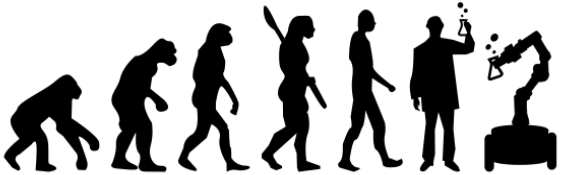
EPFL



CAT

Automated and data-driven chemistry

LECTURE 7 :
Interfacing Equipment
Theoretical Introduction

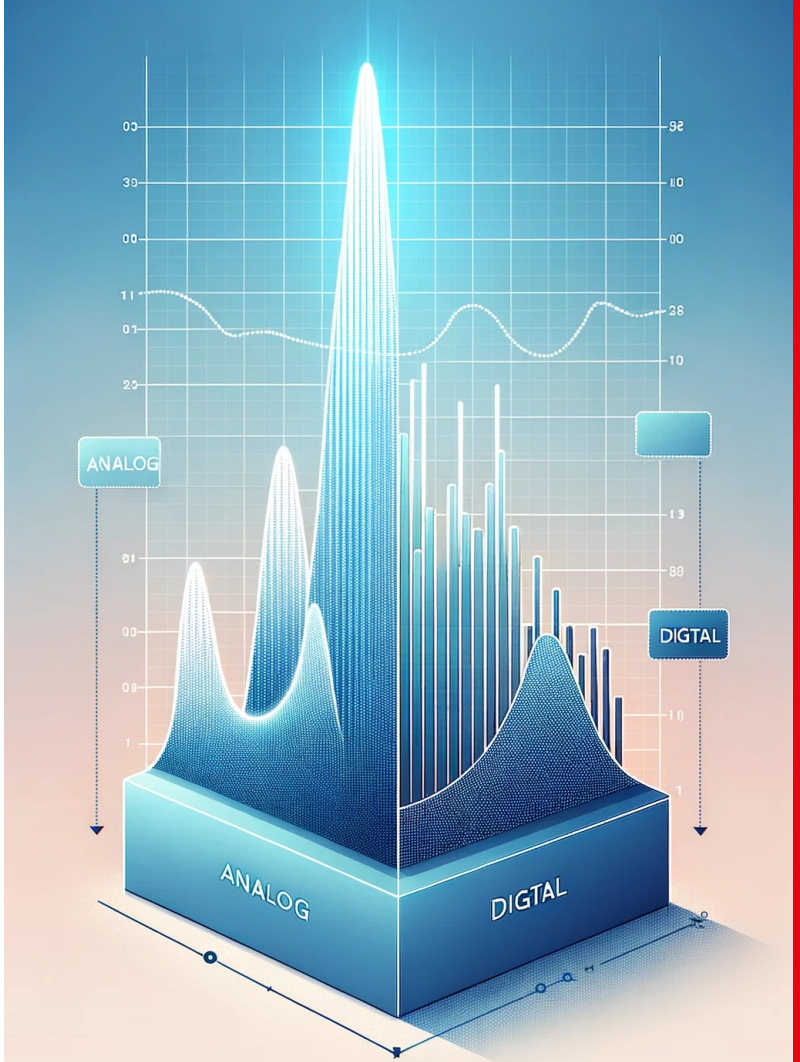
Pascal Miéville
Stefano Di Leone
Edy Mariano
Jean-Charles Cousty

