ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Ecole Polytechnique Fédérale de Lausanne

EPFL

China Hardware Innovation Camp

2nd milestone – May 1 2015


fimi

The Team

FiMi
The Smart BabyBottle

English
Français
Deutsch
中国

HOME TEAM PROJECT CONTACT

The Team

Florian Maushart
EPFL

Xingyu Xu
EPFL

Florian Lemarignier
EPFL

Philippe Gannagé
HEC

Arthur Desmet
ECAL

Structure

- Business
- Industrial design/mechanical design
- Material
- Software/firmware
- Electronics
- Take-away

What is Fimi ?

Feed me = Fimi

- Fimi is coming from the CHIC project
- Fimi is a smart baby bottle
- Fimi is a small connected device
- Fimi solves the needs of the consumers and the problems they have

Business

Problem

Solution

Market

Business

Topic: Baby bottle & safety - Field Study

Problem

Preparing a baby bottle is long and painful

It is hard to know if the temperature is alright

It is hard to know how much the baby is drinking

Parents don't have a track of the baby's consumption

Solution

Market

Business

Problem

Solution

A smart baby bottle that:

- Is made out of break-resistant material & bio compatible
- Monitor Temperature and display it
- Measure volume & time of drinking
- Is resistant to heating and cooling
- Good design (doesn't roll, funny for kids, easy to hold)

A mobile application that:

- Shows all sensor information of the bottle
- Gives table/profile/overview statistics
- Gives access to comparison database -> warning for bad values
- Makes a sound when the temperature is right
- Set the goal temperature for milk
- Chat service
- Practical advices & tricks

Market

Found via field study, questionnaires, etc…
(more details on the blog)

Business

Problem

Solution

Market

Public target: « Who ? »

- **Must:** Parents
- **Should:** Brothers, Sisters, Day nursery
- **May:** Grand parents, nurses

Target market « Where ? »

Channel « How ? »

- Own brand, recurrent revenues
- Partners
- Website

Price « How much? »

Cost production: 35.-

Cost production: 10.-

Price: 99.- (17,5% net margin) ✓

> Ok for the people

Found via field study, questionnaires, swot analysis, price analysis, a lot of work
(more details on the blog)

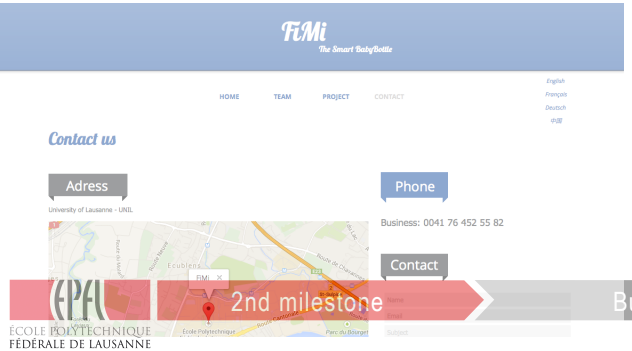
Business

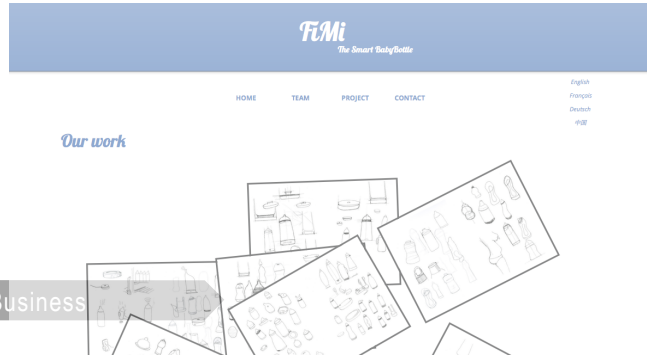
Website

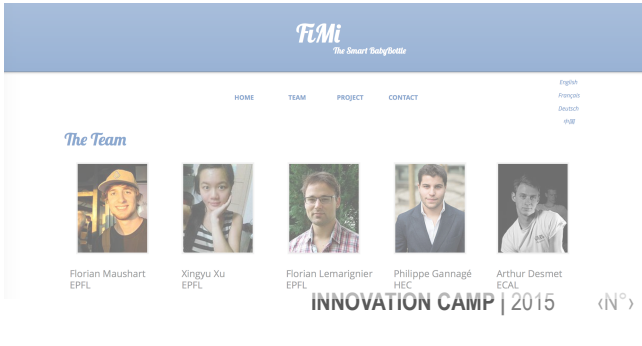
Problem

Solution

Market







Industrial/mechanical design

Two main parts :

Bottle

Device

Industrial/mechanical design

The bottle

Main requirements :

Easy to wash and to fill → Wide opening/ avoid sharp angles

Watertight → screw based on the Philips model

Nipple → ring adapted to Philips nipples

Thermal → insulating enough to keep the milk hot during the feeding but not too much to be able to cool the milk down.

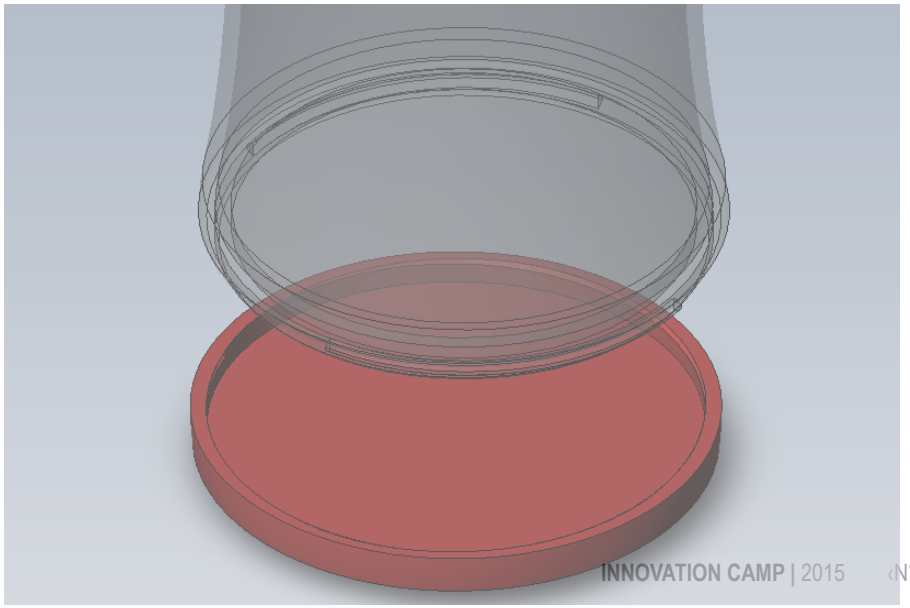
Industrial/mechanical design

Junction with the device

Clips: can be hard to remove, usually not beautiful

Bayonet style (like on some light bubbles) → small features that go out on the sides of the bottle : potentially dangerous for the baby and inconvenient

