



**Ecole Polytechnique
Fédérale de Lausanne**

EPFL

China Hardware Innovation Camp

1st milestone – March 13 2015

1st milestone

fi mmi

Structure

- Problem statement
- Business Model and Value Proposition Canvas
- Validation/invalidation of interviews
- Exploratory sketches
- Hardware solutions (mechanical)
- Block diagram
- Components and electronic modules
- Software solutions (libraries – API)
- Material solutions

Problem statement: ...

- Problems :
- *It is hard to check the temperature of the milk inside a baby bottle*
 - *Keeping track of your baby's consumption is tedious but can be useful*

Verification method:

Field studies based on interviews of :

- *Professionals (nurses, shopkeepers)*
- *Parents*

Market target



Recurrent Revenue:

How we make money:

- We create our own brand*
- Free vs charge application*



Validation/invalidation of interviews: ...



Field Study:

- - Interviews (in french)
- - Customer segment for interviews:
 - Vendors
 - Baby Shop Managers
 - Nurses – Nursery
 - Mothers, Fathers
 - Grand-mothers/fathers, brothers, sisters

Validation/invalidation of interviews: ...



- *Report from the field:*

Temperature sensor ✓

Time of preparation ✓

Tables & statistics ✓

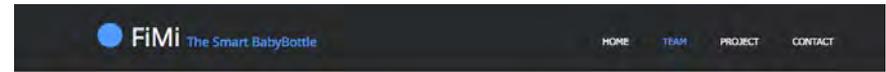
Follow-up of the baby ✓

Application's partnership with the day nursery ✗

30 degrees babybottle ✗

Validation/invalidation of interviews: ...

- - *To get contacts*
- - *To present our device*
- - *To measure the impact of our interviews*



The Team



Florian Maushart
EPFL



Xingyu Xu
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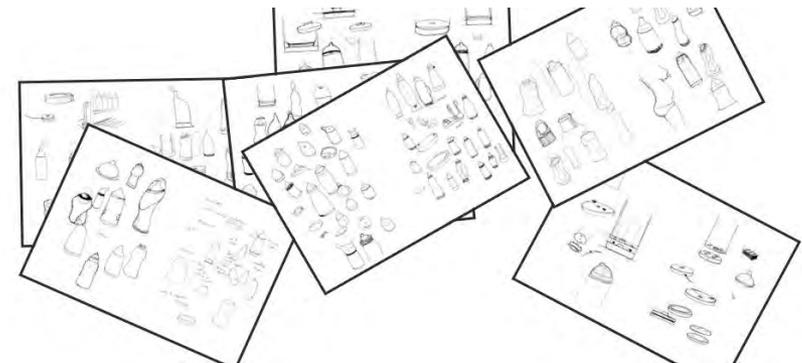
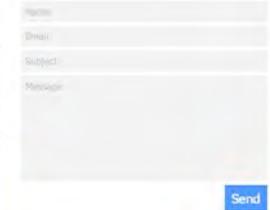
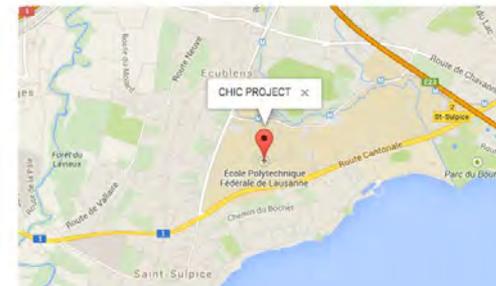
Florian Lemarignier
EPFL



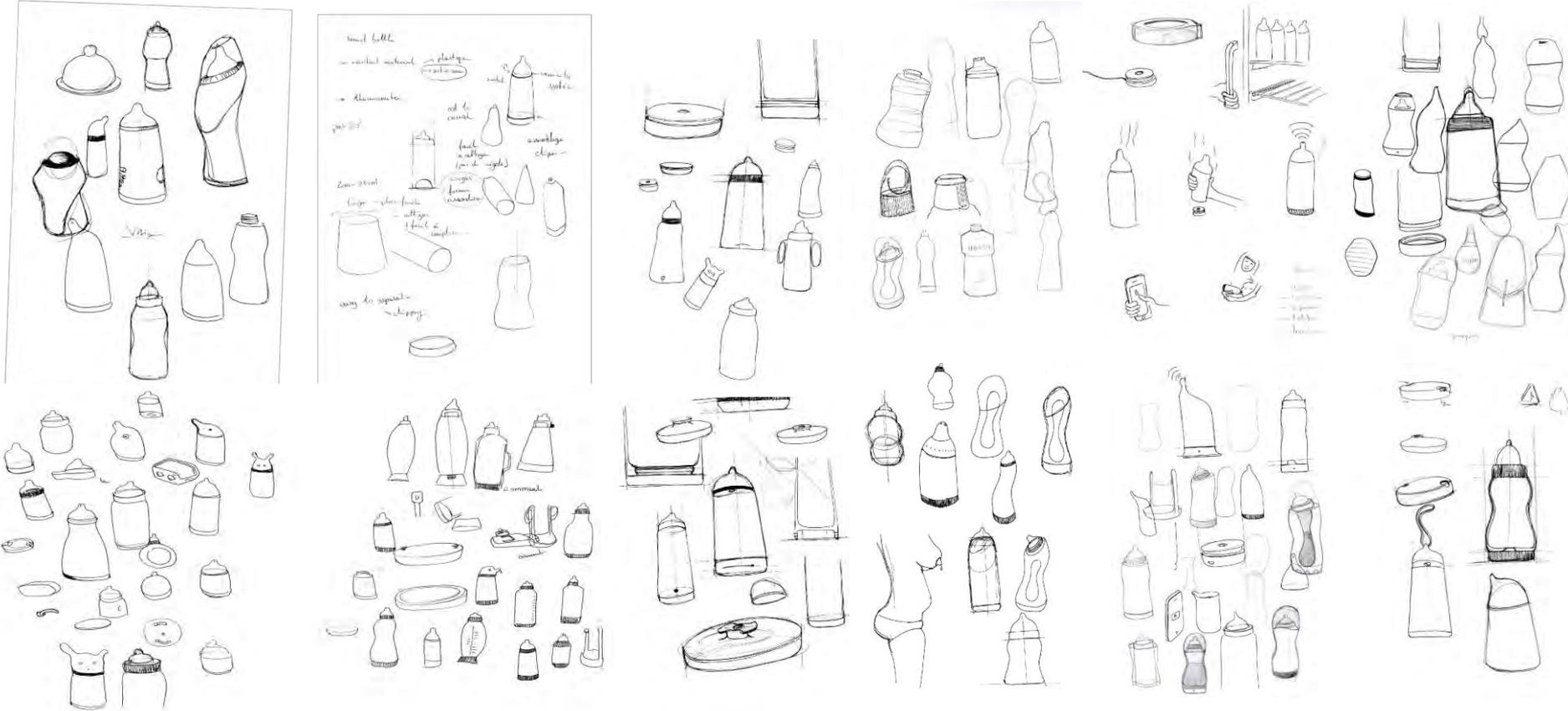
Philippe Gannagé
HEC



Arthur Desmet
ECAL



Exploratory sketches



Models



Exploratory sketches

- How have you made and what motivated your design choice?
 - The device must be discrete but not invisible (the bottle must be honest and not trying to look like a normal baby bottle).
 - The bottle must be handy both for adults and young children and be as stable as possible
 - The baby bottle must be affordable, so the electronic part is independent and does not impact the bottle price.
 - Each part must be easy to assemble and prevent any leaks.
 - The bottle needs to be large enough to be easily cleanable.
 - The bottle must be an entity and strongly recognizable. It should not look like a patchwork of difference pieces.

