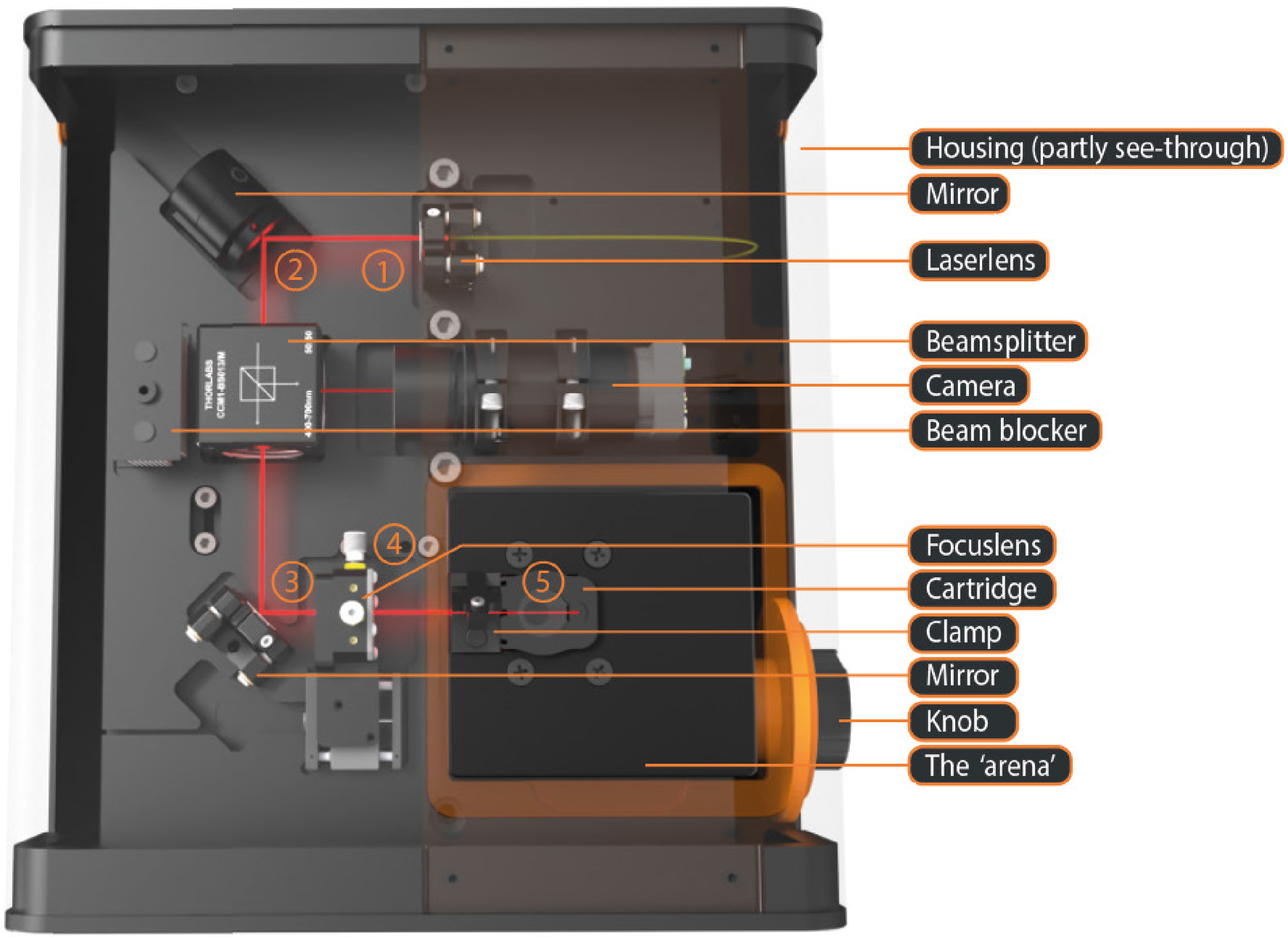
List of appendices

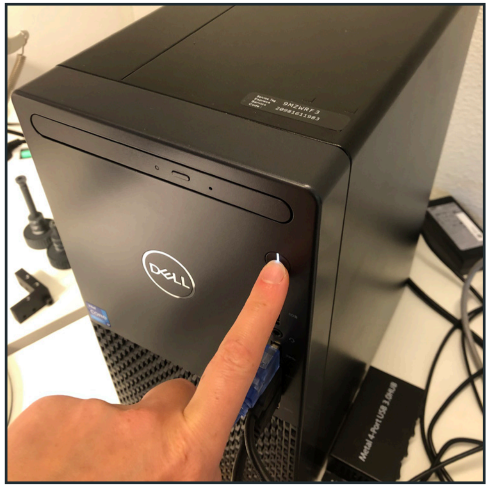
Appendix A - Inner working of the NanoCET



