Ecole Polytechnique Fédérale de Lausanne
EPFL

China Hardware Innovation Camp

2nd milestone – May 1, 2015

Structure

❖ Business

❖ Software/firmware

❖ Electronics

❖ Industrial design/mechanical design

❖ Material

❖ Take-away

Problem statement

Let the kids experiment the parameters of water
& Sensitize kids with environmental issues

2nd milestone   Business

Problem statement

Let the kids experiment the parameters of water
& Sensitize kids with environmental issues

→ More and more programs in schools, camps...

But it's not an easy task to take the pupils outside

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Our solution

dory is an educative tool to help the teacher to do outdoors experiences

- ❖ **Device**
- ❖ **Sensors**
- ❖ **Box**
- ❖ **Software**
- ❖ **Game mode**

Who will buy it?

❖ Secondary schools
➢ Out- and indoors experiments
➢ 14 years old pupils

❖ NGOs for their educational activities
➢ Outdoors experiments
➢ 8-15 years old

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"It's not a fundamental need, but it would be a real plus for our activity!"
Arianne Derron, Responsable Ecole, WWF Suisse Romande

WWF

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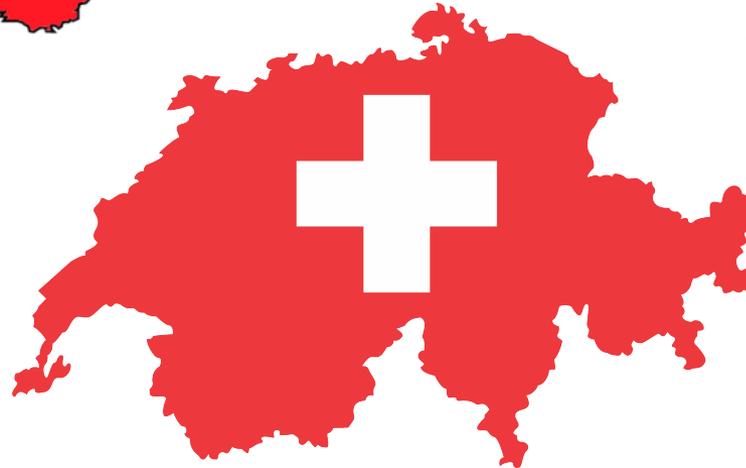
Market Analysis

Market Analysis

Why those countries?

❖ Developped countries
❖ Global reach
❖ High education
❖ Interest for the environment

Market Analysis

Strengths

- Combined device
- Game mode
- **Swiss made** with the label of the EPFL, UNIL, ECAL
- **Contacts**
- Familiarity with the swiss culture and habits

Opportunities

- Increasing interest in teaching about nature
- **Mandatory outdoors experiments**
- **Growth in the swiss education**
- Budget of the schools
- **Lot of activities for pupils organised by NGOs**
- Budget of the NGOs
- **Import/export agreemen**ts

Weaknesses

- **No experience**
- Hardly no knowledge in italian

Threats

- **Non-homogeneous market**
- Multi-cultural country
- Different languages

Market Analysis

Strengths

- Combined device
- Game mode
- Swiss made with the label of the EPFL, UNIL, ECAL
- **Knowledge in French and of the french culture and education system**

Opportunities

- **Wide-homogeneous market**
- **Same eduactional program everywhere**
- Interest in scientific education
- Interest in environmental education
- Increase of number of student

Weaknesses

- No experience
- **Small knowledge of the French market**

Threats

- **Low price index**
- Euro crisis
- **Economic and financial crisis**
- Slow economic growth

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Market Analysis

Strengths

- **Combined device**
- **Game mode**
- Swiss made with the label of the EPFL, UNIL, ECAL
- Knowledge in German

Opportunities

- **Wide-homogeneous market**
- **Same educational program everywhere**
- Interest in scientific education
- Interest in environmental education
- **Budget of the schools**
- Economic growth
- **Long term relationships**
- Importation legislation with China

Weaknesses

- No experience
- **No knowledge of the german market**
- Small knowledge of the german culture and education system
- **Need extra-help**

Threats

- **Very competitive**
- **Demanding market**

Market Analysis

- ❖ Swizerland
  - ➢ invest 5.8% of its GDP for education
  - ➢ 90% of the budget is dedicated for current activities.
  - ➢ 25.79 spending per student (high school) (2007)
  - ➢ 563'000 pupils (secondary school) (2004)

- ❖ France :
  - ➢ 26.63 spending per student (high school) (2006)
  - ➢ 5.83 mio of pupils (secondary school) (2004)

- ❖ Germany:
  - ➢ invest 5.08% of its GDP for education (2000)
  - ➢ 12.9% of this budget was dedicated to the secondary schools.
  - ➢ 20.66 spending per student (high school) (2006)
  - ➢ 8.38 mio of pupils (secondary school) (2004)

Public expenditure per student is the public current spending on education divided by the total number of students by level, as a percentage of GDP per capita.

nationmaster.com
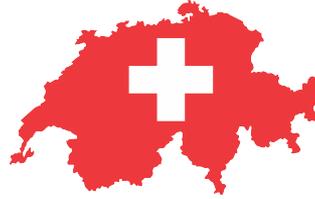
Market Analysis - 2 choices

❖ Swizerland & France

❖ Swizerland & Germany

➢ One Language
➢ Common characteristics

➢ One Language
➢ Common characteristics

But :
Euro crisis might affect the investment in education

But :
Germany sensitive to price
No knowledge of the german education system

→ Cost and price analysis

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Software

dOry
data management system

Communication with outside

Inside functions

Import data through UART interface from the device

By using the UART interface, to implement the function of getting data from the device.

To implement the function of sending commands to the device

By doing this, the students can easily change some basic setting of the device without using the professional device.

Identify different kinds of data and store them according to the item

The data includes the temperature of the air, the temperature of the water, the GPS, the conductivity the transparency of the water,

To store the data by time and management them by using database

To be able to make the data well organized.