Inspirations



Barbabapa



Pierre Charpin « ignotus nomen »



Starck « large Flamme »



Breastfeeding



Karim Rashid « iamo » babybottle



Ross Lovegrove

Hardware solutions

Cleaning

- needs to be machine washable (Design, Materials)
- needs to be anti-bacterial (Materials)
- needs to be easy to clean (Design)

Preparation

- should be microwaveable (Materials, Design)
- can be stored in fridge (Materials)
- contains boiling water (Materials)
- should be easy to fill (Design)

Hardware solutions

Handling

- needs to be shock resistant <3m (Design, Materials, Electronics)
- easy to handle (grip)

Smart Functions

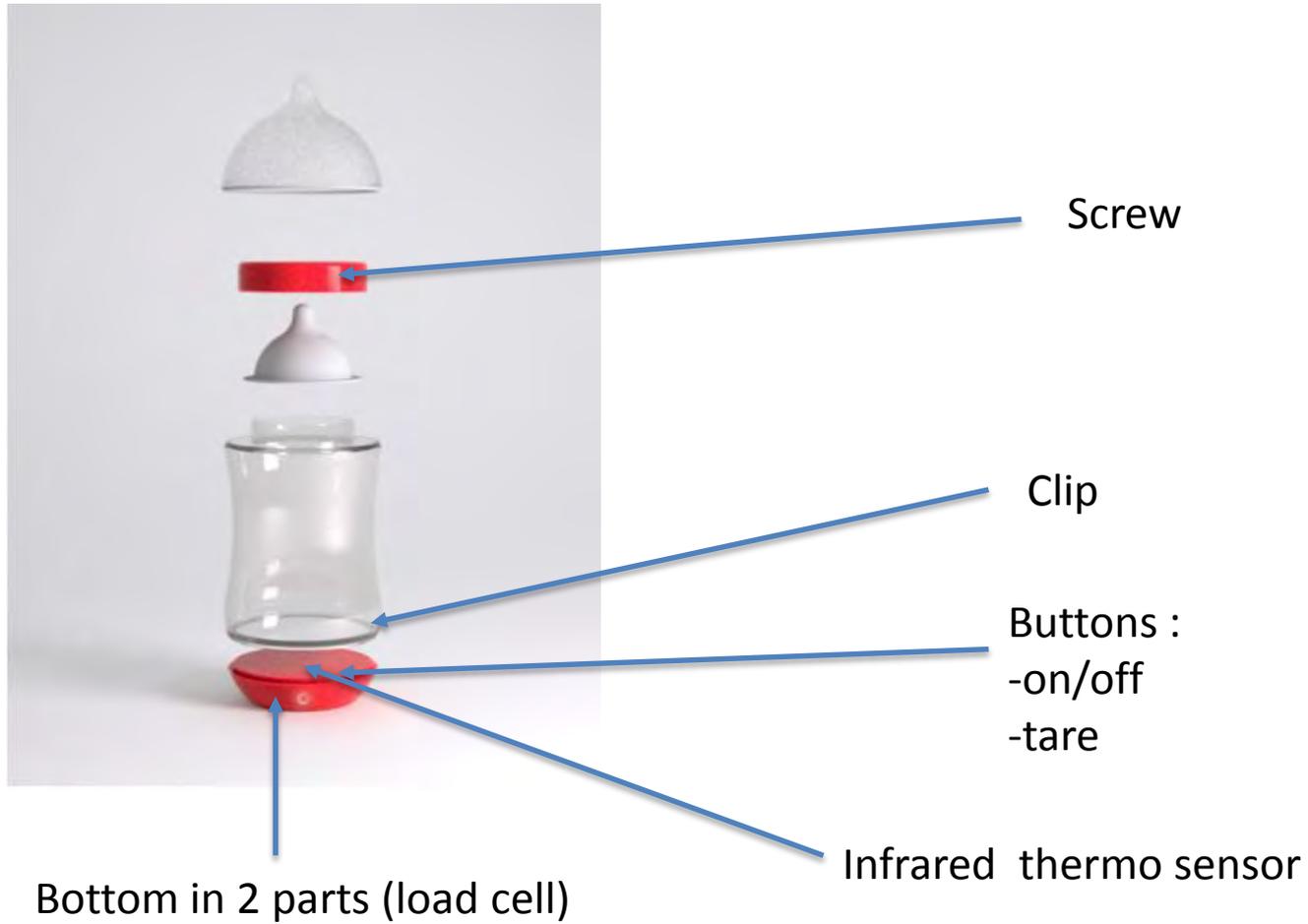
- needs to monitor temperature $\pm 0.5-1^\circ \text{C}$ (Electronics)
- needs to monitor consumption: $\Delta V: <5\text{ml}$, $\Delta t: \pm 10\text{sec}$ (Electronics)
- needs to be energy efficient: autonomy ≥ 1 week (Electronics)
- should provide statistics via BT & Smartphone App (Electronics, Design)

Hardware solutions

General Design

- Volume of 300/350mL (Design, Materials, Electronics)
- Nipple adjusted to baby's needs (Design)
- Secure against spilling/hurting baby (Design, Materials, Electronics)

Hardware solutions



Components and electronic modules

- Selection process:

Required measurements

→ Possible sensor solutions

→ suitable MCU

→ Sensors that go well with the MCU

→ Connectivity, OA, Power Supply, Memory...

