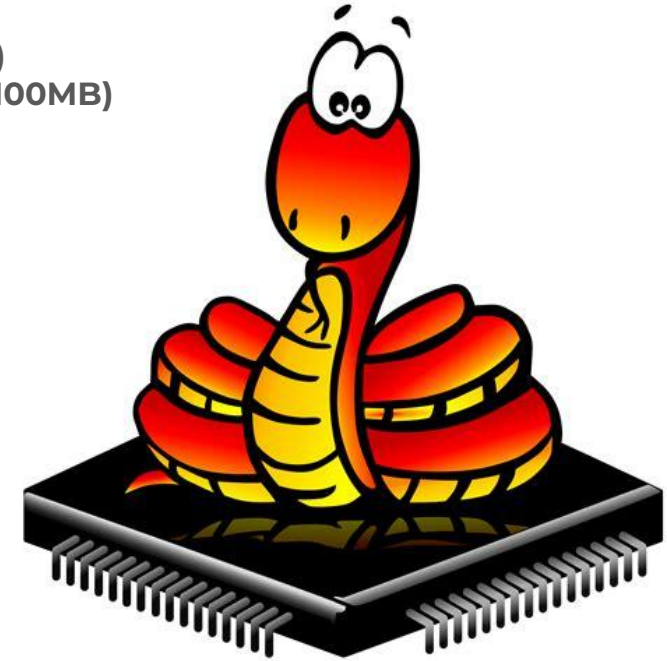
Microcontroller	ESP-WROOM-32
Arcitecture	Xtensa® dual-core 32-bit LX6 + Ultra low power processor
USB to Serial convertor	CP2102N
Supply voltage	5V
IO voltage	3.3V
Flash memory	4 MB
SRAM	520 KB
Clockfrequency	240 MHz
Interfaces	WiFi, Bluetooth,1 x ADC, 2 x DAC, 1 x Hall effekt sensor, 10 x Capacitive touch sensor, 1 x Ethernet, 4 x SPI, 1 x MMC, 3 x UART, 2 x I2C, 2 x I2S, 8 x IR, PWM, 4 x SPI og kryptografiske acceleratorer (SHA, AES, RSA og ECC)
ADC input pins	16
DAC output pins	2
Capacitive touch pins	10
EEPROM	512 KB
DC power per I/O pin	15 mA
Digital I/O pins	15
Powerconsumption	67 mA
Powerconsumption In deepsleep	350uA

ESP32 DevKitC V4 PINOUT



What is MicroPython?

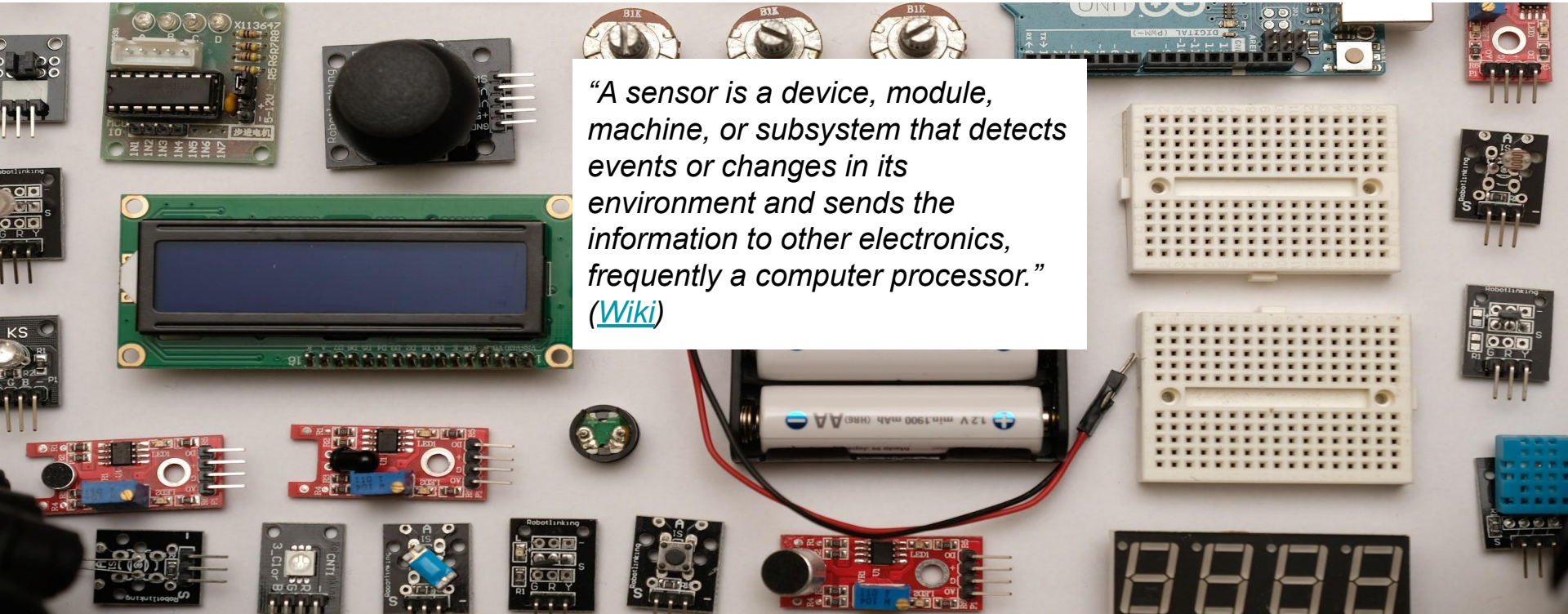
- MicroPython: re-implementation of “regular”(C)Python
- Resource optimized (smaller size and less memory usage)
- Kompact > 1MB (256KB storage, 16KB RAM) vs CPython (~100MB)
- Open source (MIT license)