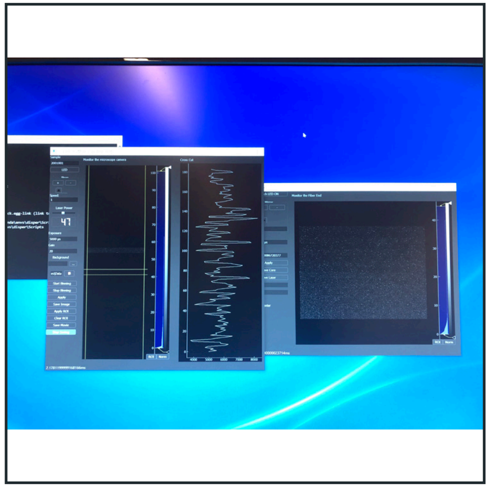
1. Laser comes from laser-lens
2. Laser changes direcetion because of mirror
3. Laser changes direcetion because of mirror
4. Laser is focused by focus-lens
5. Laser shines in the core of the fiber to meet the particles

Appendix B – Full workflow scenario of current NanoCET

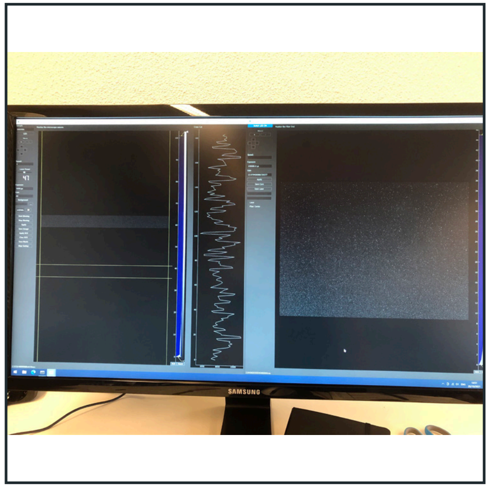
1). Switch on the device at the back side.



2). Turn on the computer.



3). Open Software 1 and the camera view.



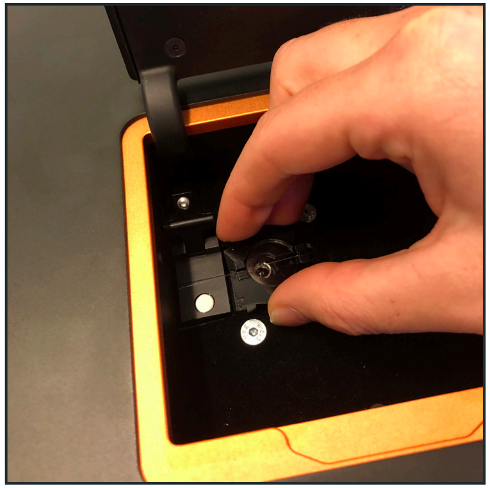
4). Split the screens of Software 1 & the camera view, so they are both visible.

5). Open the lid of the NanoCET.

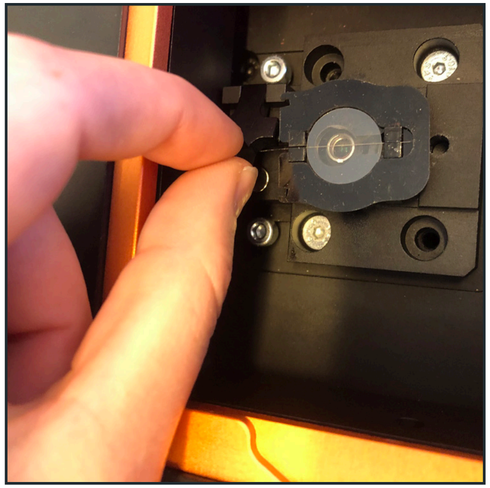
6). Open the clamp inside the 'arena'.

7). Unpack the cartridge.