Components and electronic modules

- Selection process:

Volume [ml \pm 5], Temperature [$^{\circ}$ C \pm 1], drinking speed

Components and electronic modules

- Selection process:

Volume [ml \pm 5], Temperature [$^{\circ}$ C \pm 1], drinking speed

→ Possible sensor solutions

Volume:

Method	Pro	Con
Capacitive	inexpensive, non-contact	Integration, precision
Ultrasonic	non-contact	Expensive, unreliable
Optical	intuitive	Integration, bias, discrete
Resistive		discrete, expensive, contact
Flowthrough	exact	expensive, contact
Weight cell	Inexpensive, exact, non-contact	size

Components and electronic modules

- Selection process:

Volume [ml \pm 5], Temperature [$^{\circ}$ C \pm 1], drinking speed

→ Possible sensor solutions

Temp.:

Method	Pro	Con
Thermistor	inexpensive	integration, precision
IR	non-contact	expensive, integration
Thermocouple	inexpensive	contact, precision
Pyrometer	exact, non-contact	big, expensive

Components and electronic modules

- Selection process:

Volume [ml \pm 5], Temperature [$^{\circ}$ C \pm 1], drinking speed

→ Possible sensor solutions

Speed: Accelerometer

Components and electronic modules

- Selection process:

Volume [ml \pm 5], Temperature [$^{\circ}$ C \pm 1], drinking speed

→ Weight cell, Thermistor, IR sensor, Accelerometer

→ Arduino Uno

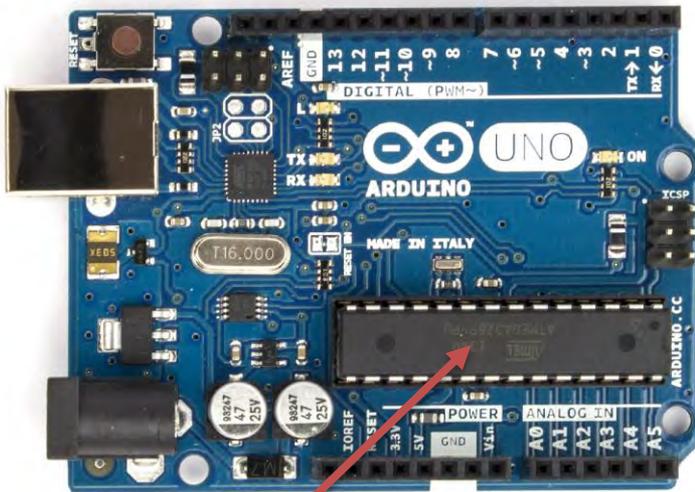
→ easy to use, open source, API/IDE

→ reusability, also on breadboard

→ switch to cheaper solution after tests possible

Components and electronic modules

- Arduino Uno:



ATmega328

Serial:

0 (RX) and 1 (TX) with USB-Serial connection

SPI:

10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK)

6 analog inputs

A0 through A5, 10 bits of resolution each

TWI/I2C:

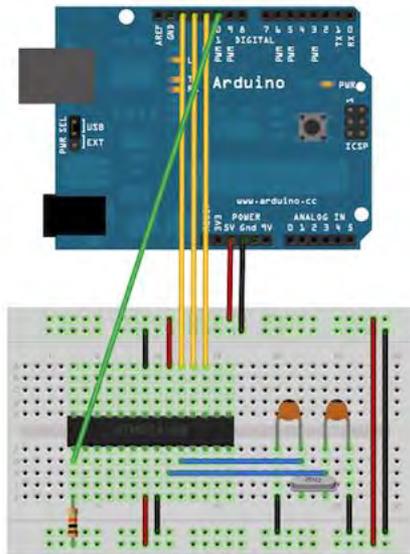
A4 or SDA pin and A5 or SCL pin.

AREF:

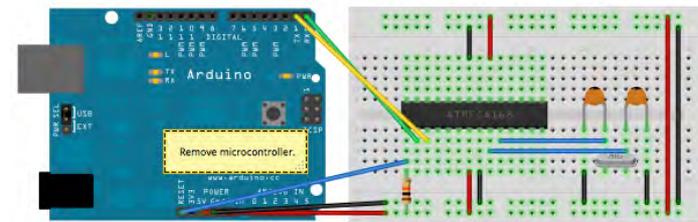
Reference voltage for the analog inputs.

PWM, ...

How to recycle the Arduino



Using the Arduino as an ISP



Using the Arduino USB-Serial to upload

taken from: <http://arduino.cc/en/Tutorial/ArduinoToBreadboard>

Components and electronic modules

- Selection process:

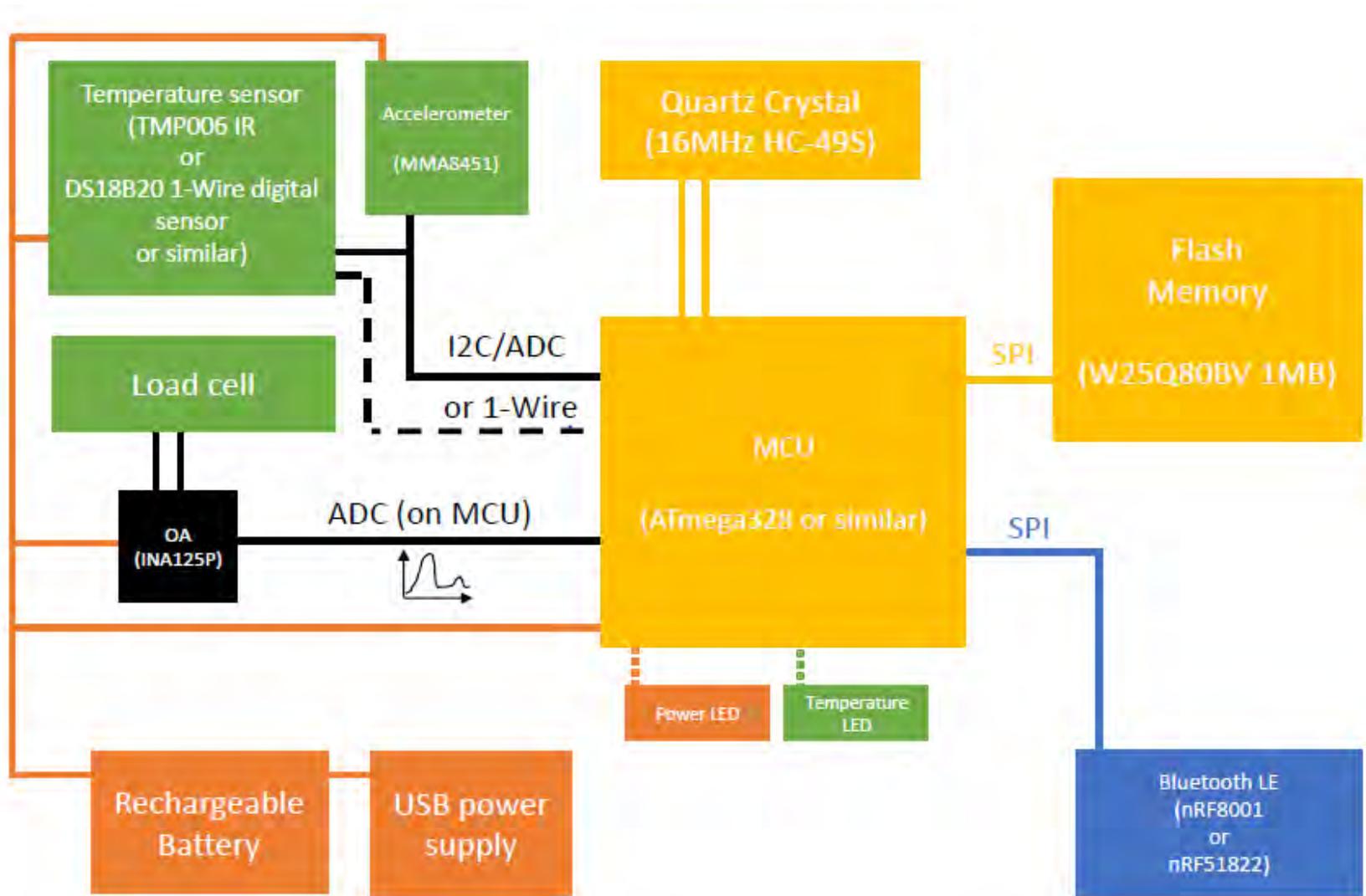
Volume [ml \pm 5], Temperature [$^{\circ}$ C \pm 1], drinking speed