Includes:

- Compiler & runtime on “bare metal”
- REPL (interactive prompt)
- Compatibility with Cpython

Sensors/Inputs



“A sensor is a device, module, machine, or subsystem that detects events or changes in its environment and sends the information to other electronics, frequently a computer processor.” (Wiki)

Actuators/Outputs

*“An **actuator** is a component of a machine that is responsible for moving and controlling a mechanism or system, for example by opening a valve. In simple terms, it is a "mover" ” (wiki)*

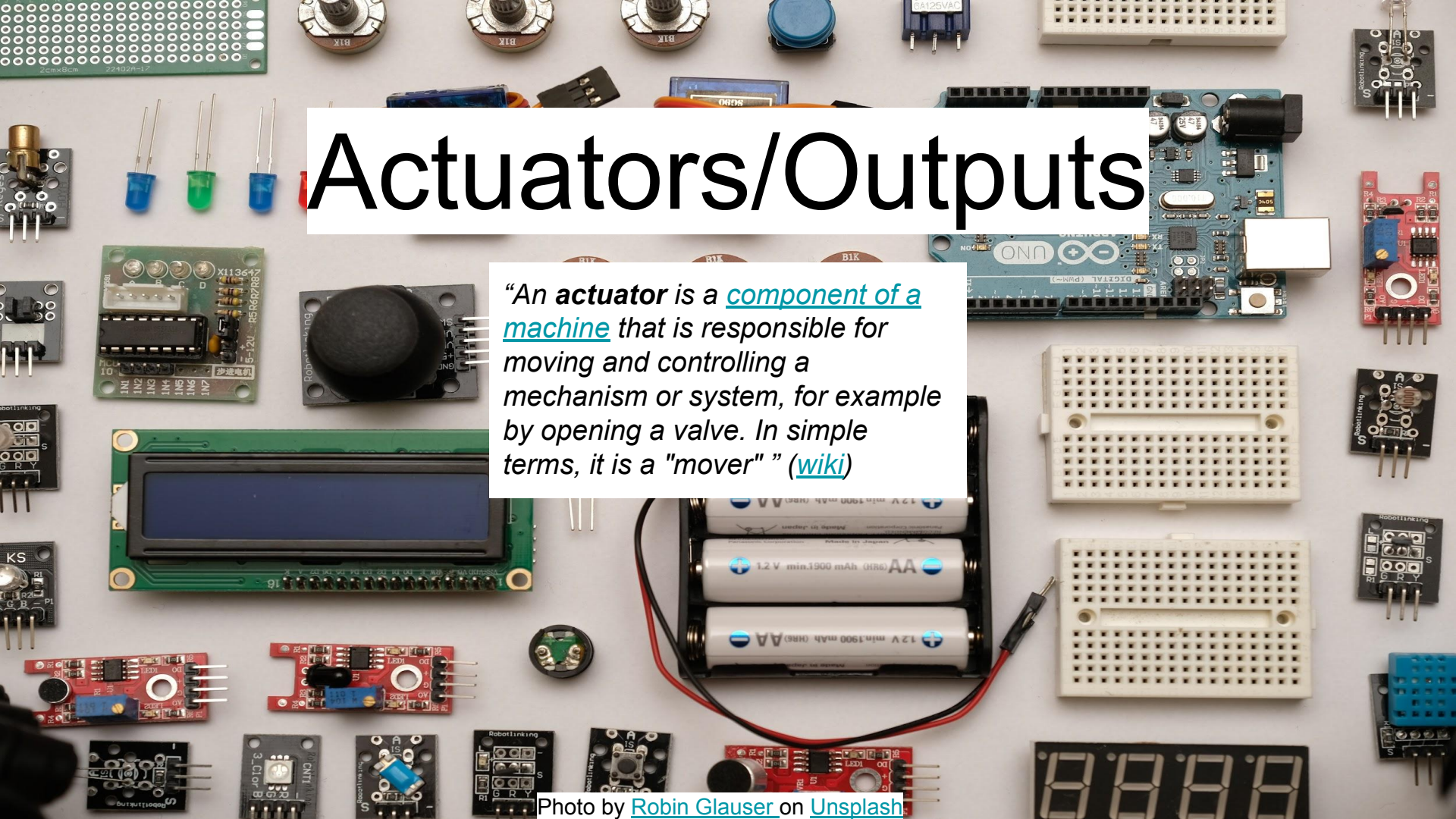
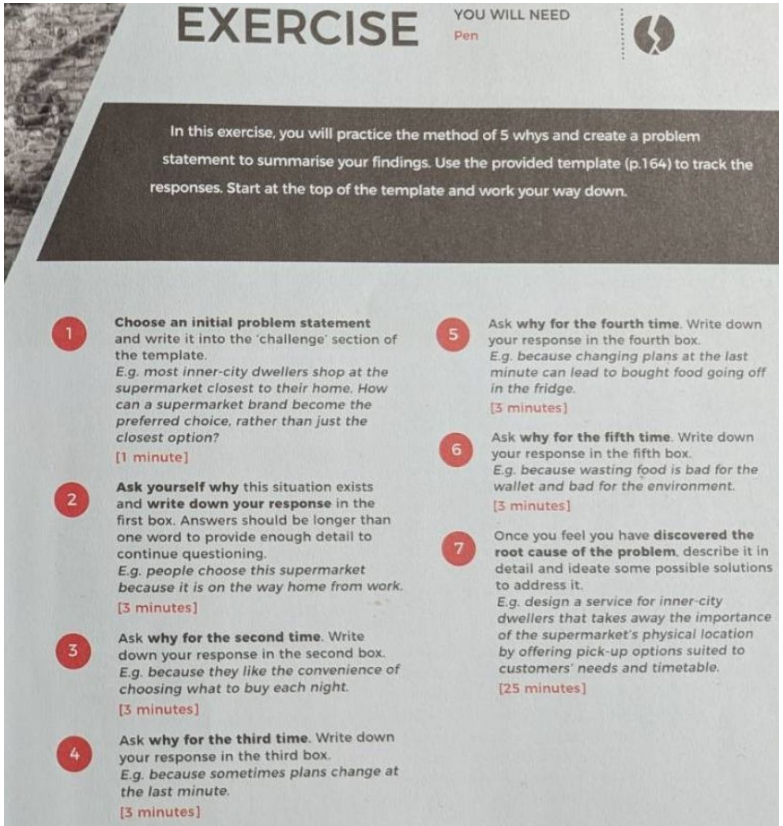