Screw with ¼ turn → easy to use



Industrial/mechanical design

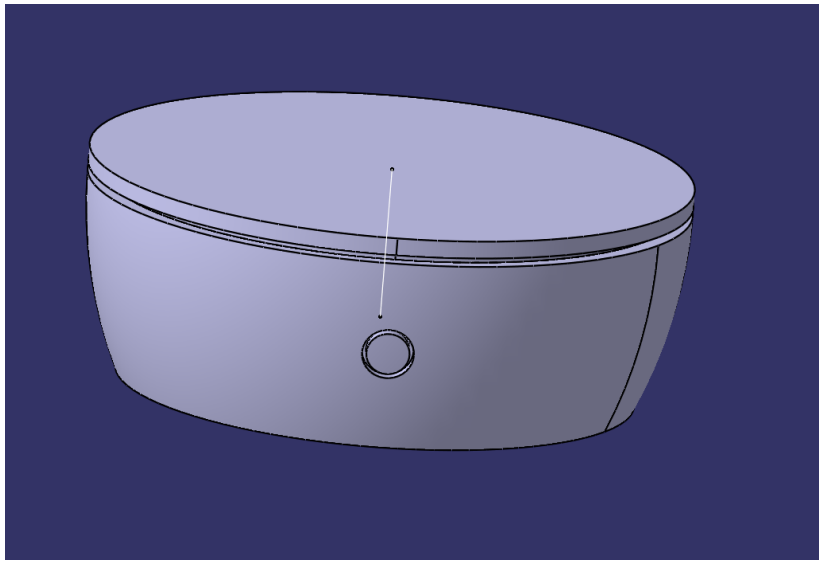
The device

What we need to implement

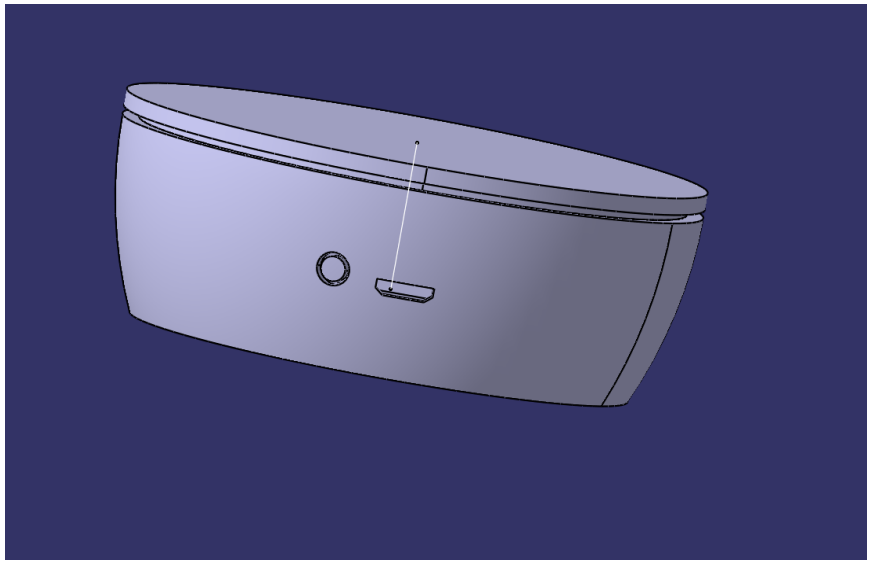
- PCB (circle of diameter 62mm)
- Load cell (9x6x45mm)
- IR thermo sensor
- Bluetooth button
- Battery(20x7x30mm)
- Micro USB plug
- On/off button

Industrial/mechanical design

How we tried to implement them?



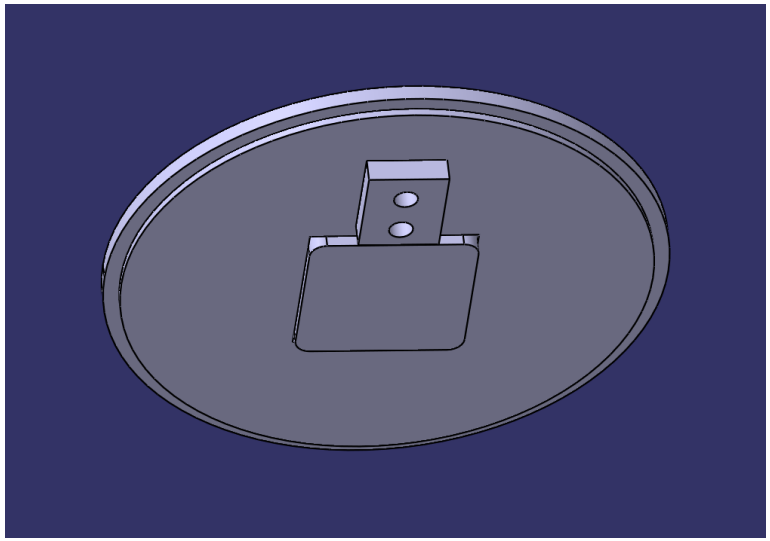
Front view



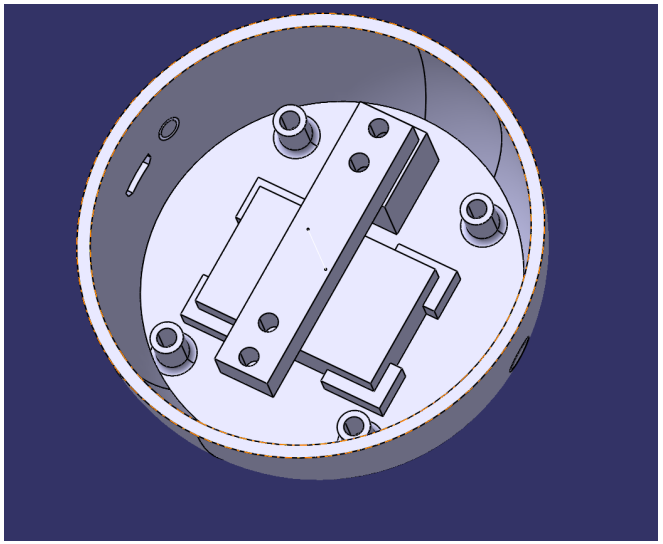
Rear view

Industrial/mechanical design

How we tried to implement them?