01 Signal Types & Transmissions

02 Communication Tools

03 Interfacing Devices

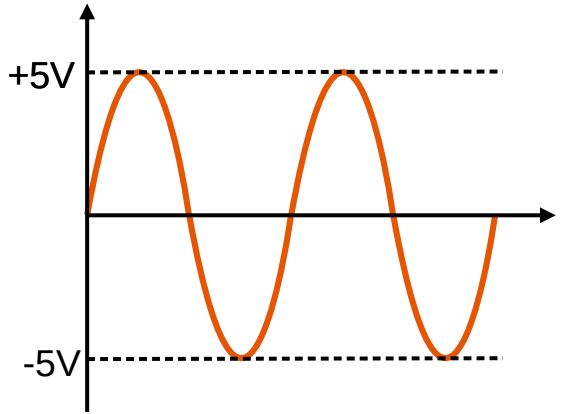
04 API



1. Signal Types & Transmissions

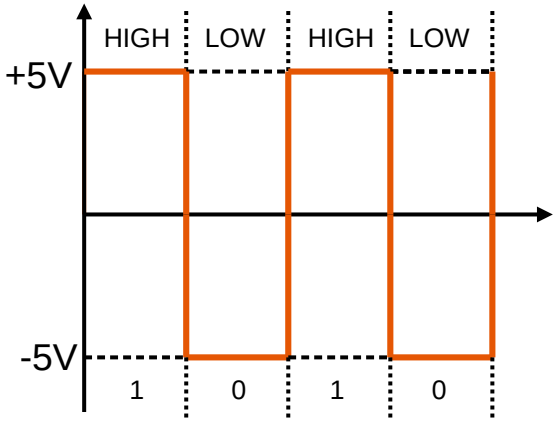
Digital & Analog

Analog



Continuous signal

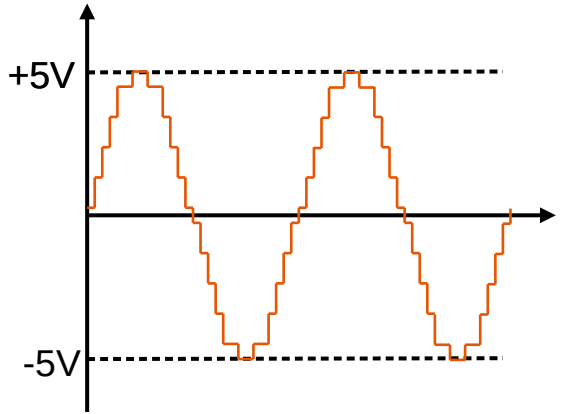
Digital



Discrete signal

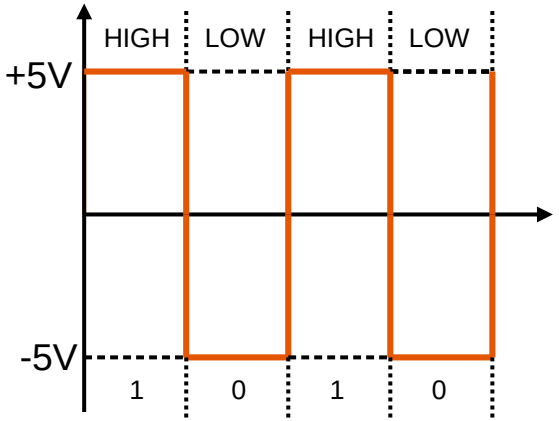
Digital & Analog

Digitalized Analog



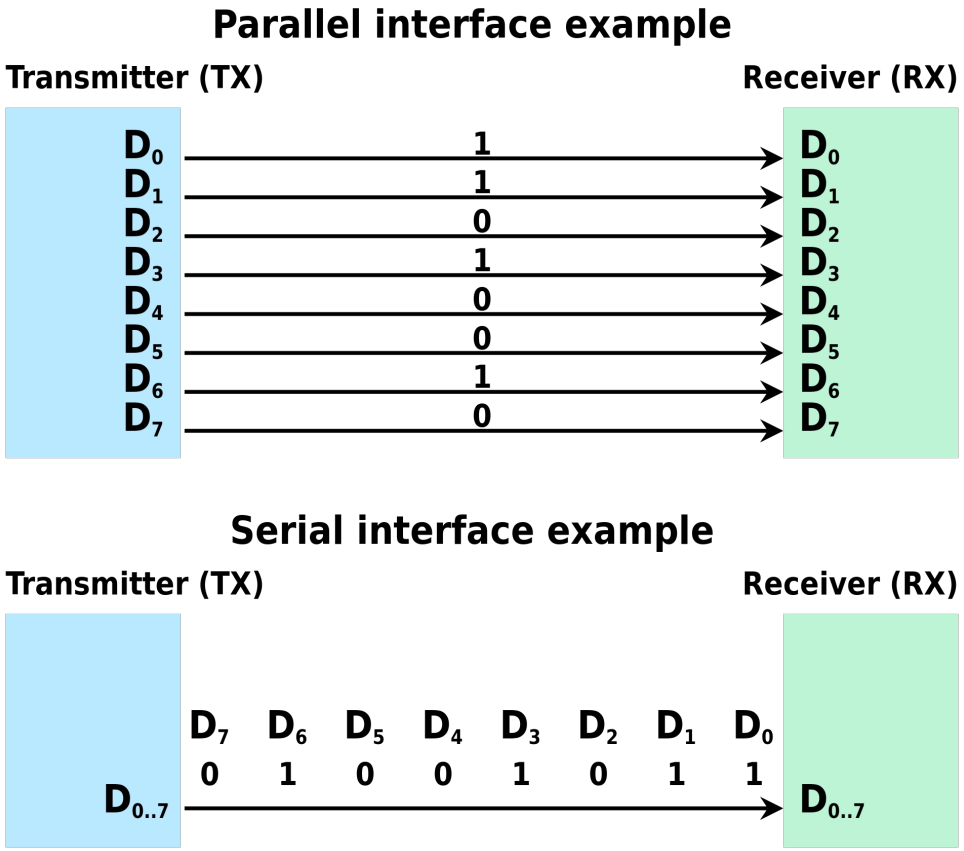
Discrete signal

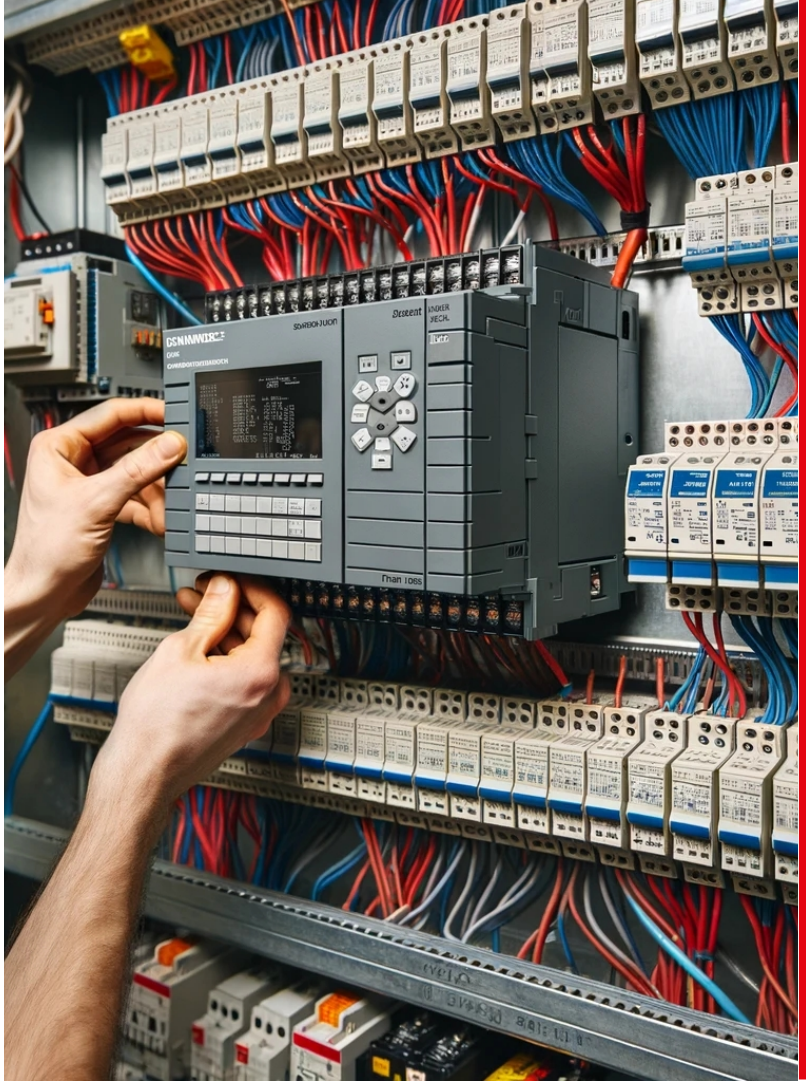
Digital



Discrete signal

Communication





2. Communication Tools

Communication