→ Weight cell, Thermistor, IR sensor, Accelerometer

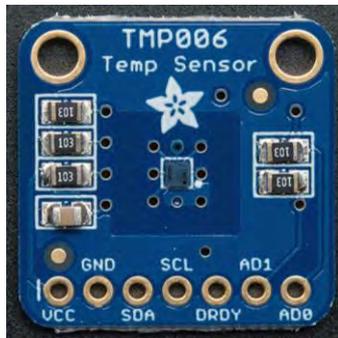
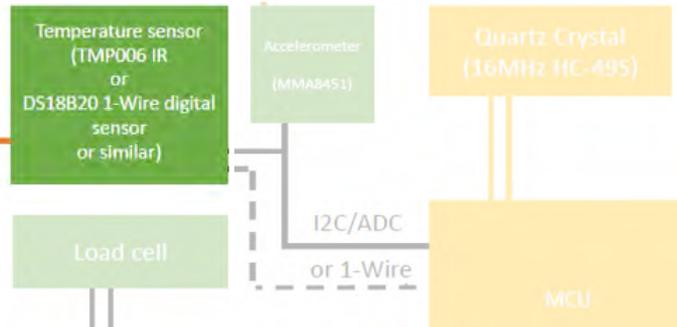
→ Arduino Uno

→ Sensors that go well with the MCU

Block diagram



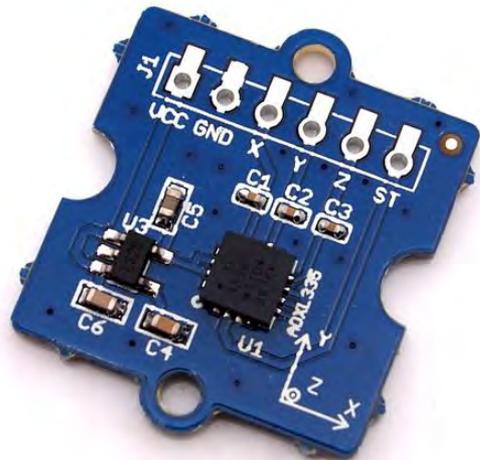
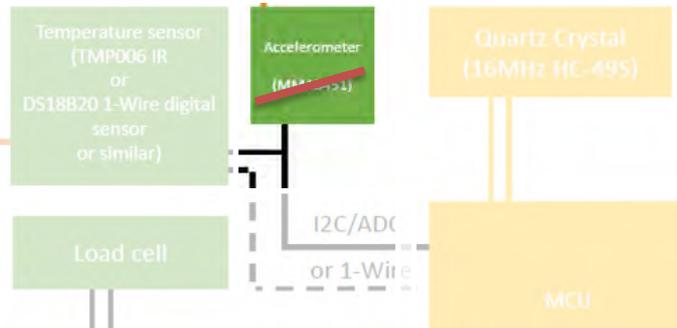
Choice of components



- Adafruit userguide
- Dallas temperature library
- Tutorials (I2C and 1-Wire)

- Range: $-55^{\circ}\text{C}/-40^{\circ}$ to $+125^{\circ}\text{C}$
- Accuracy: $\pm 0.5^{\circ}\text{C}$ (-10°C to $+85^{\circ}\text{C}$)

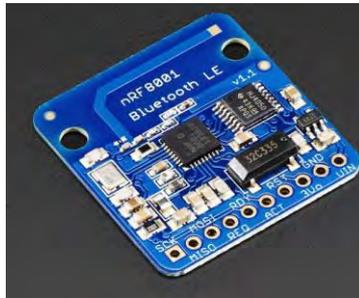
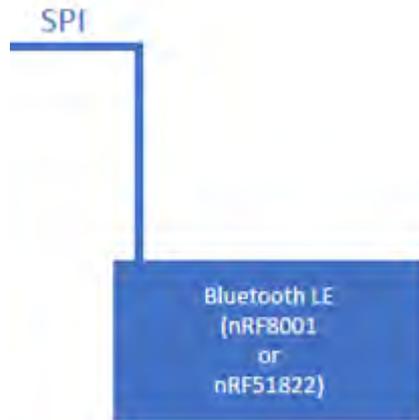
Choice of components



- Seedstudio [ADXL335](#) breakout
- tilt & dynamic measurements
- good resolution and range

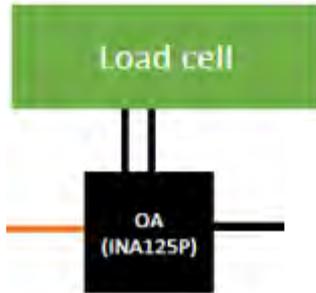
- Instructables Tutorials
- Not too expensive

Choice of components



- nRF51822 vs. nRF8001
- Higher throughput vs. lower complexity
- Tutorials exist for both
- Both BTLE
- Seedstudio vs. Adafruit
- Breakout boards

Choice of components



- Instrumentation amplifier
- Seems to be used a lot for weight cells
- Tutorials available
- For load cell: take apart scale?