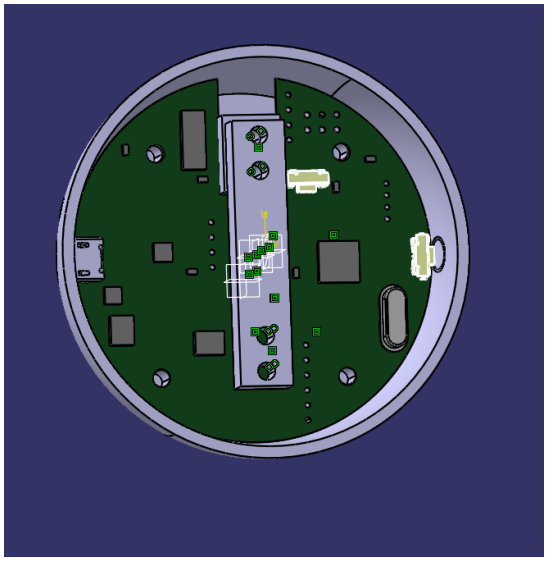
Top part + Thermo sensor



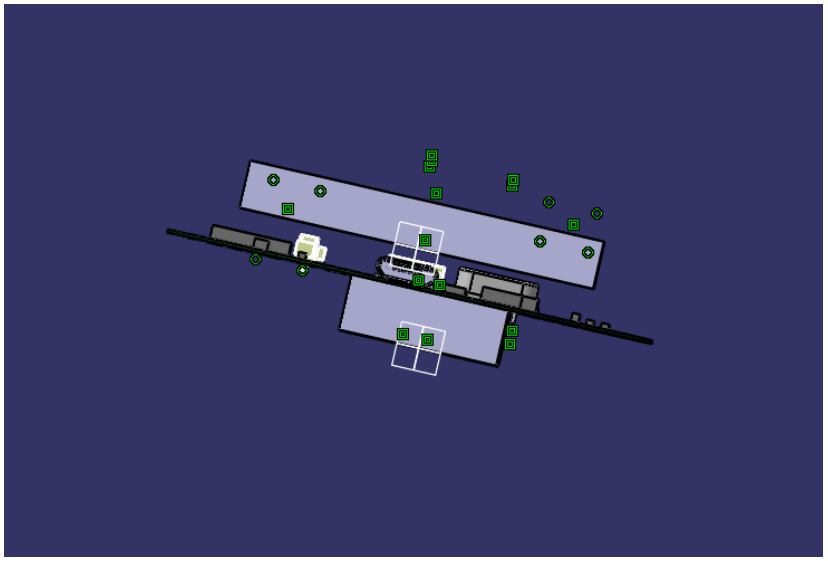
Bottom part +load cell +battery

Industrial/mechanical design

How we tried to implement them?



Bottom part with PCB



PCB +Load cell +battery

Industrial/mechanical design

Estimated weight ≈ 125 g

What can be improved?

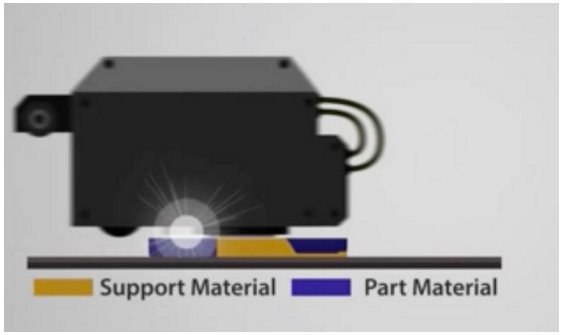
- battery and PCB close to each other → might heat up
- heat can influence the load cell
- device is not watertight

Materials

Prototype: 3D printing

Material -> Verowhite(ABS like)

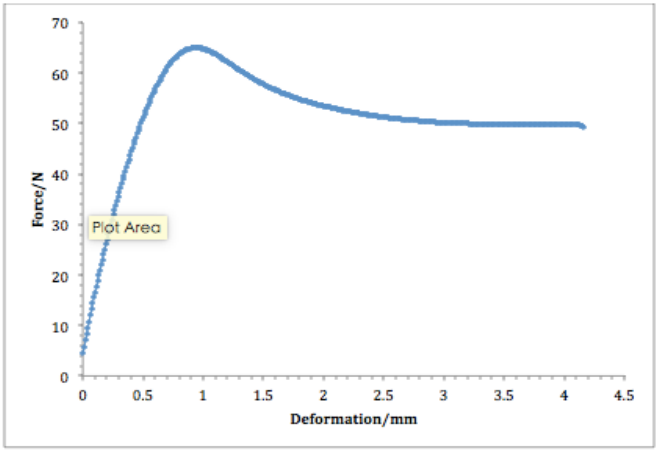
Manufacturing -> MJM technology

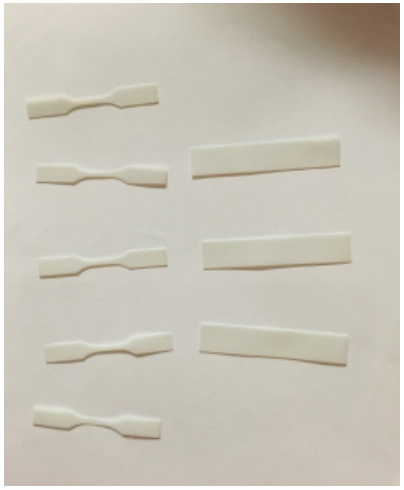


Materials

Prototype: mechanical property

Tensile strength





Material	Young's Modulus(MPa)	Yield strength(MPa)	Tensile strength(MPa)
Verowhite	446	13.6	35.3

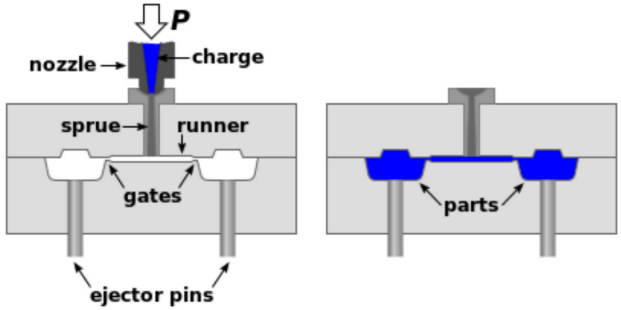
Materials

Mass production*: *Injection molding

Material -> Polypropylene

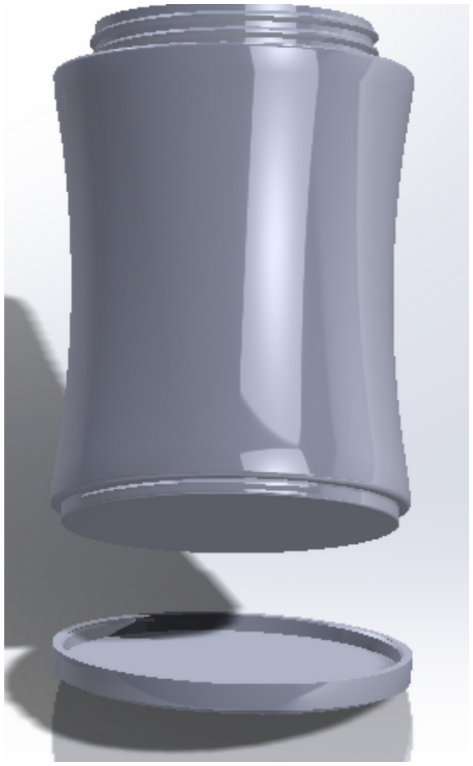
Material	Price CHF/Kg	Impact strength (KJ/m^2)	Maximum service temperature	Transparency	Weak alkalis
PP	1.5-1.65	71.6-200	104-124/° C	Translucent	Excellent