To implement some basic statistical calculations for the data. Like drawing the distribution chart or forecast.

For those student, after they got the data, they can use this function to do some basic research about the water.

To link the Google Map with our software to see the exact position of the GPS information

Something like a funny thing which can let you see your exact position where you measure the water.

Above all, the software is designed for pupils, so the user interface should be cute and friendly, also easy to use.

The important thing is to implement the function of communicating with the device. So, after the implementation of the software, some debug work needs to be done together with the finished device.

Software Demo

Software Curent Situation

- To add the command sending function after the PCB board has been finished.

- Try to find a way to implement the Google map function.

- Try to refine the data arrangment.

RF part

Benefits and disadvantages of 6LoWPAN:

- Can connect with the IP network.
- Software 'stacks' requires less RAM and ROM than a ZigBee stack.

- ❖ No enough documents to follow.
- ❖ No idea about the hardness of the implement of these new features.
- ❖ The design of it aims at the fixed equipment, because we need the bridge device.

RF part

Benefits and disadvantages of Zigbee:

- More convenient to design the required functions.
- Cheaper.
- The number of pins of Zigbee are much less than 6LoWPAN.
- The distance of transforming is large.

❖ Hard to connect with the internet.

Zigbee communication

Hello dOry
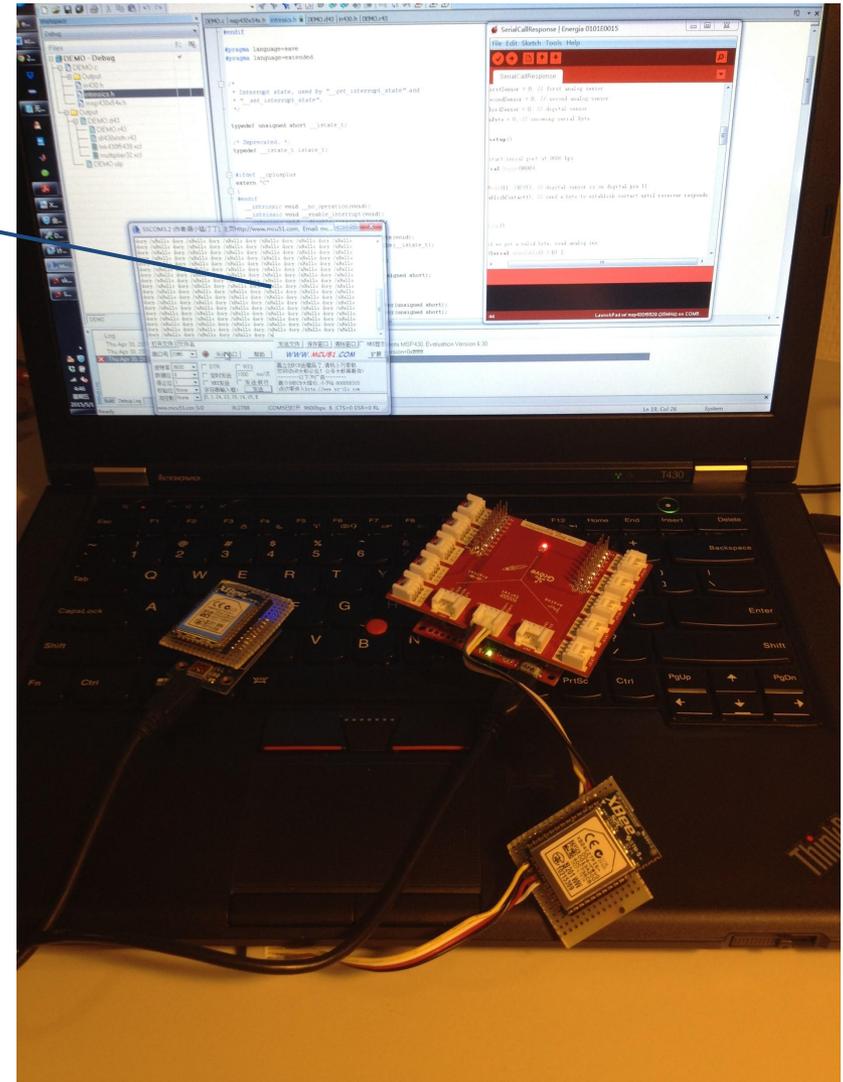
Firmware

- ## TI-RTOS

Task: I2C
- checks int. sensor
- if available, checks ext. sensors

Task: UI
- reacts to user inputs
- changes menu view
- I/O: buttons, LED, state of display, buzzer

Task: GPS
- communicates with GPSbee via UART

Task: Display
- refreshes the display content regularly, depending on state

Task: Log
- stores data in Flash
- takes care of real time clock

Task: ZigBee
- synchronizes data from log with other devices
- waits for service commands

Task: Game
- counts the achieved number of measurements
- compares results with the one of other groups