Photo by Robin Glauser on Unsplash

Design methods

Photo by Daria Nepriakhina 🇺🇦 on Unsplash

Finding a good problem - 5 whys

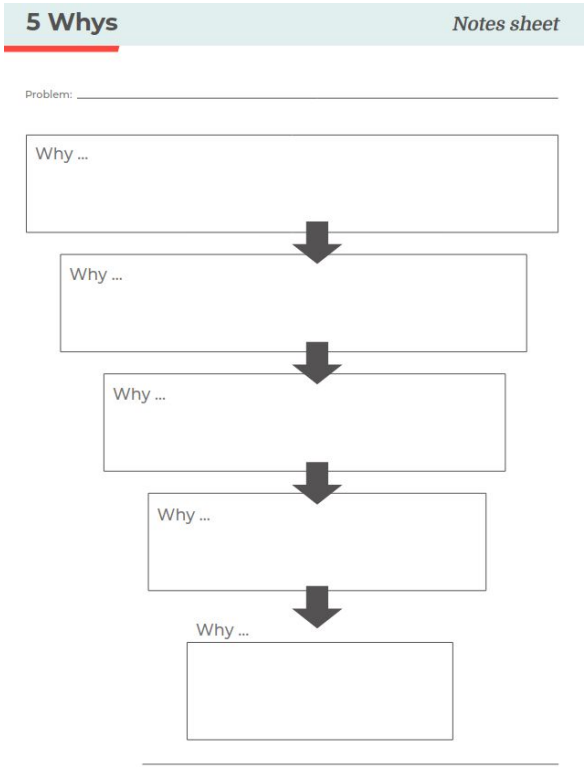


EXERCISE

YOU WILL NEED
Pen

In this exercise, you will practice the method of 5 whys and create a problem statement to summarise your findings. Use the provided template (p.164) to track the responses. Start at the top of the template and work your way down.

1. **Choose an initial problem statement** and write it into the 'challenge' section of the template.
   E.g. most inner-city dwellers shop at the supermarket closest to their home. How can a supermarket brand become the preferred choice, rather than just the closest option?
   [1 minute]
2. **Ask yourself why** this situation exists and **write down your response** in the first box. Answers should be longer than one word to provide enough detail to continue questioning.
   E.g. people choose this supermarket because it is on the way home from work.
   [3 minutes]
3. Ask **why for the second time**. Write down your response in the second box.
   E.g. because they like the convenience of choosing what to buy each night.
   [3 minutes]
4. Ask **why for the third time**. Write down your response in the third box.
   E.g. because sometimes plans change at the last minute.
   [3 minutes]
5. Ask **why for the fourth time**. Write down your response in the fourth box.
   E.g. because changing plans at the last minute can lead to bought food going off in the fridge.
   [3 minutes]
6. Ask **why for the fifth time**. Write down your response in the fifth box.
   E.g. because wasting food is bad for the wallet and bad for the environment.
   [3 minutes]
7. Once you feel you have **discovered the root cause of the problem**, describe it in detail and ideate some possible solutions to address it.
   E.g. design a service for inner-city dwellers that takes away the importance of the supermarket's physical location by offering pick-up options suited to customers' needs and timetable.
   [25 minutes]



5 Whys *Notes sheet*

Problem: _____

Why ...

Why ...

Why ...

Why ...

Why ...

EXERCISE

Pen, paper, tracing paper, scissors, sticky tape, Blu-tack

In this exercise, you will design a low-fidelity prototype that addresses a specific brief. Focus on your own design problem, or choose a design brief (p.138). If you have findings from user research (e.g. interviews, p.78), be sure to consider these in your design.

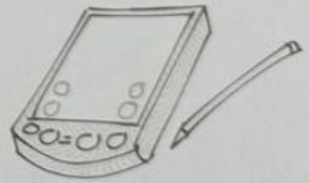
1. **Sketch** the parts of your product that you want to be **represented in the prototype**. Choose a specific task and sketch all the steps required to fulfil this task.
   E.g. adding a person to your friends in a social network app.
   [15 minutes]

2. **Create wireframes** (p.136) of your product using pen and paper. These are an iteration of the sketches produced in the first step and show the key elements on each screen.
   [30 minutes]

3. **Create a physical prototype** based on the previous step using any suitable materials.
   E.g. for the social network app example, use the smartphone drawing templates provided (p.195) to create a paper version of each screen.
   Add dynamic features to allow for user interaction. This can be achieved either by swapping out a screen or by adding layers in the form of Post-it notes.
   E.g. in a social network app, pressing the 'Find' button will bring up a new screen that lists people matching the name that was 'typed' into the search field.
   [30 minutes]

4. **Add real content** by writing it directly into your prototype or on additional materials that can be overlaid, such as Post-it notes.
   E.g. in a screen showing search results in a social network app, add names that are made up but sound real. This will help to give the prototype a more realistic feel
   [15 minutes]

5. You can also **prototype other physical aspects.** For example, you could create a physical representation of a virtual reality headset with minimal materials
   E.g. using a cardboard VR headset