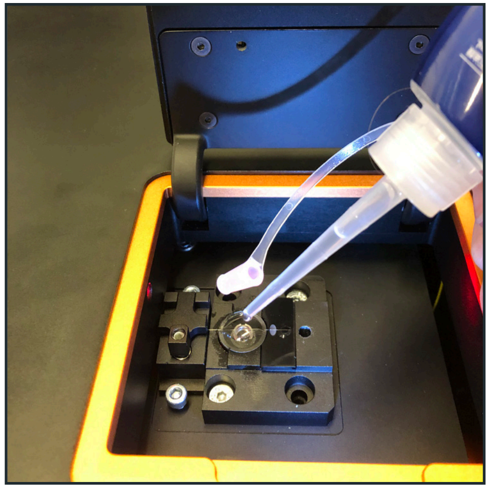
8). Take the cartridge out of the packaging.



9). Place the cartridge inside the ‘arena’.



10). Close the clamp inside the ‘arena’.

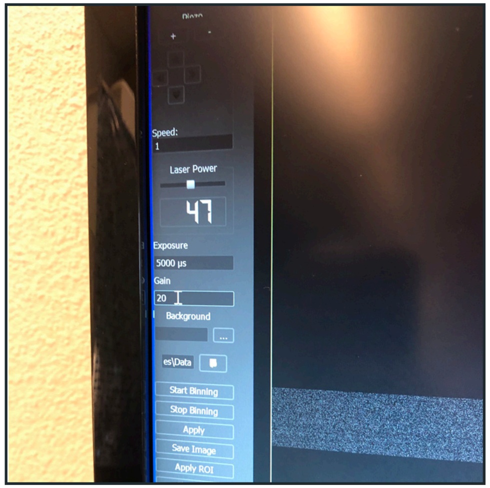


11). Insert the immersion oil on top of the cover slip of the cartridge.

12). Close the lid of the NanoCET.

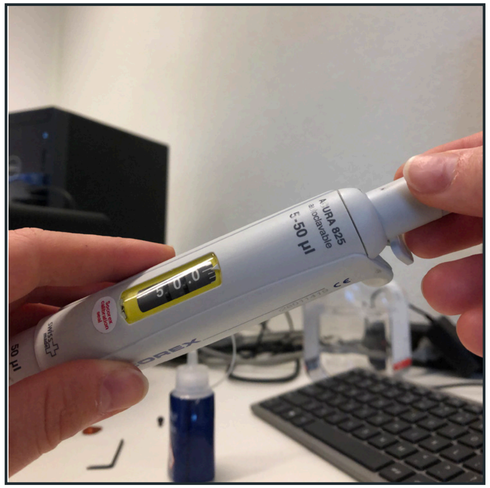
13). Focus the microscope by looking at the computer screen and turning the knob.

14). The laser inside the NanoCET automatically aligns after clicking a button at Software 1.

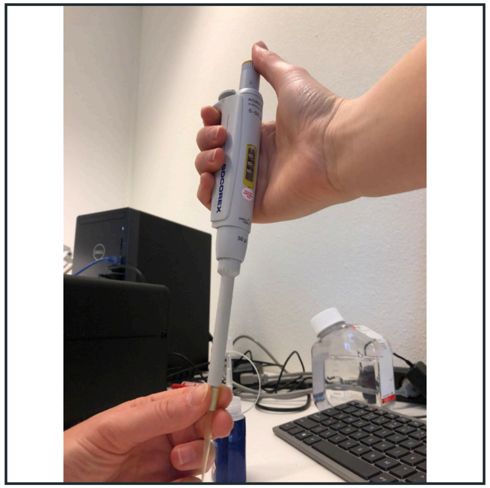


15). Insert the desired parameters for your measurement in Software 1.

16). Open the lid of the NanoCET.

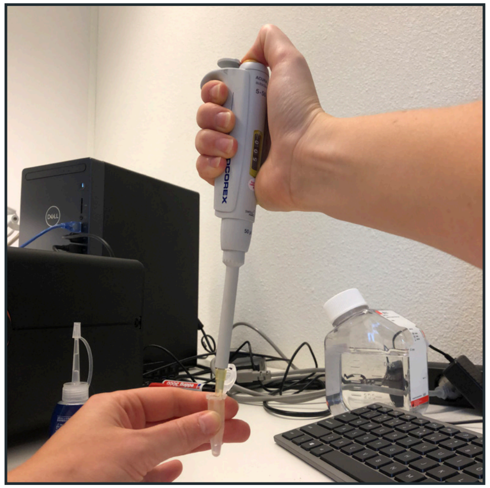


17). Turn the pipet to the desired volume.