Task: USB
- communicate to host if available

Electronics - block diagram
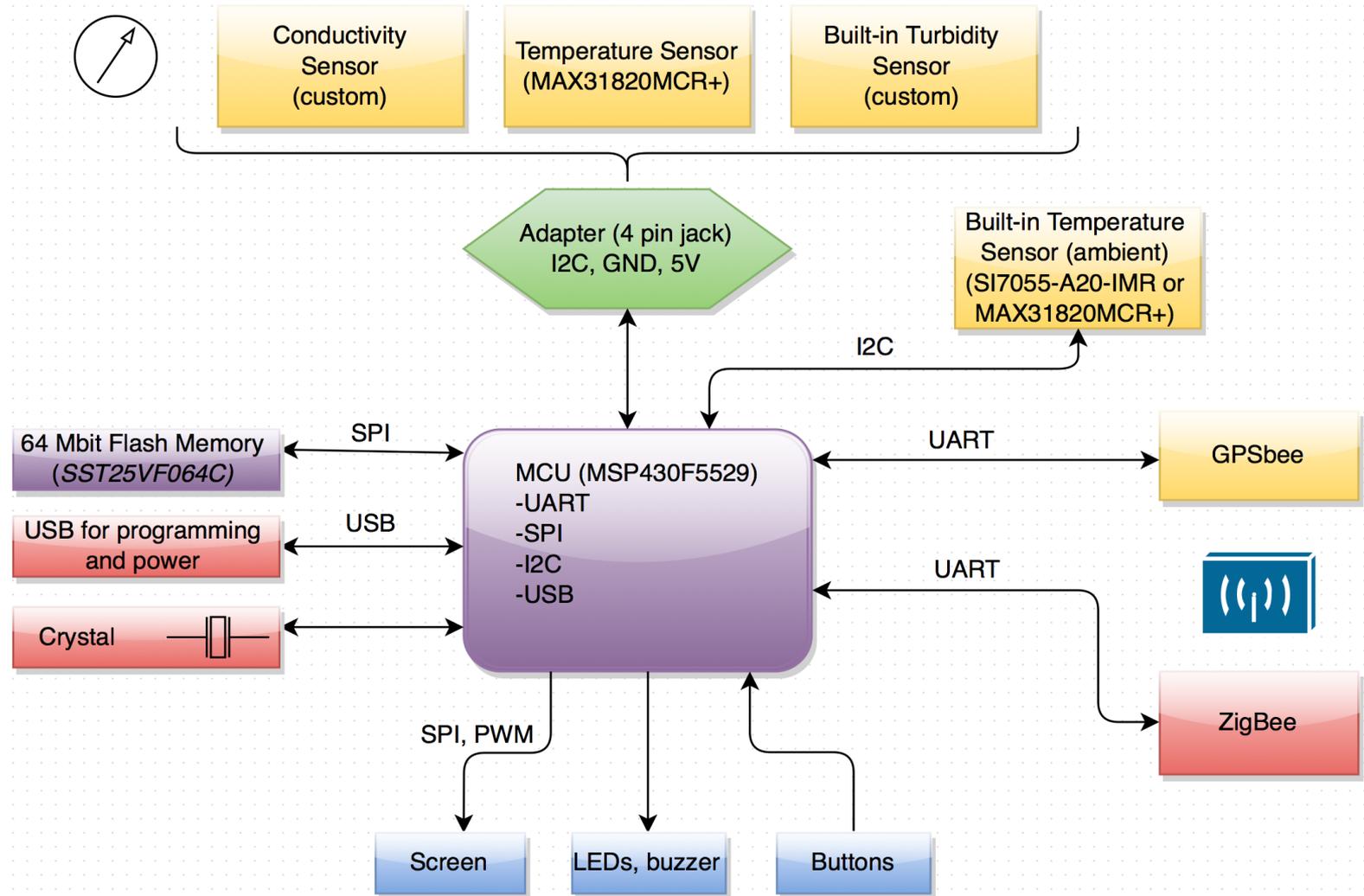
Electronics - schematics