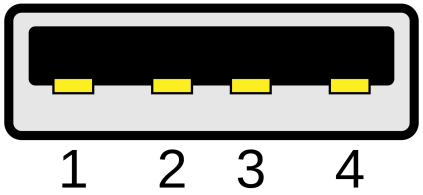
- To communicate between each others, devices need communication standards. It is a set of rules and conventions that devices must follow to communicate with each other

Cables	Protocoles
USB	TCP/IP
RJ45	UART
HDMI	Bluetooth

Communication

- Universal Serial Bus
- A dozen of type of USB port exists
- Short distance (a few meters)
- 4 wires (9 in newer version)
- Not robust (except rs232 which is old model)
- Transmitter (Tx) and Receiver (Rx)

USB

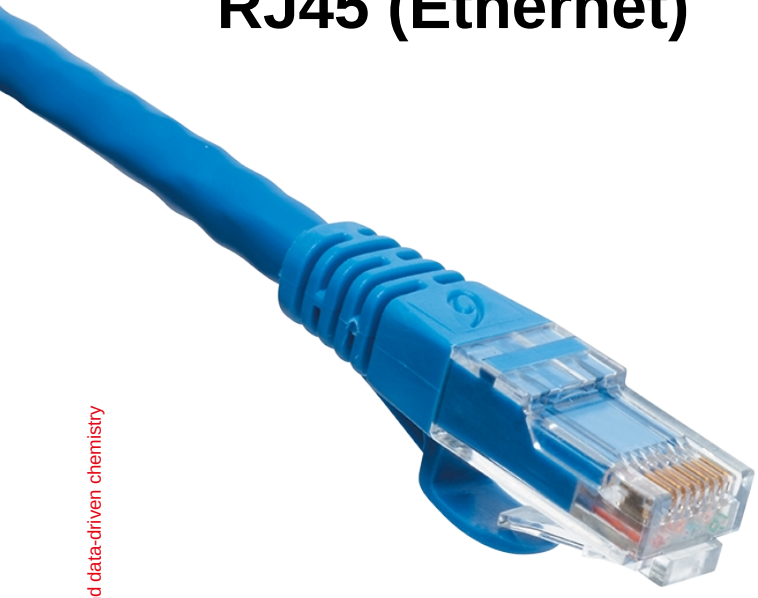


Type-A
2.0

RS232

Communication

RJ45 (Ethernet)



- Designed for Network communication
- Parallel communication (8 wires)
- Send by packets of data in any order
- Long distance (up to 100 m)
- Widely used in industrial setup (Automation)
- Dozens of protocole (TCP/IP, EtherCAT, ModBUS, ProfiNET, …)
- Stable in complex environment
- Safe

Communication

Display Port (DP)

- Designed and optimized for Audio and Video signals
- Easily adaptable to each others with adapters

HDMI

- With the high number of device in the lab, if possible, Remote Access Desktop should be privileged
- Many protocol exists, such as RDP (Windows) or VNC