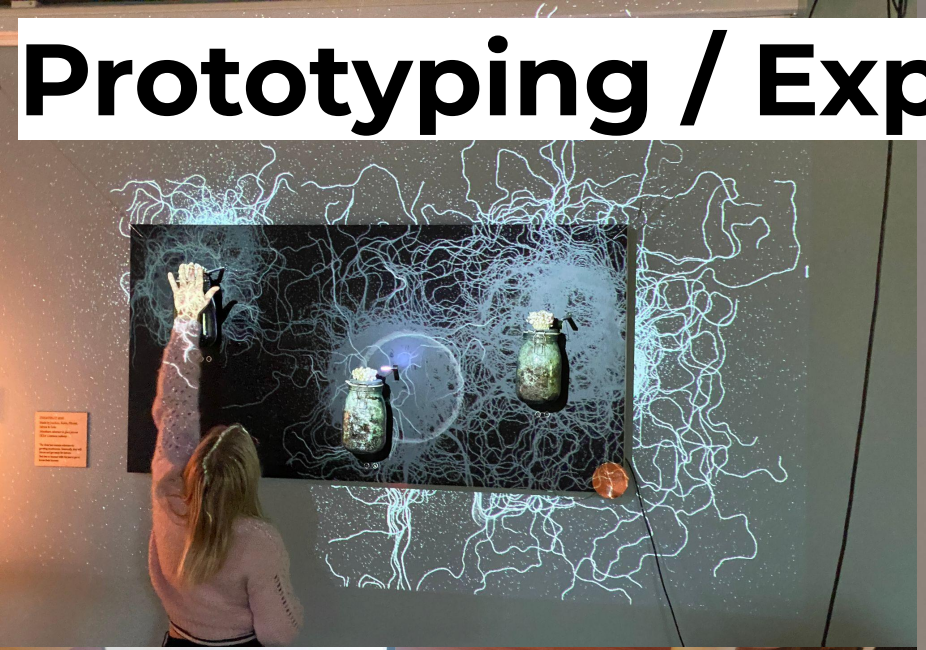


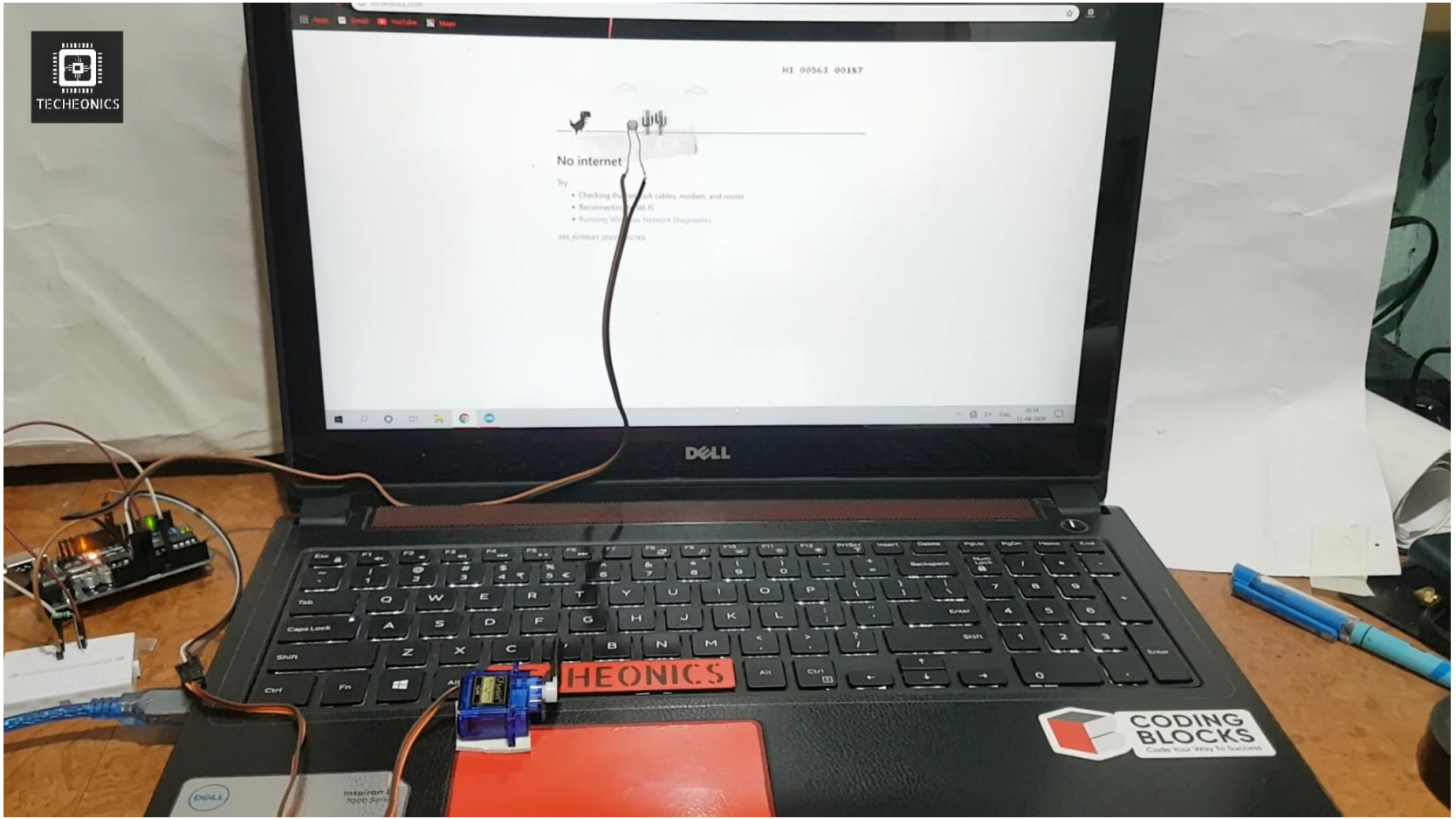
Is IT a good solution?

