

Week 3

Dr. Yuhao Jiang

Reconfigurable Robotics Laboratory

EPFL, Switzerland

This Week: Polish the idea

- **Narrow down from 3 ideas**
 - Further define the previous three questions
 - Need
 - Novelty
 - Solution
- **Quantify the metric**
 - Describe the sustainability of your idea in a **quantifiable** way, think of the 6 Rs;
 - Scope;
- **Approaches**
 - Sensors and designs;
 - How to close the loop?
 - Is it doable in 10 weeks with a reasonable cost?

How to quantify and benchmark

Fit into 6 Rs

- **Recycle**

- Recycling Rate: Mechanical engineers can design products for easier disassembly, repair, and recycling, improving the overall recyclability of materials.
- Recycle the resource
 - Energy
 - Water
 - ...

- **Repair**

- Interchangeable design that can be easily repaired?
- Easily disassemble?

How to quantify and benchmark

Fit into 6 Rs

- **Reuse**
 - Parts/materials that can be disassembled and reused for other devices?
 - Parts/materials are directly reused from other machines?
 - Modular design that can be reused directly for other functions?
- **Reduce**
 - Improved design to reduce the use of materials?
 - Reduce the environment impact?
 - Energy usage
 - Toxic pollutions
 - Noise emissions
- **Refuse**
 - Robust design that can last longer?
 - Lifecycle improving?

How to quantify and benchmark

Fit into 6 Rs

- **Rethink**
 - For a greater good
 - Human health impact
 - Fair Labor
 - Society / culture impact
 - ...

How to quantify and benchmark

Quantify and benchmark your device

- **Actuation**
 - How much force / speed / torque is required to achieve the designate motion?
 - Does the size of the selected actuator fit in the design?
 - Is it commercially available?
- **Sensing**
 - What signals are needed to close the control loop?
 - What sampling rate is needed to achieve specified function?
 - Precision requirement?
- **Control**
 - How is the control rate required for achieve designed functions?
 - Selected actuator and sensor support this rate?
 - Communication protocol needed?

How to quantify and benchmark

Quantify and benchmark your device

- **Power**
 - Power required for actuators?
 - Is it practical for the designate application?
- **Manufacture**
 - What material will be used?
 - How the structure / mechanism will be designed?
 - What manufacture methods will be used?
 - Simulations (CAD / FEA / CFD) for validating the design?

Lecture

Introduction to Microcontrollers for Sustainable Automation

Tackle Box

- 1 ESP32
- 2 Servo motors
- 1 USB power supply
- Essential parts

SPOT Tutorial

By next week

Polish the idea

- **Detailing the idea**
 - Create quantifiable metrics
 - Specify the desired functions
- **Detailing the design and part selections**
 - Select parts for first purchase
 - **First purchase day coming: Oct. 1**
 - Design on structures and transmissions
 - Actuators
 - Control loop
 - Power plan
 - Manufacture plan
 - How to improve for sustainability?

Deadline: Oct. 1

Total budget: 250 CHF

Venders:

[Digikey.ch](https://www.digikey.ch)

(Electronic components)

(Mixed/specialty electronics, motors)

[mouser.ch](https://www.mouser.ch)

(Mixed/specialty electronics, motors)

[digitec.ch](https://www.digitec.ch) or [galaxus.ch](https://www.galaxus.ch)

(General components)

[distrelec.ch](https://www.distrelec.ch)

(Special Electronic components)

uk.misumi-ec.com/

(Materials)

[tme.eu](https://www.tme.eu)

(Electronic components, motors)

uk.rs-online.com

(Development shields and other components)

How to order

- Google Sheet order form will be sent out later
 - Orders due by 15:00 on the dates (**strictly**)
 - Will place orders same day
- Will only process valid components
 - Parts *must* come from the previous suppliers
 - e.g., **digkey.ch**, *not* digkey.com
 - Part numbers must match their description or link
- Form will track budget for each group

Shipping considerations

- Groups will be charged for shipping, unless:
 - Total from all groups over “Free shipping amount”
- Example:
 - Group 1 wants components from Mouser.ch, <54 CHF
 - Group 2 wants from Digikey.ch, <60 CHF
 - Group 1 changes their order to Digikey
 - The order is now over 60 CHF, and the shipping will be free for both groups
- Work with other groups!
- Note: Distrelec has free shipping to EPFL