Power Cable 200-250V (in Europe)

C13/C14

- Max 10A

C19/C20

- Max 16A

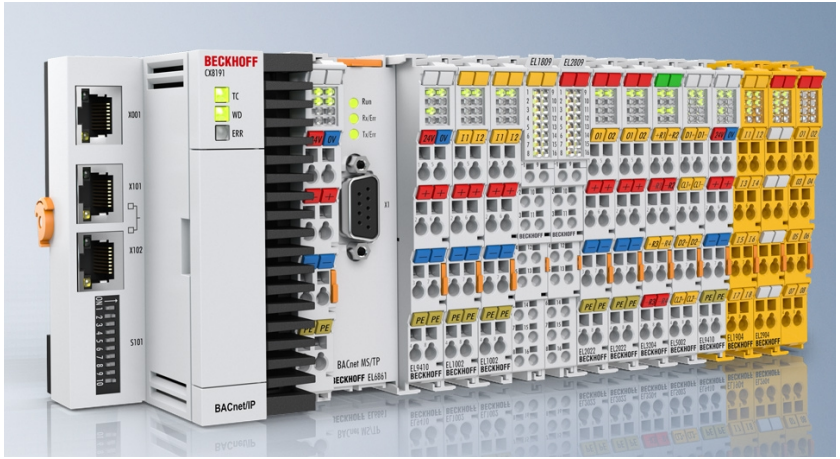
CEE Industrial

- 200-250V

- 380-480V

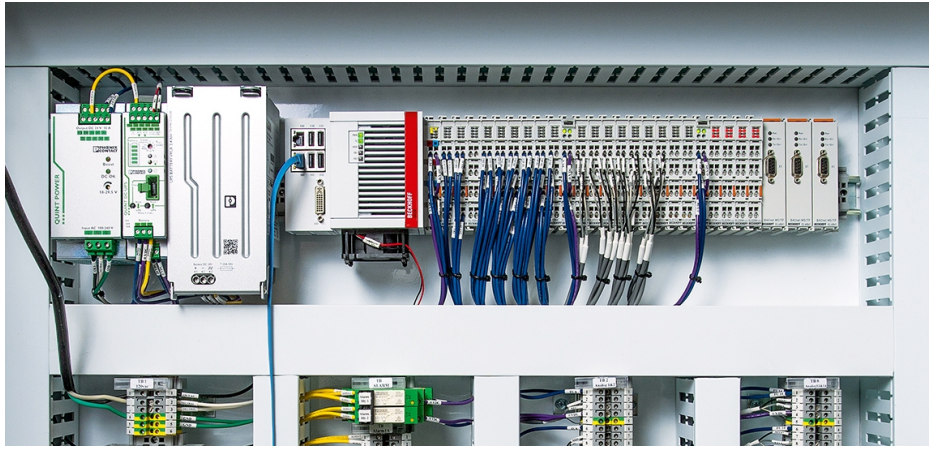
- Max 16A, 32A (and more Amp but rarely used in lab)

PLC



- Industrial controller
- Safe, durable, works in harsh environnement
- Plug & Play connectors
- Allows to easily program and connect tons of sensors and actuators
- Lots of standard communication