Manufacturing -> Injection molding



Materials

Infrared properties on Verowhite & Polypropylene



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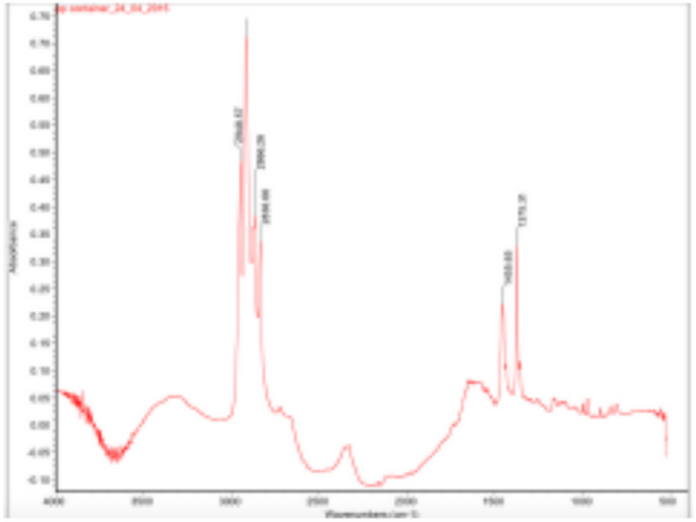
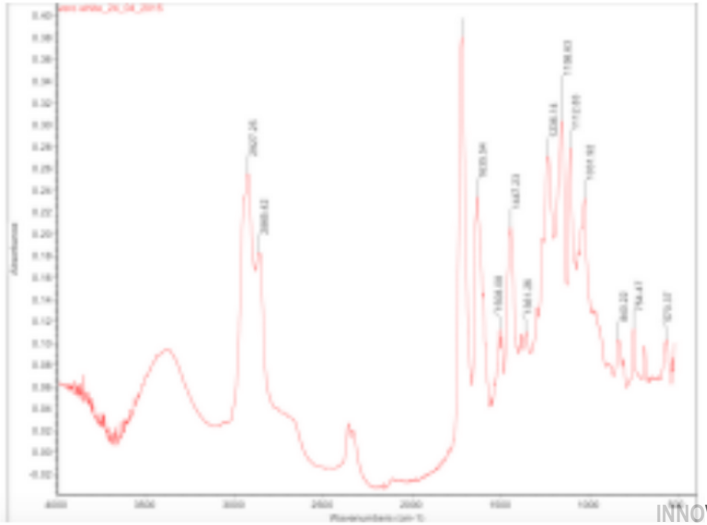
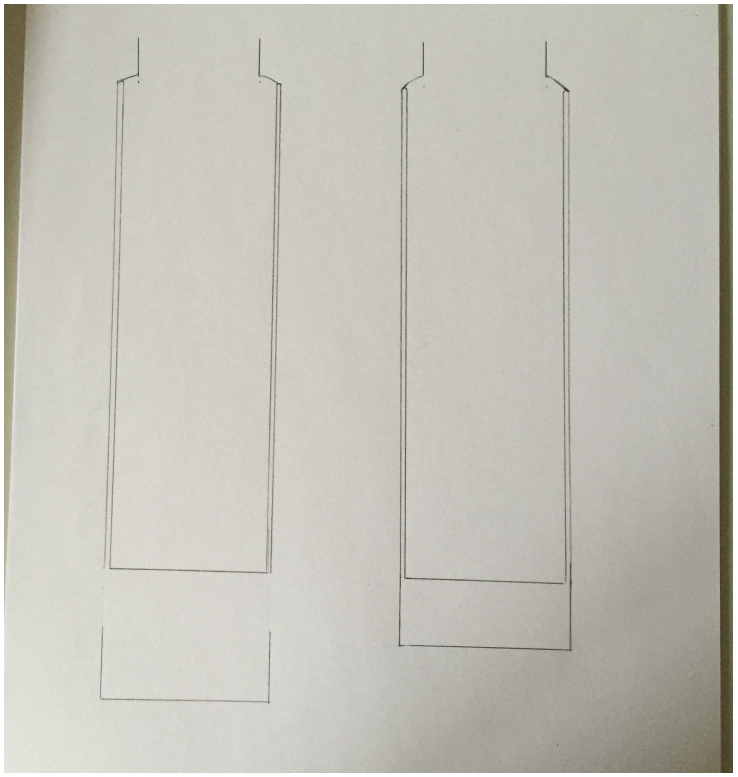