Choice of components

Flash memory: W25Q80BV 1MB Flash memory (Tutorials, SPI Flash libraries)

Quartz Crystal: Same as on Arduino Uno Board

Power supply: Not too important while working with the board, still to chose

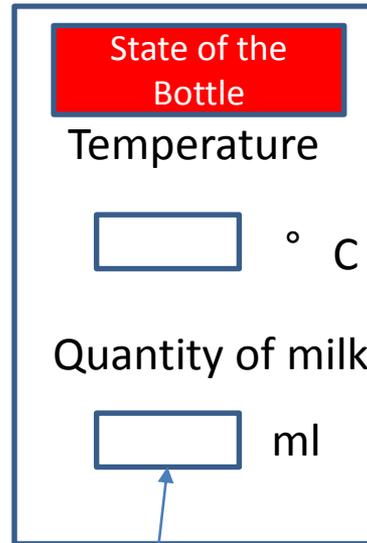
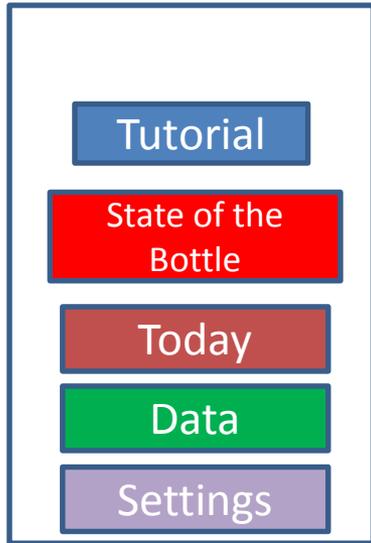
LEDs: Just any LEDs really...

Software solutions

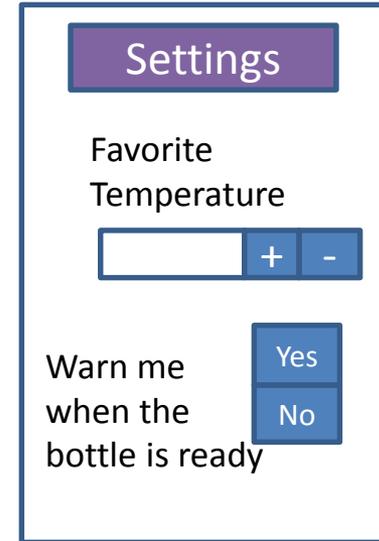
- Programming the microcontroller
 - Arduino Software (IDE) and API
 - For verification purposes maybe Atmel Studio
- Programming and App
 - Android Studio and SDK
 - Android Bluetooth API



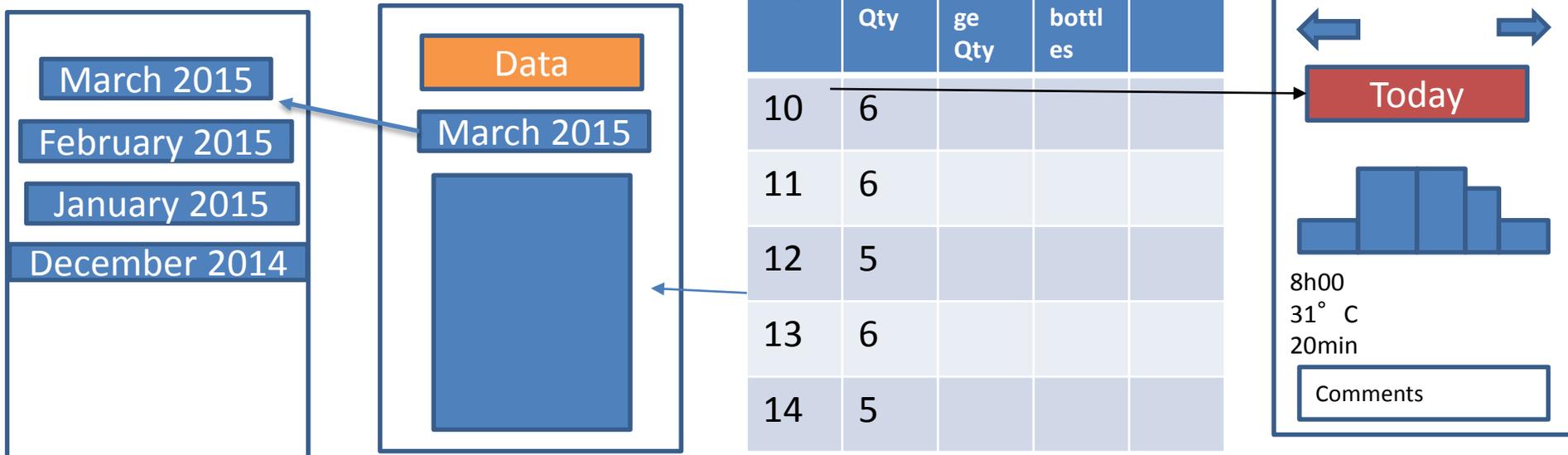
Software solutions



Can display
«Bottle up»



Software solutions



Software solutions

Preparation of the bottle

Feeding the baby

I am going to use :

A pan

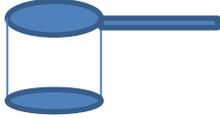
A « chauffe biberon »

1- Enter the size of the bottle you need to prepare

ml

Last quantity : ... ml

2- Heat at leastml of water



3-Put Fimi on the bottle- and put it on a flat surface



4-When the bottle is ready and empty. Click on the button (on the bottle)



Software solutions

← →

5-Pour the hot water inside the bottle

To be poured

ml

Ready

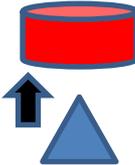
← →

6- Take the spoon inside the powder bottle. And pour spoons.



← →

7- Put the nipple inside the upper ring. Close the bottle.



←

8-Shake the bottle.