USB
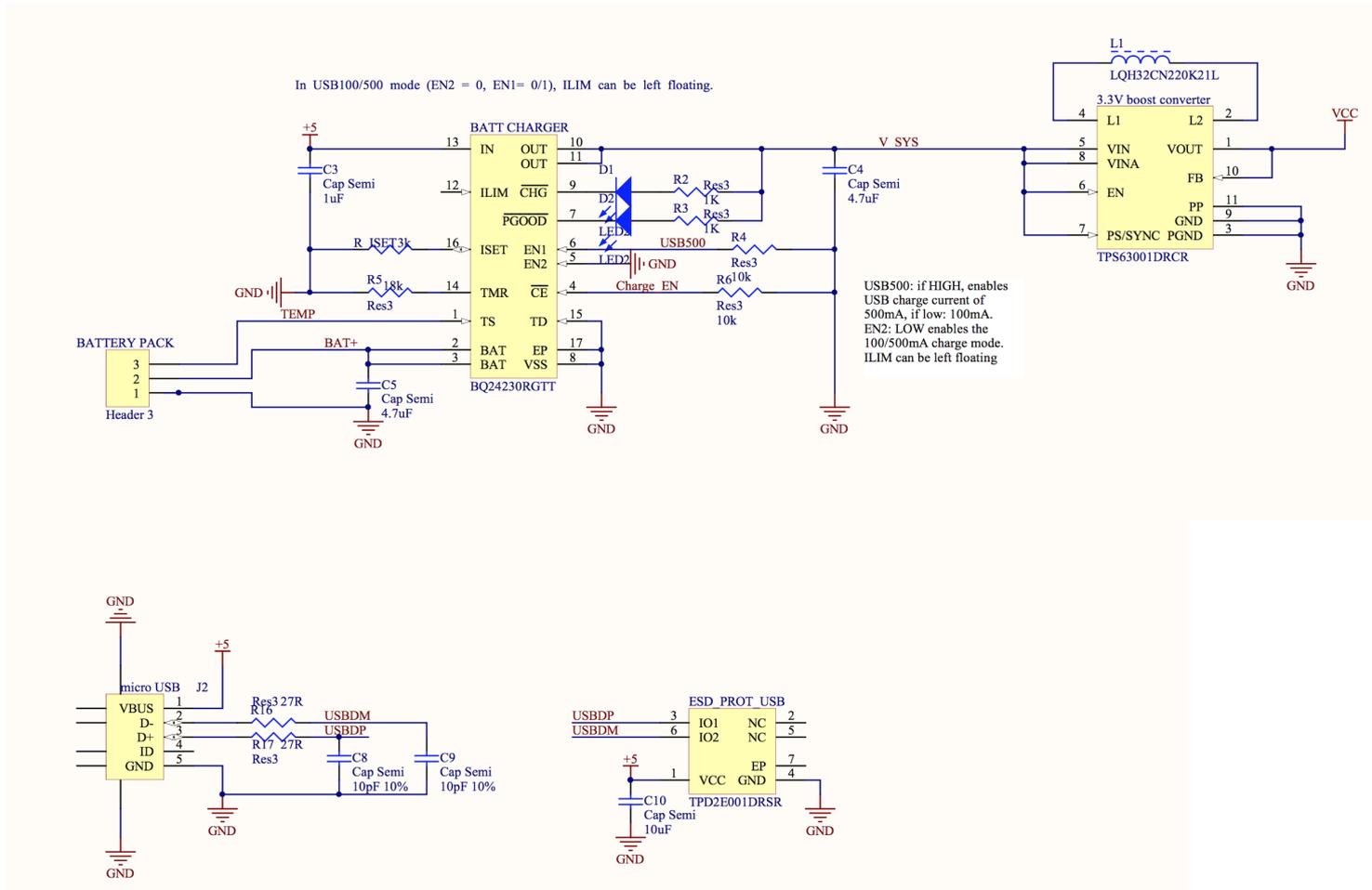
Electronics - schematics

I2C
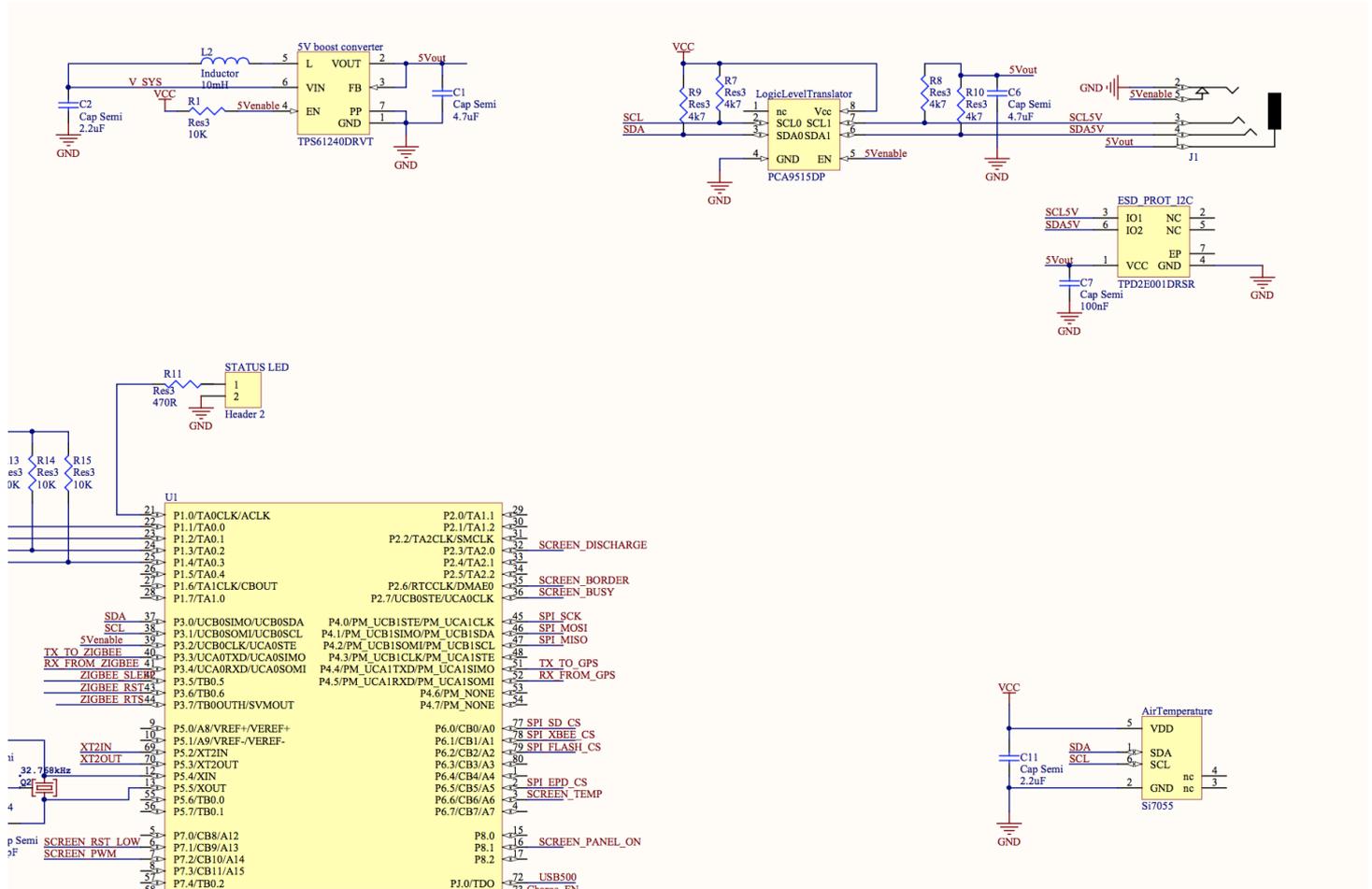
Electronics - PCB
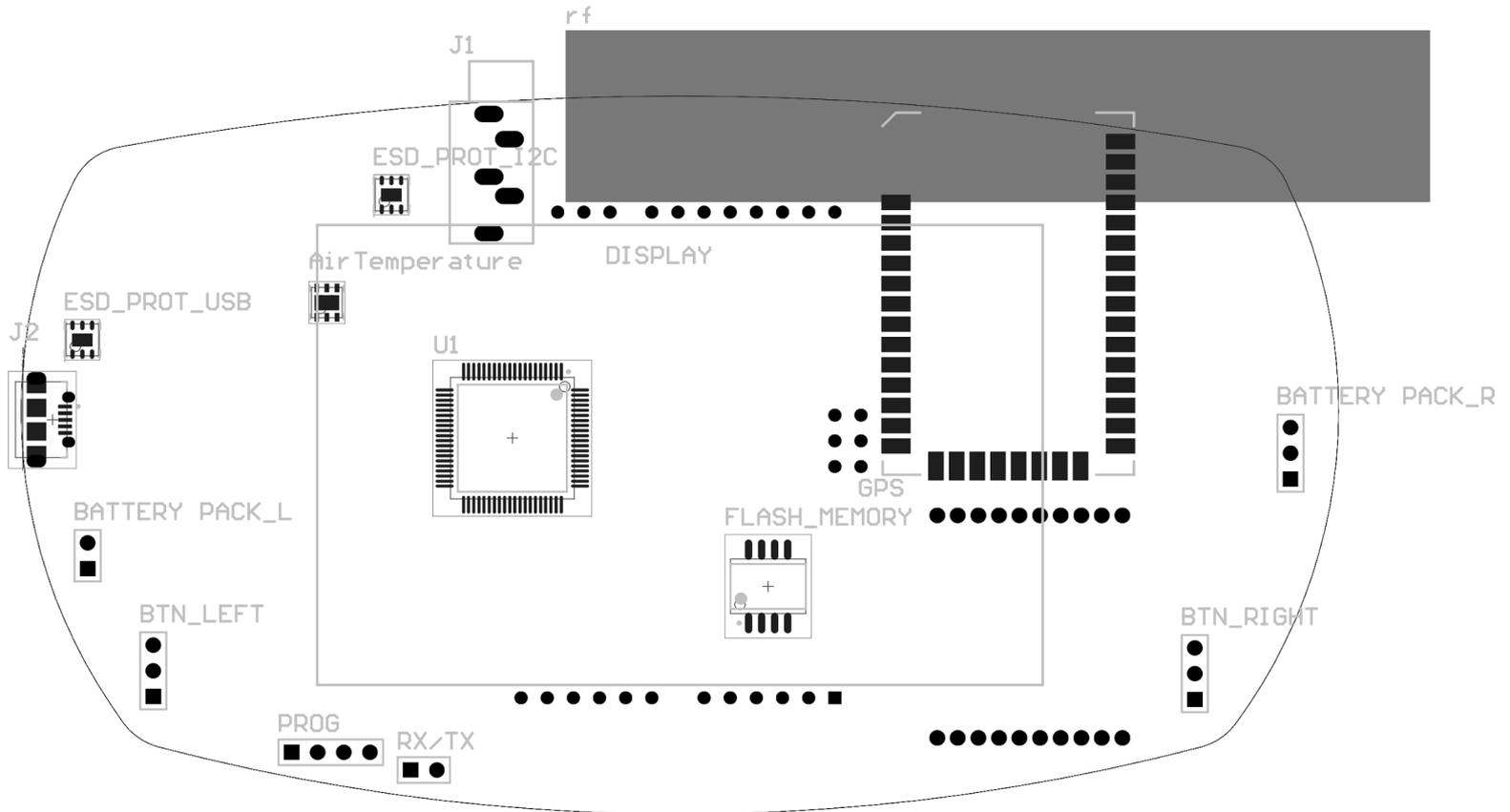
Electronics - PCB