Verowhite



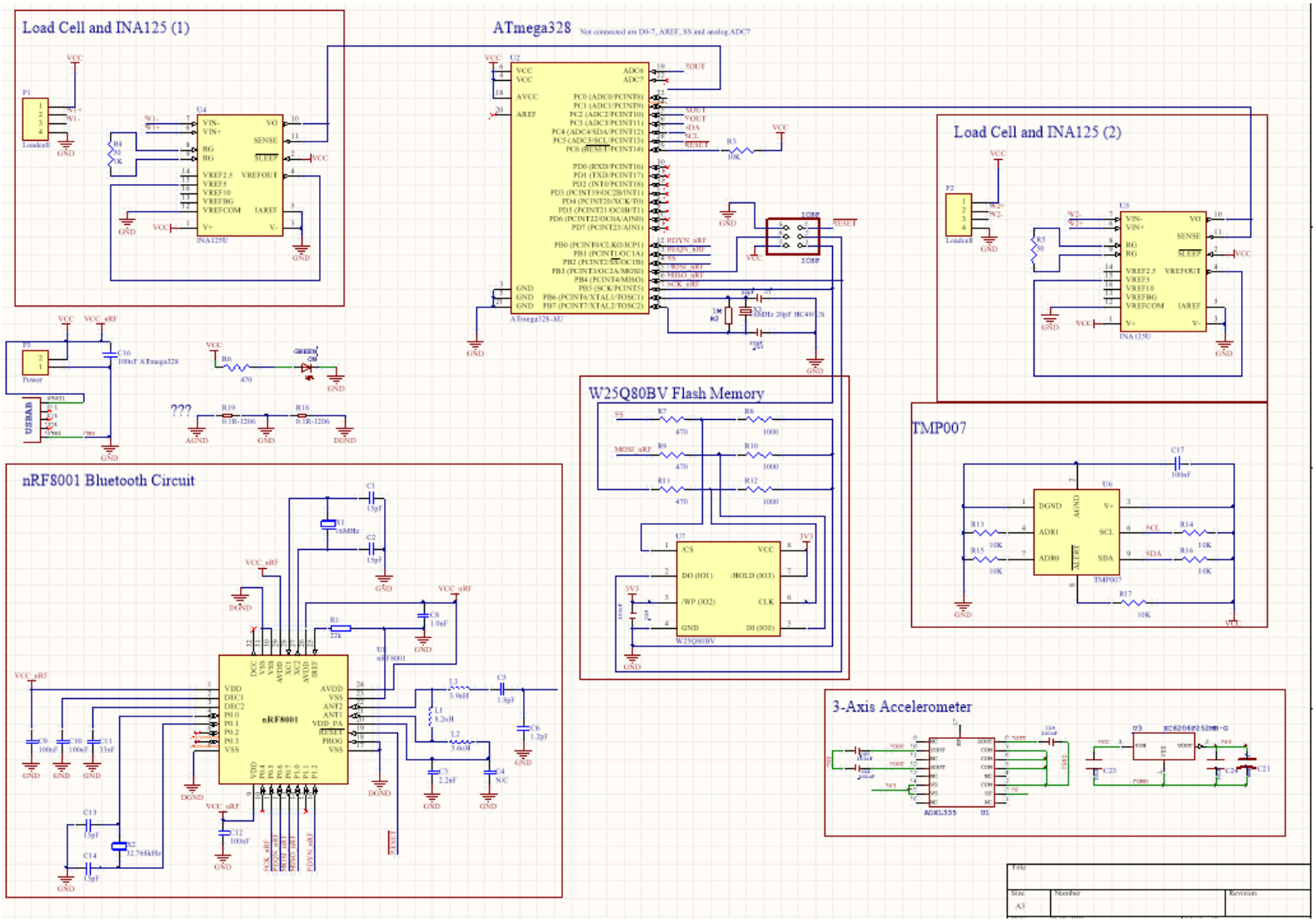
Materials

Proposition: Double wall structure for insulating structure

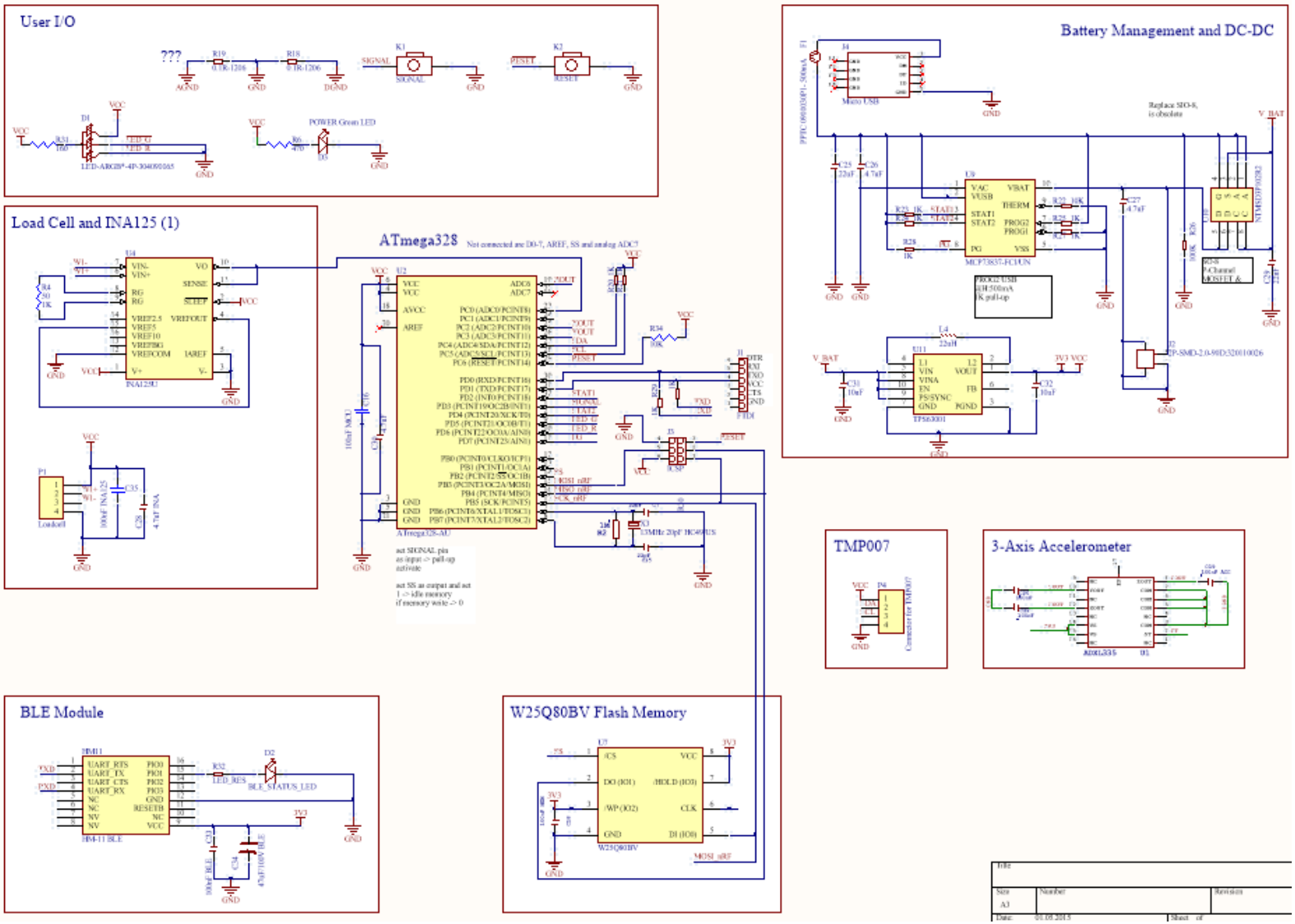


- Insulating baby bottle without influencing its heating and cooling
- Not necessarily expensive and difficultly manufactured
- The thickness can be 2mm in prototype
- Can be revealed by injection molding