Let the bottle cool down

Ready

↕

Excess of

ml

Take out some water and put the bottle back

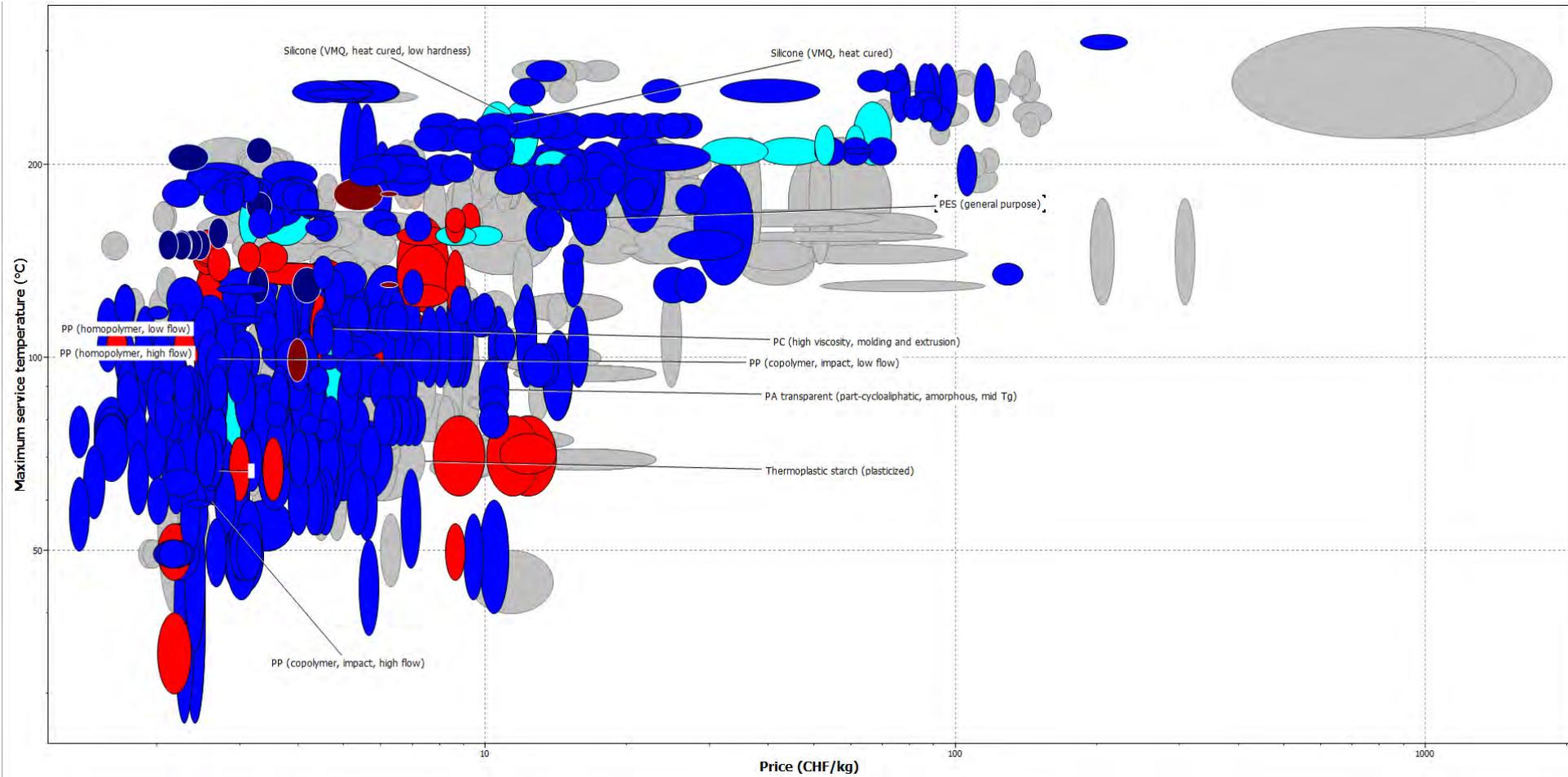
Material solutions

Materials Regulation

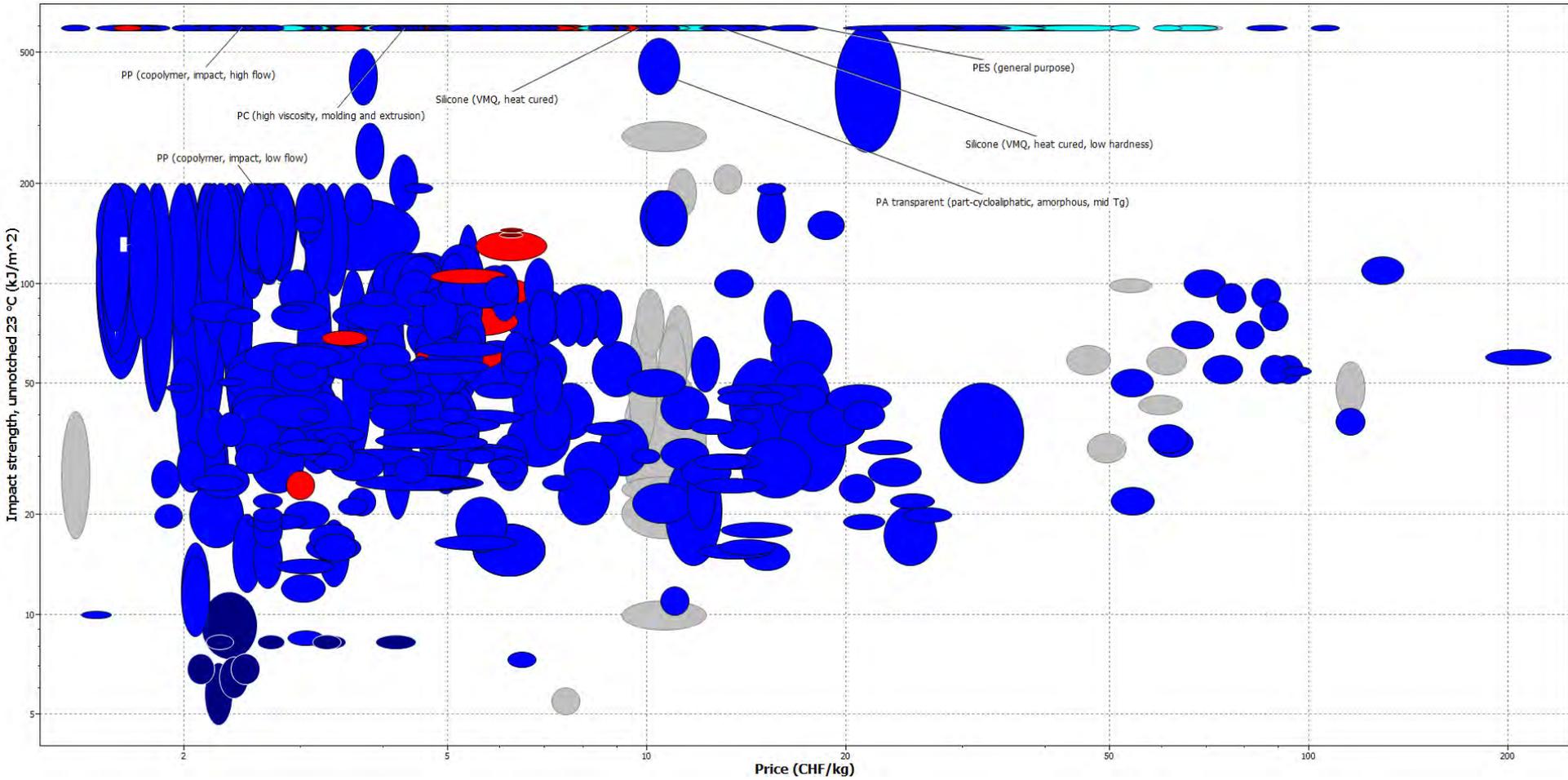
Materials	Substance name	Substances No.	Use as monomer
Polycarbonate	Bisphenol A,Diphenyl carbonate	00151;00201	No
Polypropylene	Propylene	00275	Yes
Silicone	Dimethyl silicone	00964	Yes
Polyamide	Aliphatic	00003	Yes
Polyethersulfone	4,4'-Dichlorodiphenyl sulfone		Yes