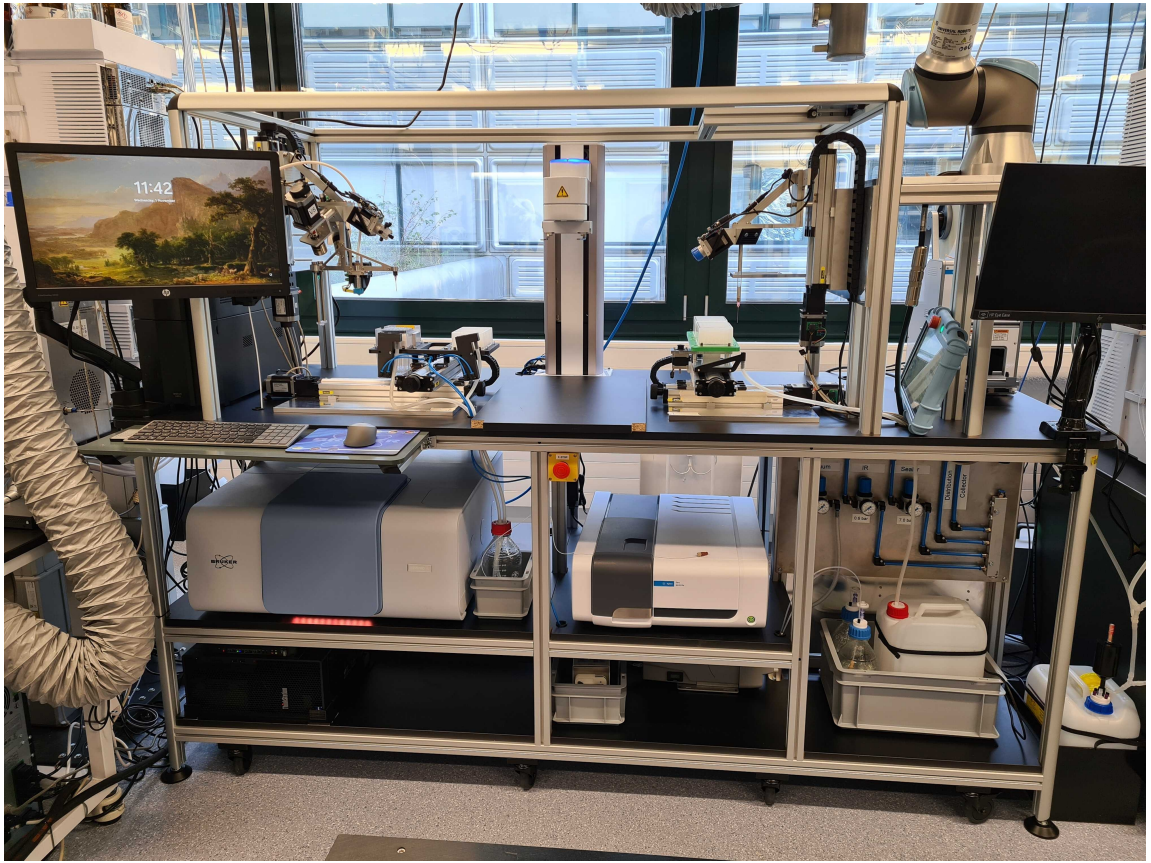
- Installed in Electrical Cabinet
- Requires special training
- Lots of norm to respect
- Dangerous to operate when on
- Proprietary software
- Expensive and long delivery time



OmniFire


Lower gripper to load seal
Press to close gripper
Support
US: 1.800.979.4811
service.automation@agilent.com
OTHER REGIONS:
https://www.agilent.com/en/contact-us/page
SMC
MPa
AIR ON
OFF