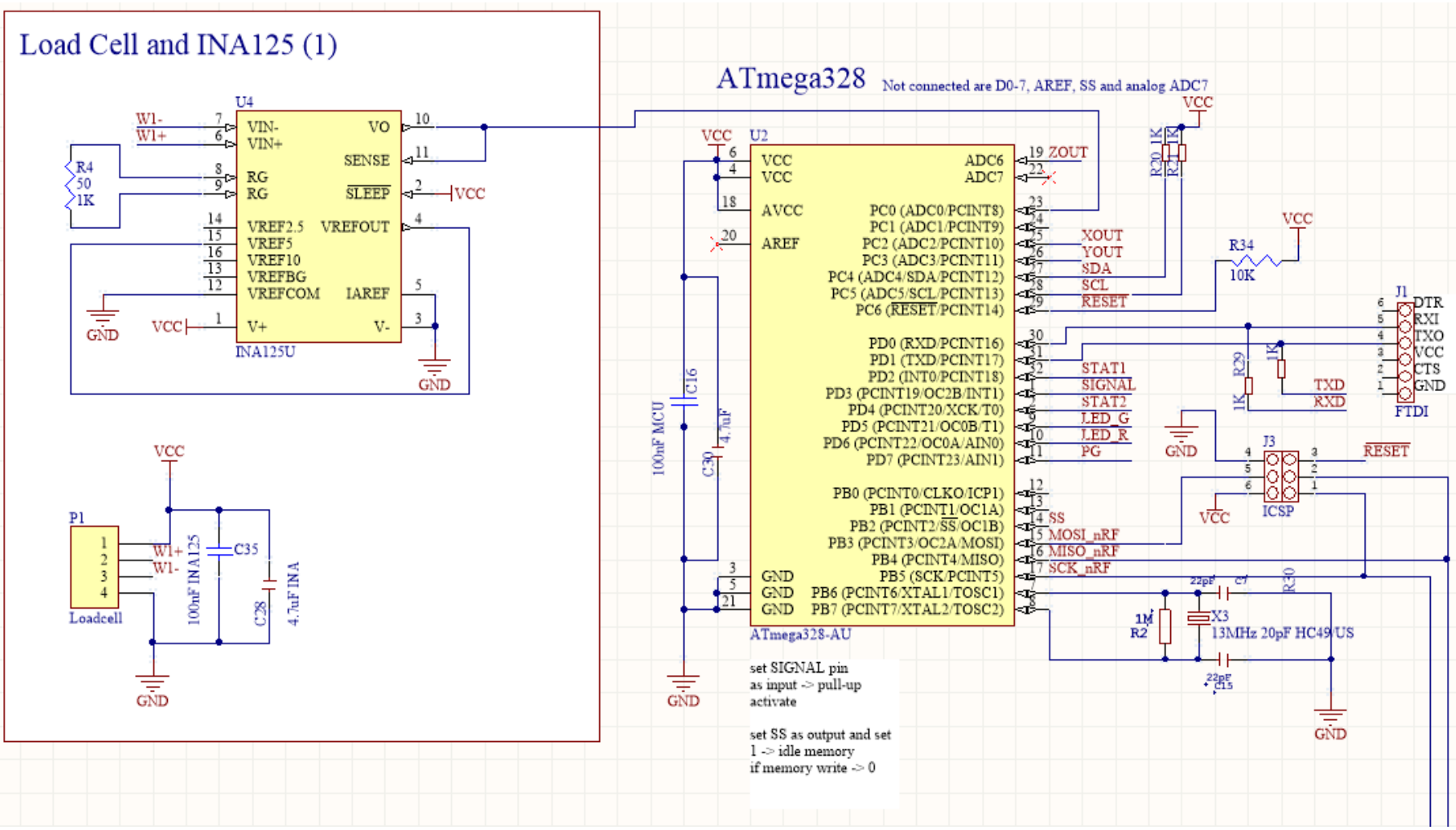
First Shematics



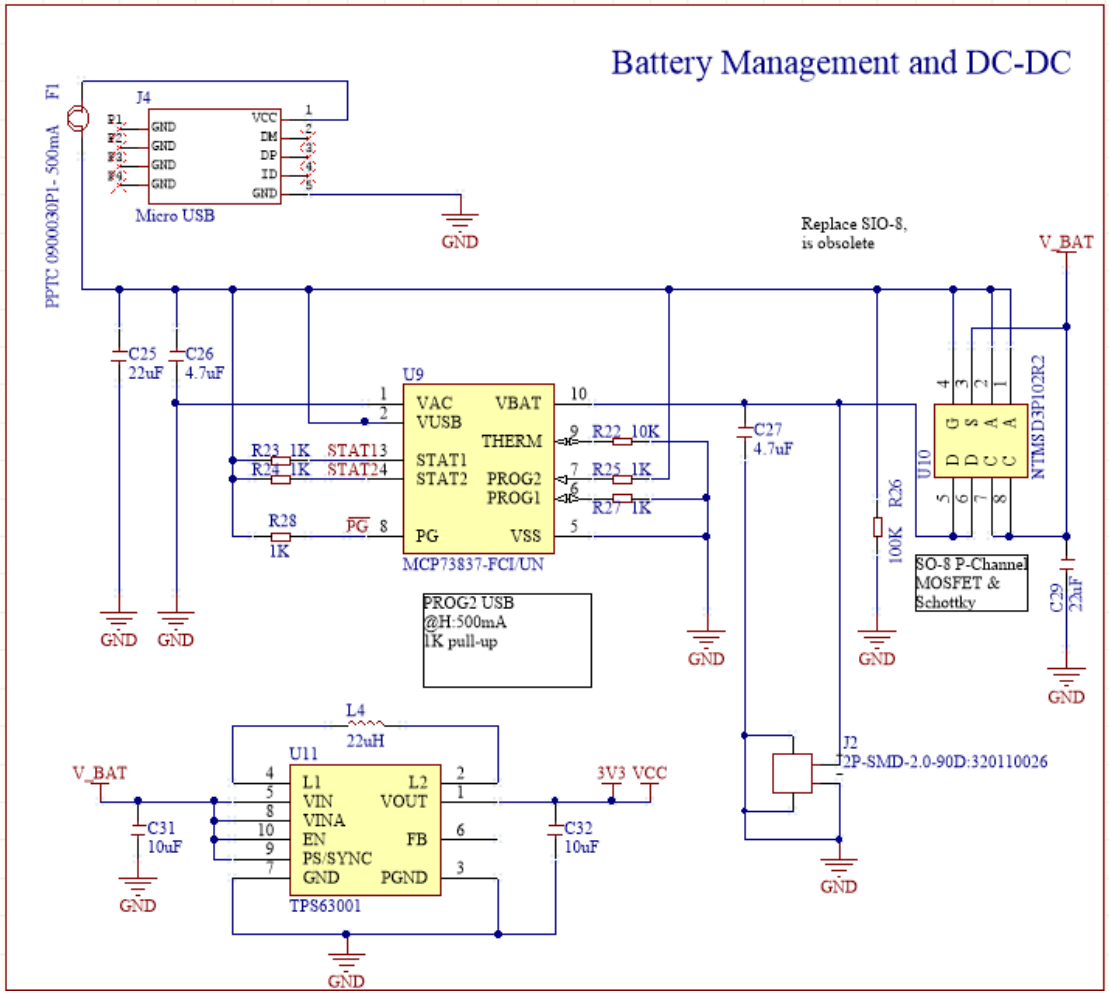
New schematics: spot the difference!