Reuse seeed display shield (add buttons, enlarge plane)
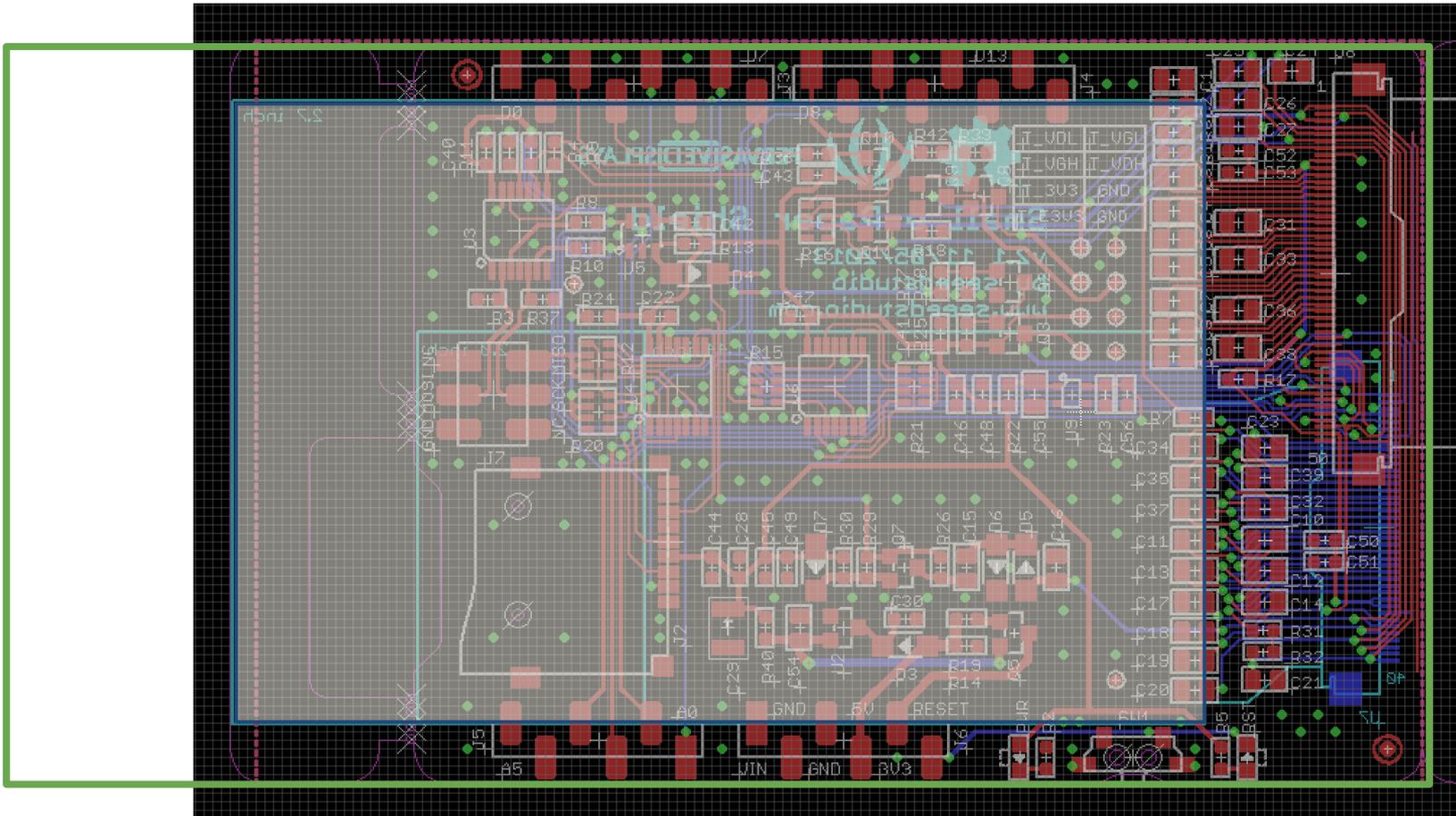
Electronics - PCB

3D model demo ...