OmniFire



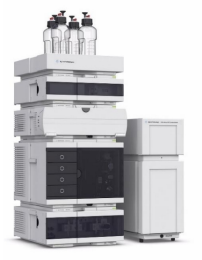
OmniFire

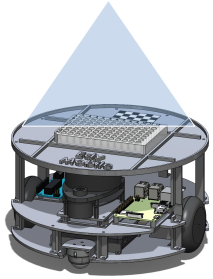

NDR-480-24
NDR-240-24


Vacuum
IR
Sealer
Distribution
Collector
0.6 bar
7.0 bar

2. Interfacing Devices

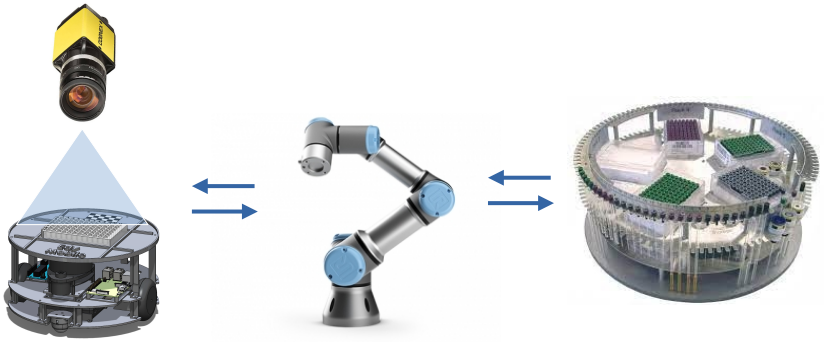
Now.. How do we interface all the devices…



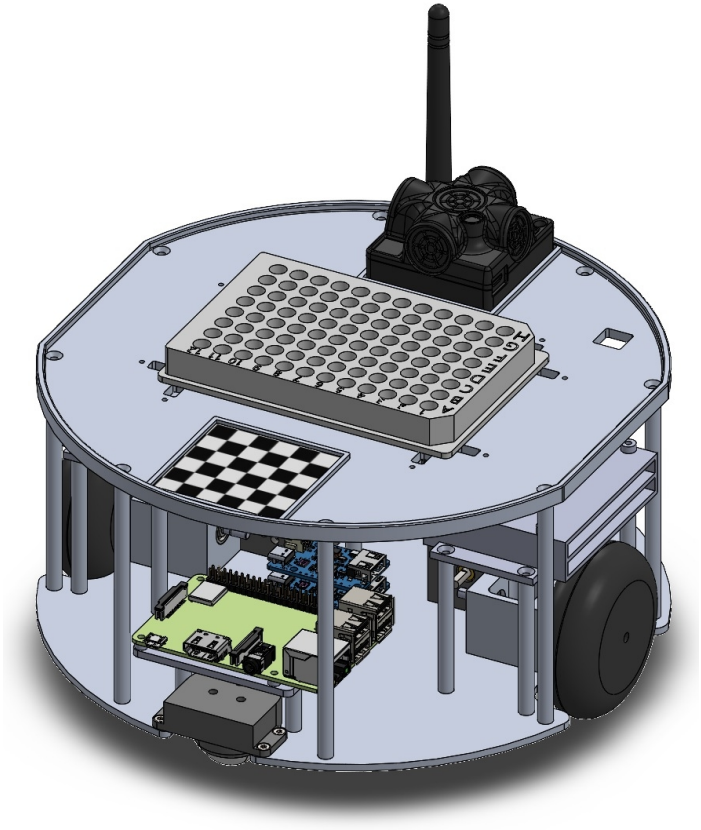


NMR Example

- Plate must be transported into NMR track
- NMR data must be exported into database
- Plate must be transported back on Robot