MCU and weight cell



Software/firmware

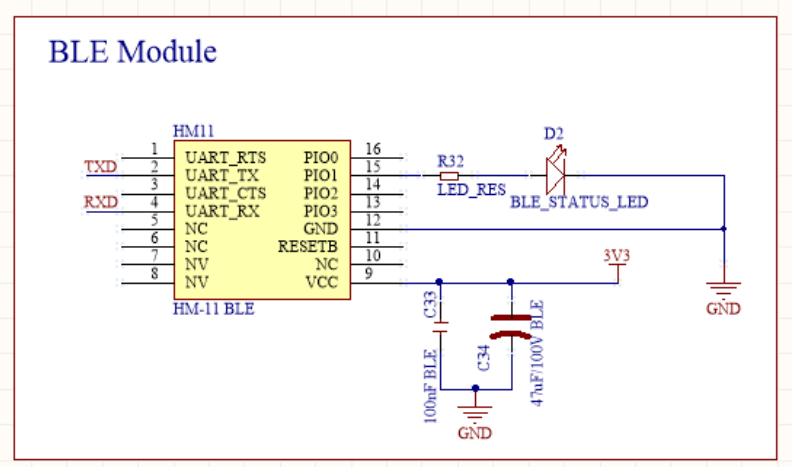


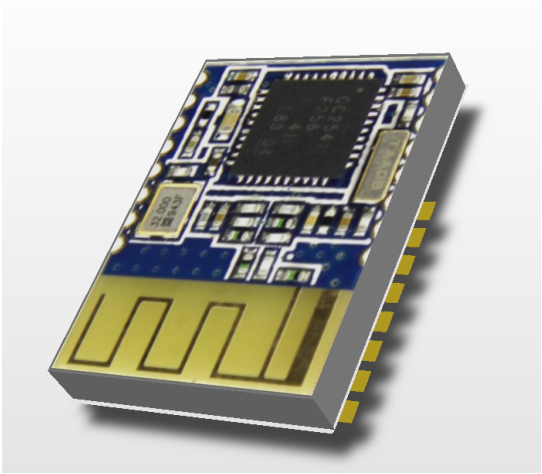
MCP73837 fully integrated Li-Ion charger for mobile applications

TPS63001 Converter with fixed 3.3V output voltage

Micro-USB Connector

Bluetooth Low Energy (4.0)





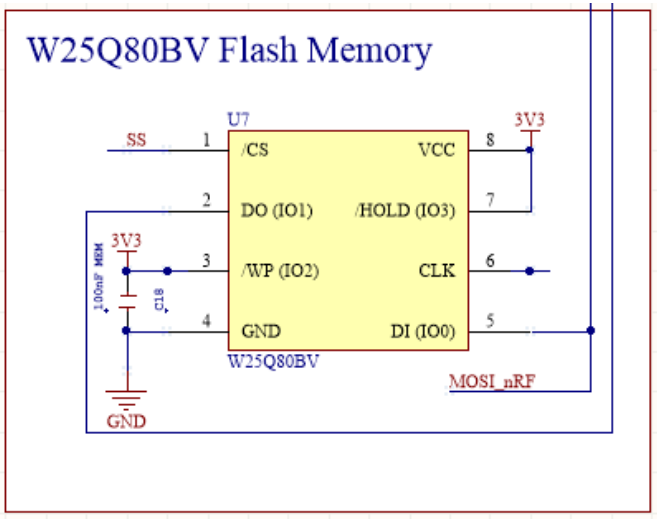
Big Change: HM11-BLE Module from seeedstudio instead of nRF8001

HM11-BLE is used on a « Grove » board that's adapted to Arduino

only 13.5 x 18.5 x 2.9mm

tests needed, but code available

Flash Memory

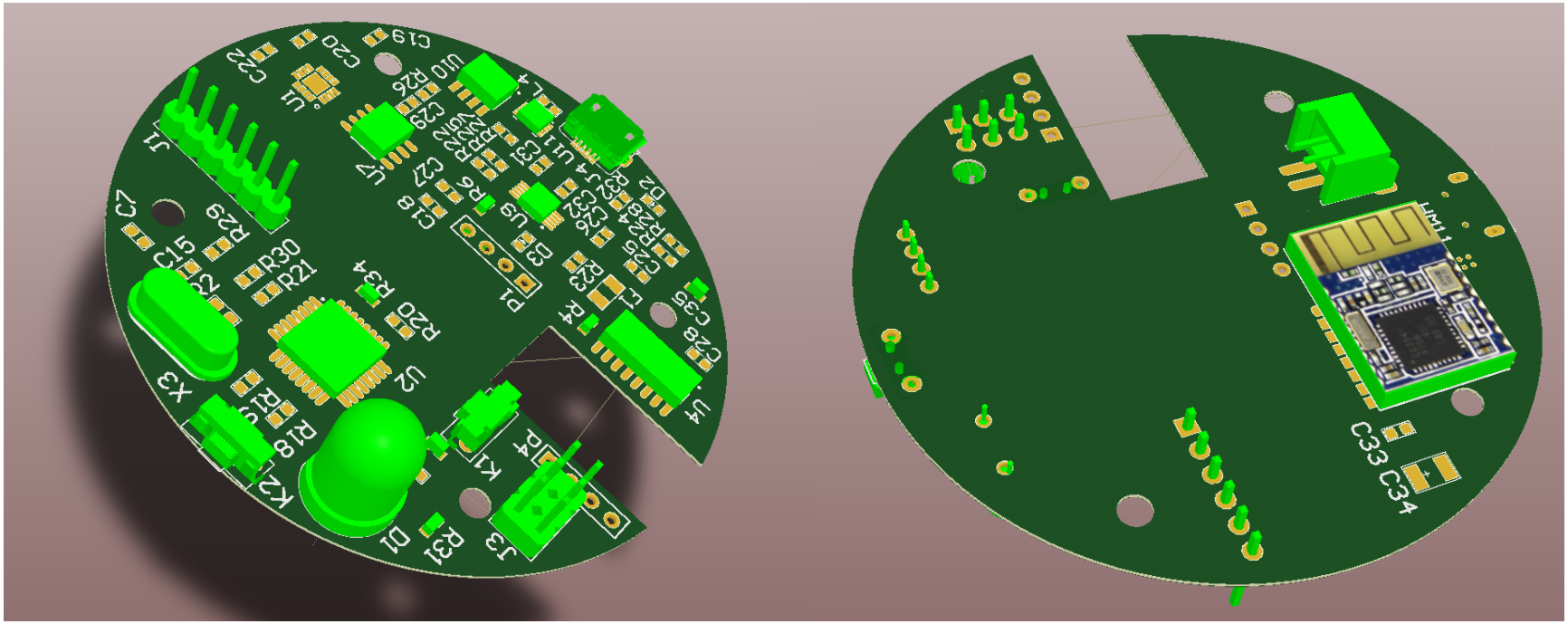


New 3.3V design reduces components needed

Memory structure:

timestamp - data1 - data2 - … - end

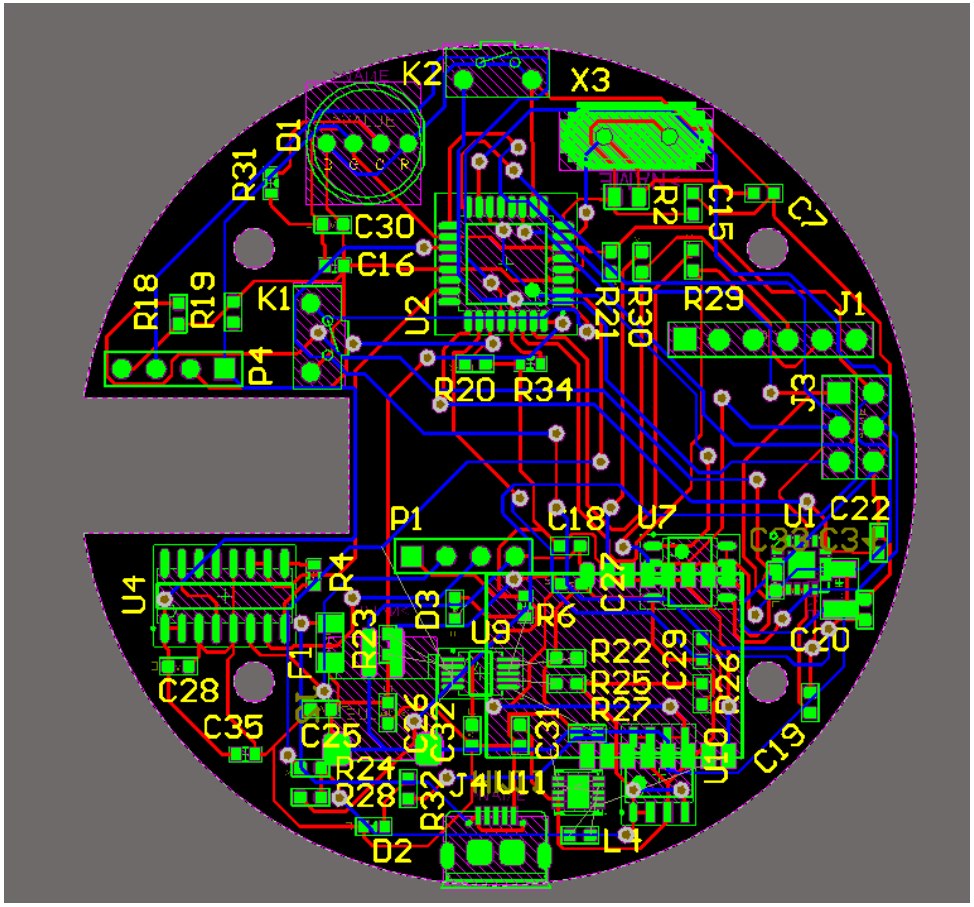
PCB Layout



Iteration with design / mechanics to assure that everything fits

3D components added and functional grouping on PCB

Routing



Well… autoroute is not the way

Regrouping needed to better expose IC connectors

4-layer layout?

Software/firmware

Idea: Start measurements after button has been pushed

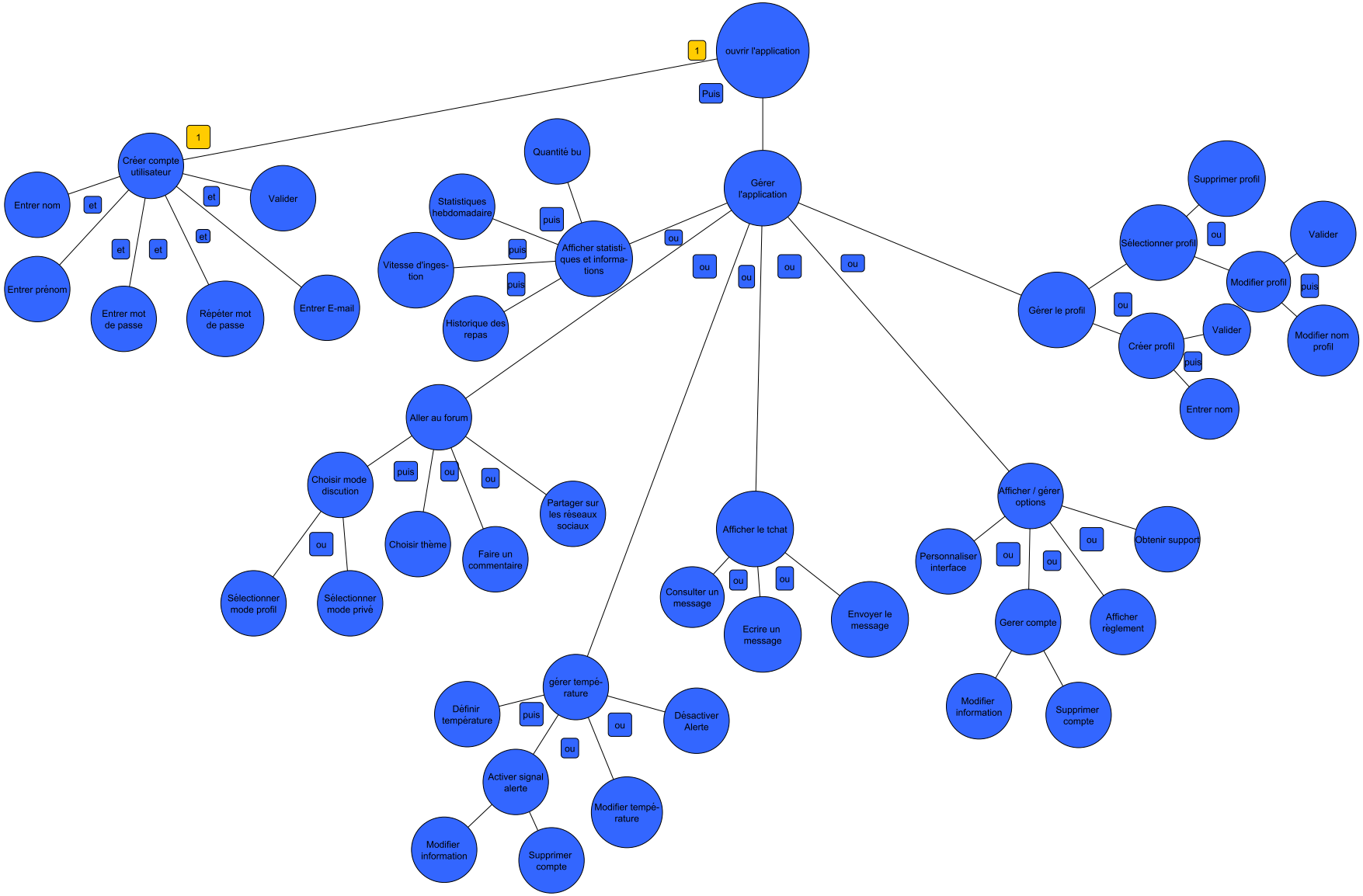
Measure and write in buffer

Read and write a « write protection » : If active can not be overwritten and indicates to synchronise via Bluetooth

App design:

Tutorial
Direct Measurement (tare, temperature)
Statistics
Messages (?)
Forum (?)

Software/firmware



Software/firmware

Firmware based on Arduino libraries

Can be flashed via ICSP

Debugging with FTDI of Arduino board

What have we learned and where do we need help

How to communicate in a multi-cultural group

How to ask questions

How to collaborate between engineer, design & business

That PCB is difficult

How to do design iterrations

To design the bluetooth protocol

Program the mobile application

PCB check

Specialize 3D design for the double wall

It is time !

Sponsors and partners

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