Electronics

- Things that are currently working:
    - turbidity sensor (analog)
    - conductivity sensor (analog, breadboard)
    - I2C temperature sensor (Energïa, not in C)
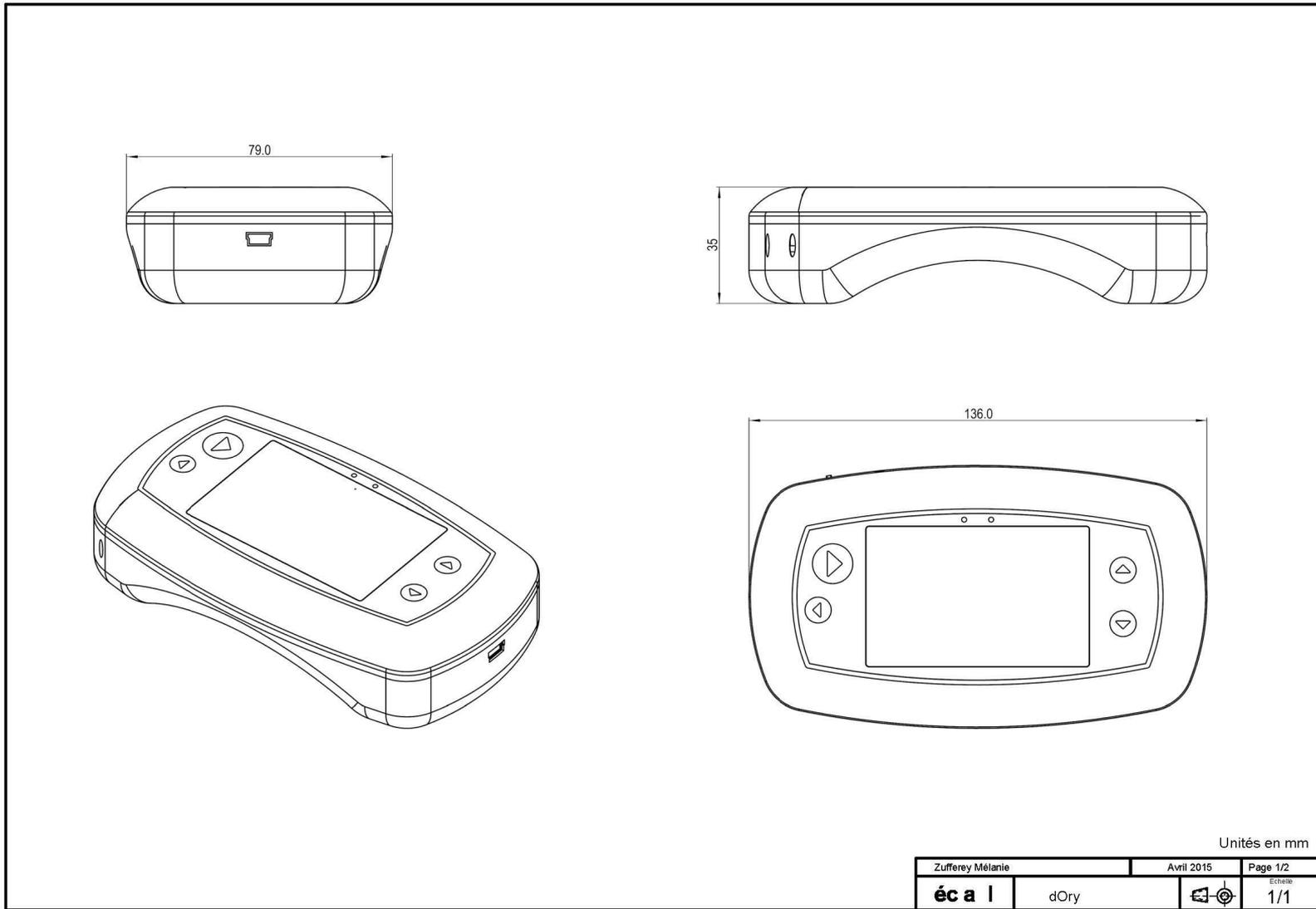   - Display (Arduino, C)
    - USB HID (C)

- Demo!

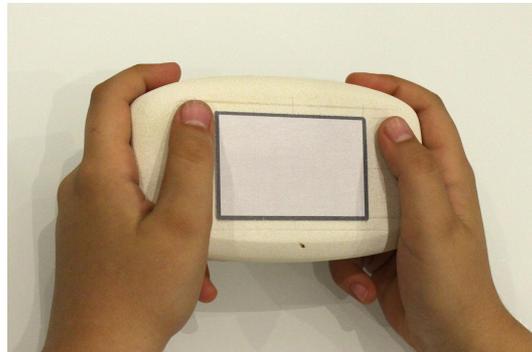# Industrial design

Industrial design

Industrial design

79.0

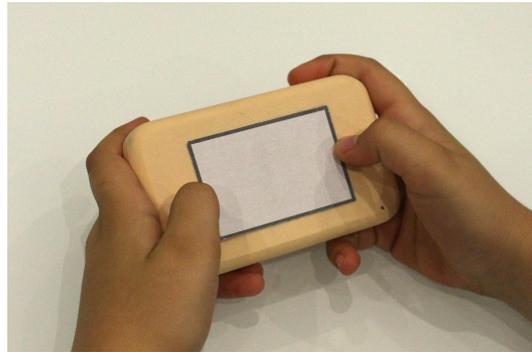35

136.0

Unités en mm

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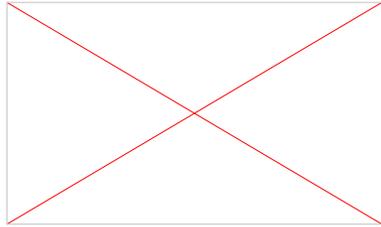
Industrial/mechanical design