What qualities does computers systems have?

Does it make sense to solve the problem with a material with the chosen qualities?

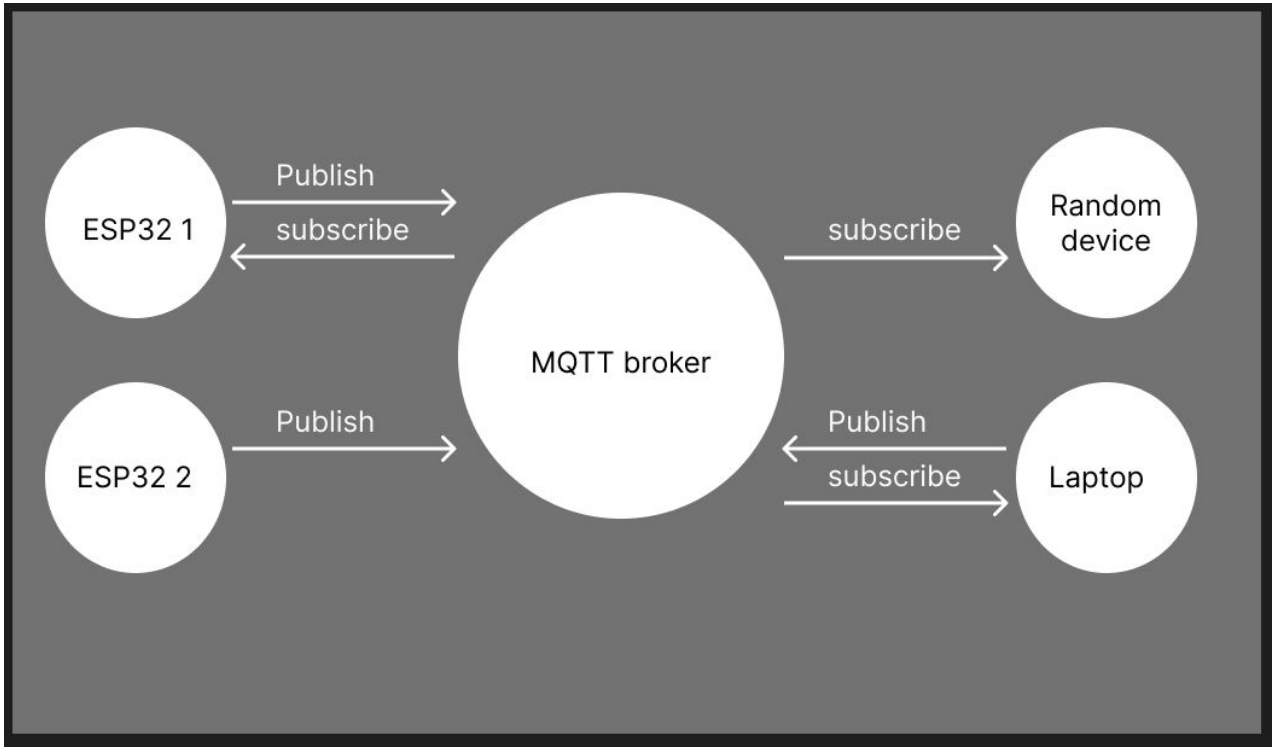
Prototyping / Exploration





https://www.youtube.com/watch?v=2HEF2_I-2KA

MQTT protocol



Hall sensor to adafruit text message

https://io.adafruit.com/

https://randomnerdtutorials.com/micropython-mqtt-esp32-esp8266/

Find a thing to embed the system into/onto