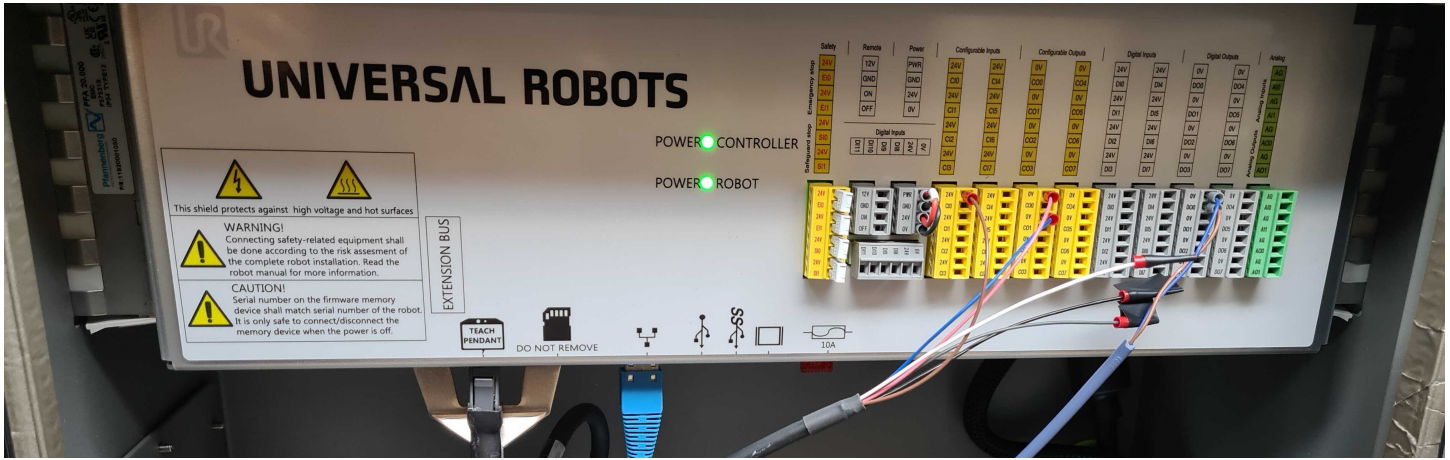
NMR Example



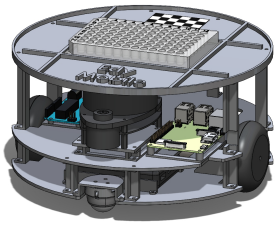
- Onboard PC has WiFI
- Arduino is connected through USB, sending sensors value and receiving motor speed command.
- GPS is connected through USB, sending sensor position

NMR Example

- Controller with Input & Outputs to control Sensors & Actuators (like a PLC)
- Ethernet port with TCP/IP to communicate with it

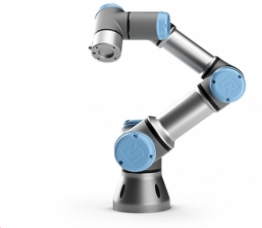


NMR Example



- WiFI
- TCP/IP

- RJ45
- TCP/IP



- RJ45
- TCP/IP

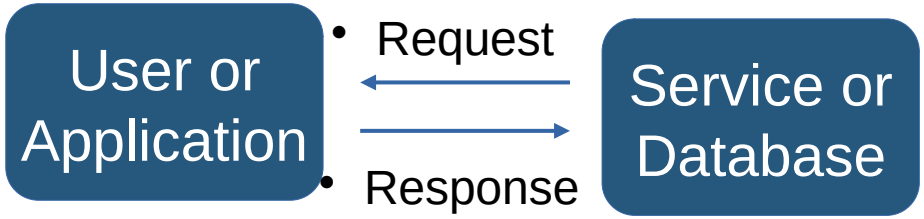
- RJ45
- TCP/IP

- RJ45
- API

1. API

API

API (Application Programming Interface) is a set of rules and protocols that allows different software entities to communicate with each other.



APIs enable seamless integration and data exchange between systems, making them essential for modern software development.

NMR API Features

- **Move Rack Holder** : It will move the rack holder to the selected position, allowing the robot to put the rack

- **Measure Sample** : It will charge the sample into the NMR, make the measurement depending on the selected method, uncharge the sample and return the measurement data

API Interface

Scale API 1.0.0 OAS 3.0

API for managing a scale with tare, weight, door, and temperature functions

default

- POST /scale/tare Tare the Scale
- GET /scale/weight Get Weight
- POST /scale/close-door Close the Door
- GET /scale/temperature Get Temperature
- POST /scale/stabilize Stabilize Weight

- Rest API or Soap API for examples are widely used to easily interface two devices in the same network

Conclusion

Thank you for your attention.

Thanks to

Swiss CAT+ team & partners

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

ETH-RAT

EPFL

Innosuisse

Gimp, Ubuntu Foundation