Assembly

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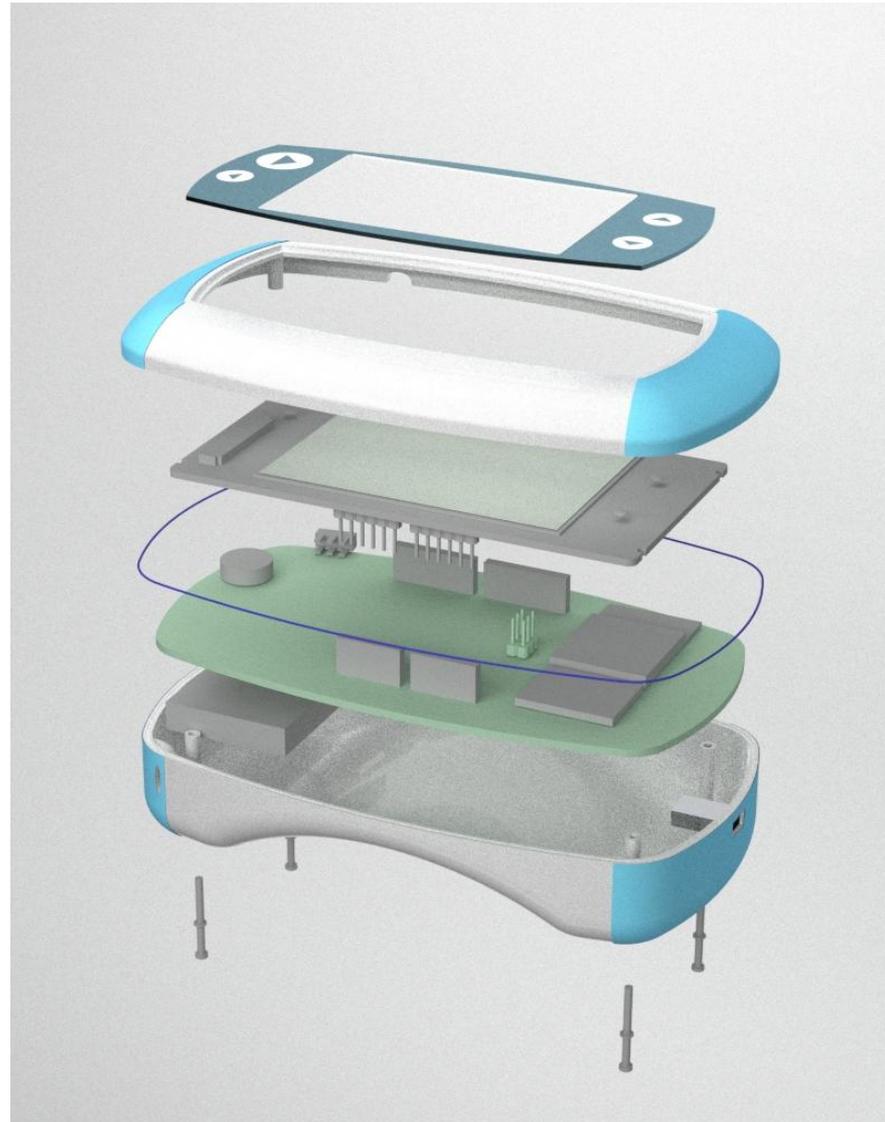
Industrial design

First tester
Théo, 12
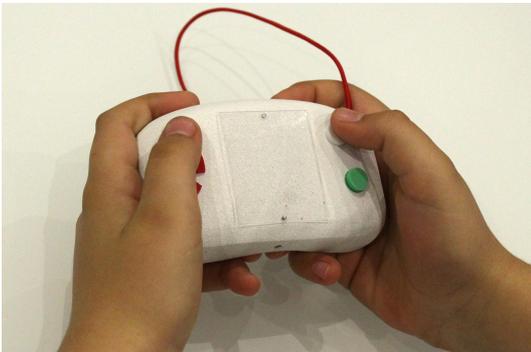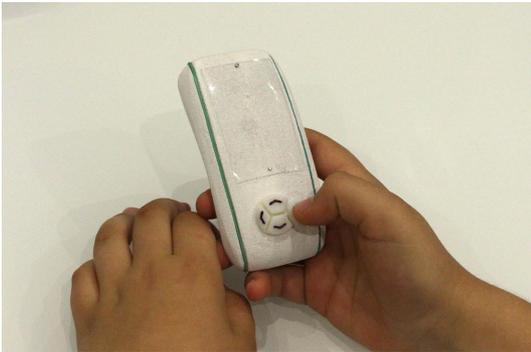
Industrial/mechanical design