https://webgate.ec.europa.eu/sanco_foods/main/index.cfm

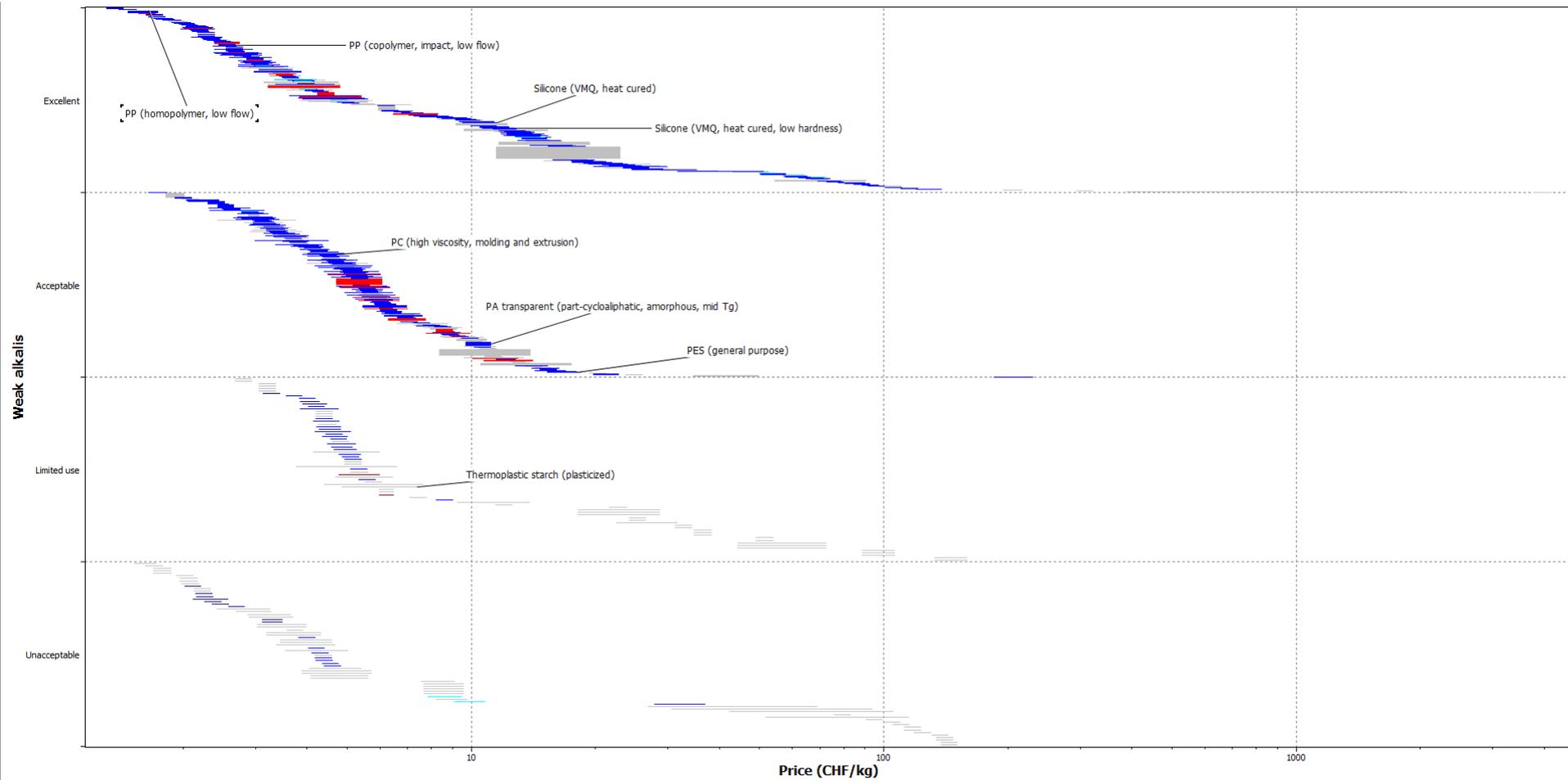
Material solutions



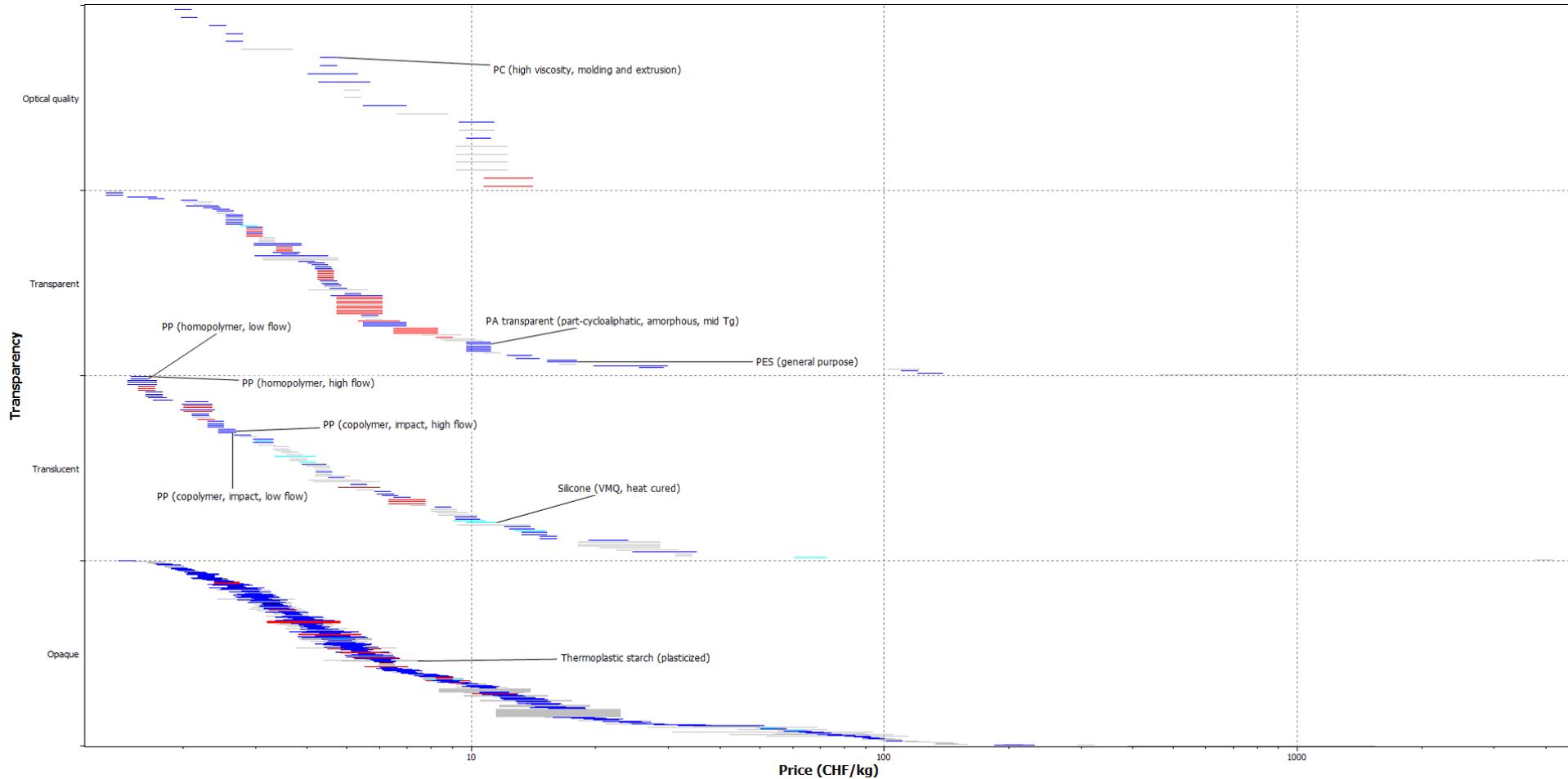
Material solutions



Material solutions

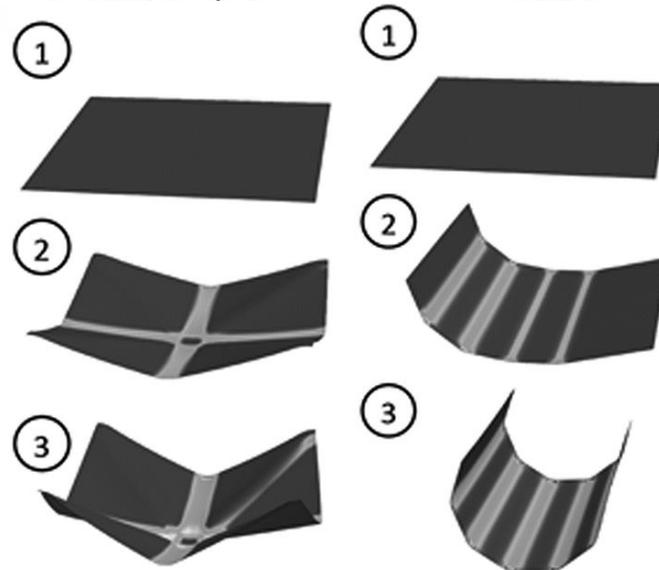
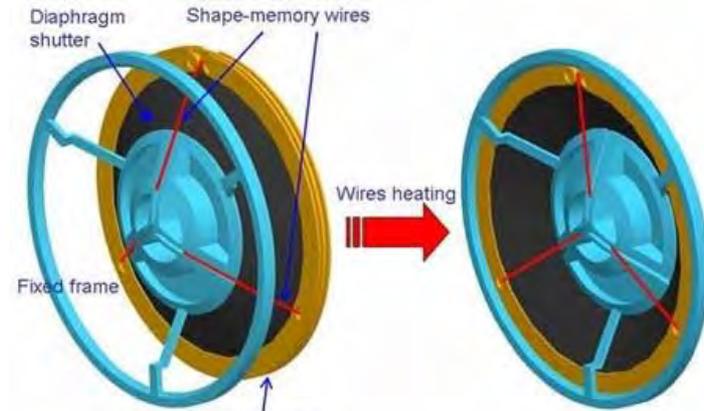
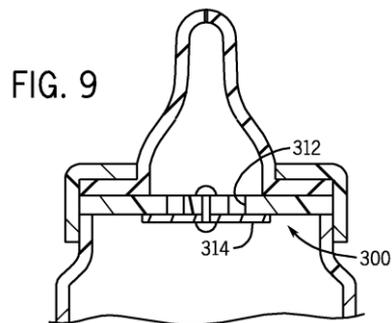
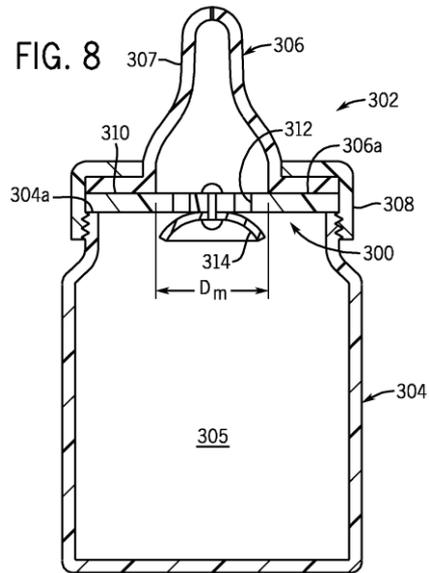


Material solutions



Material solutions

Shape Memory Alloy valve



The process so far...

- How do you work together?

At least one general meeting on Tuesdays evenings

One engineer meeting on Fridays

- Which tool do you use to collaborate?



The process so far...

- How do you communicate?



- How could this be improved?

Weekly report with what everybody has done so far and the questions that need to be answered

What have I learned and where I need help

What have I learn so far?

- Florian L :
 - *how to ask questions to a non-engineer speaker*
 - *how to pitch an idea*
 - *how to integrate market information to a design*
- Philippe :
 - *how to communicate with a multi-cultural group*
 - *on a business side, how the field study is crucial*
 - *how collaboration between engineer, design & business is important. No one can work alone in this project*

What have I learned and where I need help

What have I learn so far?

- Florian M :
 - *how to make use of Maker movement*
 - *baby bottles: their design and how to prepare them*
 - *working with non-engineering project partners*
- Xingyu :
 - *how to find the product service*
 - *how to think independently and work cooperatively*
 - *how to search materials in business version*

What have I learned and where I need help

For what each of I feel I need help at the moment?

- Florian L :
 - *how to mechanically implement a load cell*
 - *maybe for the design of a clip connection (bottom of the bottle)*
- Philippe :
 - *Probably to program the mobile application*

What have I learned and where I need help

For what each of I feel I need help at the moment?

- Florian M :
 - *Bluetooth connectivity*
 - *Memory management*
- Xingyu :
 - *Whether we should use the alloy valve as long as it can't be put inside the microwave oven*
 - *need a laboratory to manufacture the bulk materials and test properties*

Sponsors and partners