Logo research
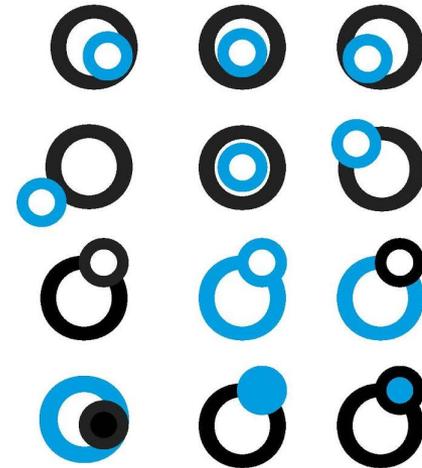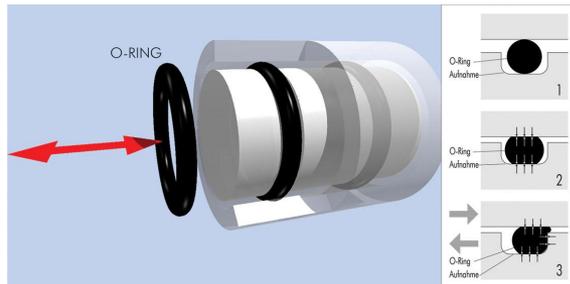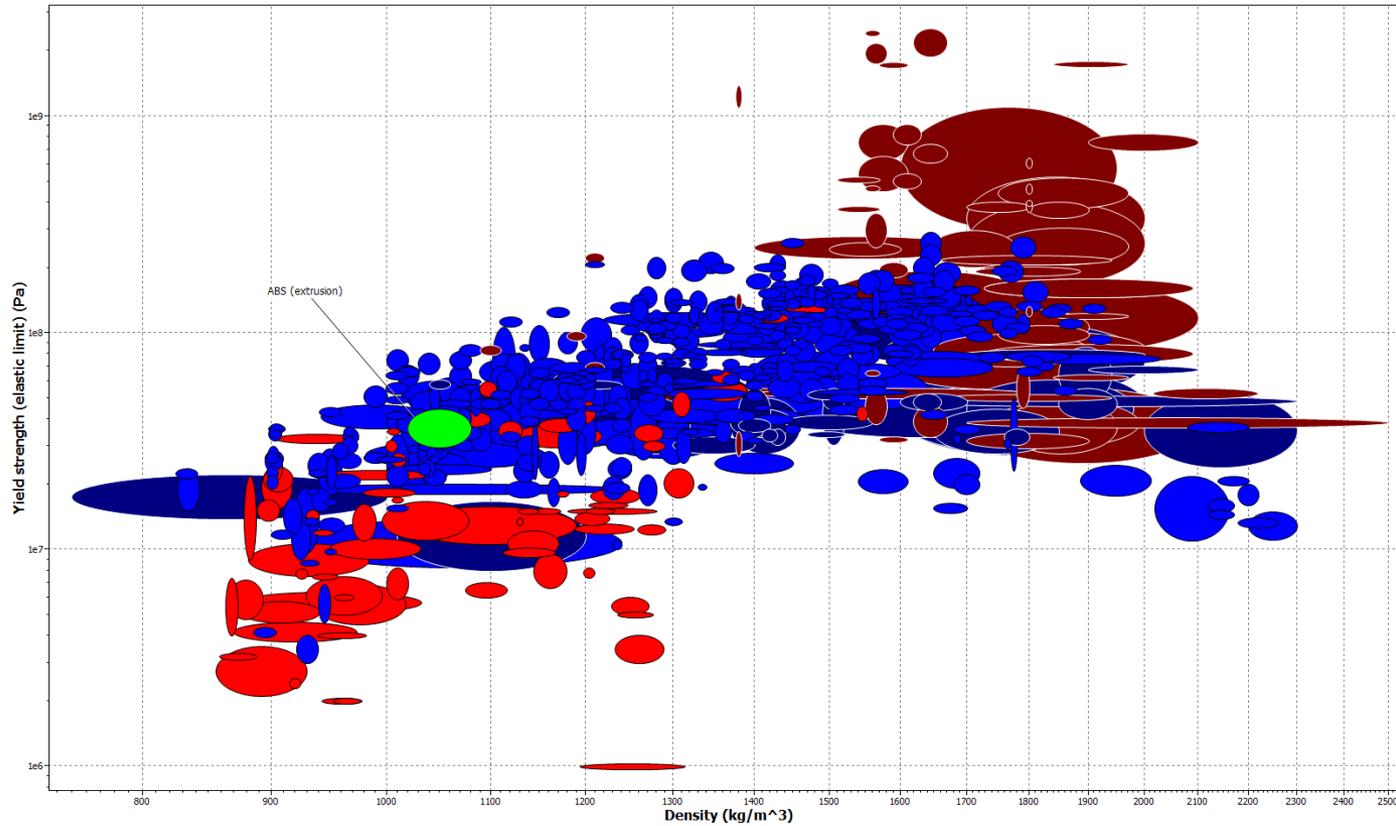
Materials

Materials

Tasks	New findings
1.Water proof	glue sealant
2.Outshell of the device	PETG Polyethylene Terephthlate Glycol-Modified
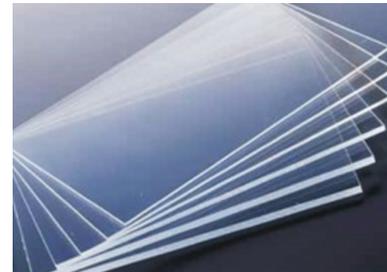
Materials

	ABS(injection)	PETG
Young's modulus	2.4e9 Pa	2.05e9 Pa
Yield strength(elastic limit)	4.4e7 Pa	5e7 Pa
Tensile strength	4.4e7 Pa	6.3e7 Pa
Elongation	0.175 strain	1.1 strain
Flexural modulus	2.55e9 Pa	2.05e9 Pa
Glass T	100-110	81-91

Materials

- Experiment on 3D printing

4 sets of samples of different fill density---time and strength

- NEXT step:test all the samples

Fill density	3 point bending test	tensile test
100%		
75%		
50%		
25%		

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What have we learned and where do we need help

	Mélanie	Noémie	Raffael	Xiadong	Ziyu
What works?	Teamwork	The Team Value proposition	Motivation	All the team members cooperate with each other very well.	Communication
What could work better?	Organization - time	- Estimate size of market - Decide what's the best solution	Regular meetings.	If I could do them faster. Like a kolb cycle.	Time arrangement
What have I learned?	-Interaction with engineer -PCB design (electronic assembly...)	- What kind of information and where to find them - Time management	-This process needs TIME! -Altium, CSS -Interaction with designer	Thinking from the customer's point of view. Some technical stuff.	Knowledge of 3D printing, lab skills

Sponsors and partners