18). Click the pipet tip on the pipet.

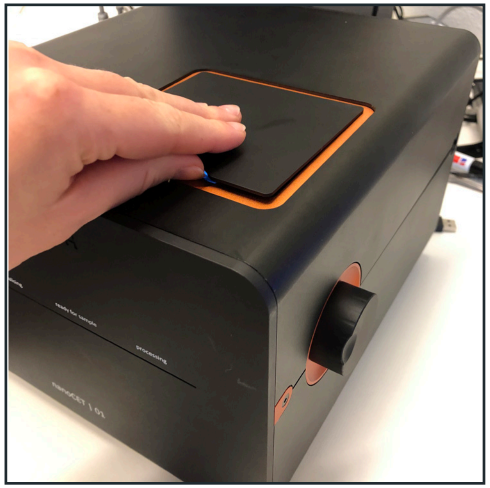
19). Open the lid of the sample tube.



20). Pipet the sample out of the sample tube.

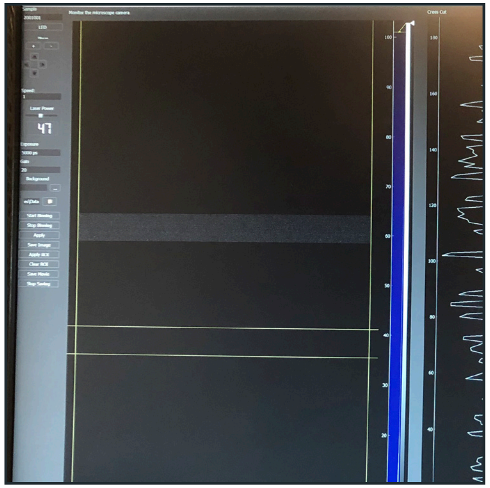
21). Pipet the sample on the sample spot at the cartridge.

22). Dispose the pipet tip.

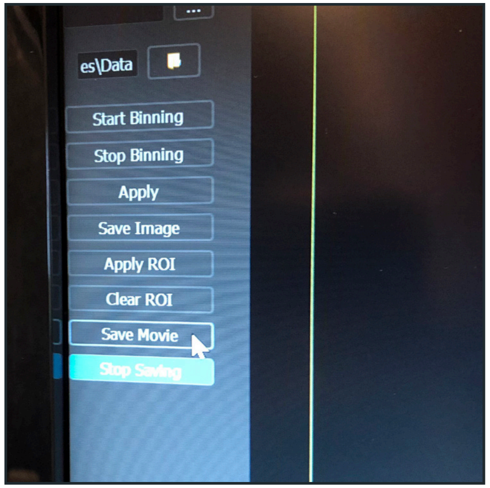


23). Close the lid of the NanoCET.

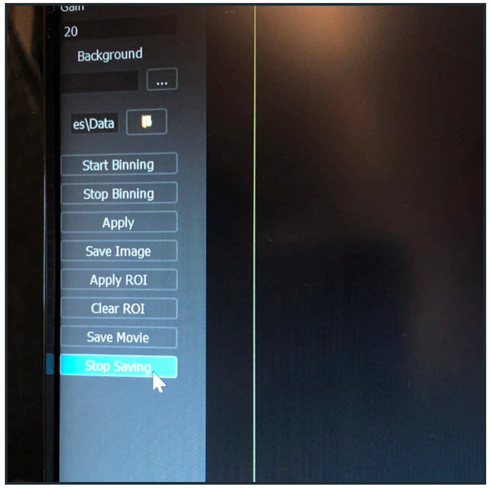
24). The sample liquid starts running through the fiber.



25). Select the desired frames of the camera view by a right mouse click: Region Of Interest.



26). Click 'Start Movie' to capture the camera view.



27). Click 'Stop Saving' when you don't see particles running anymore.

Now the cartridge needs to be removed and disposed in order to finish the measurement or start a new one.

Appendix C – Project brief

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy". Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: Meijer 5269

initials: M.C.H. given name: Mirjam

student number: 4442628

street & no.:

zipcode & city:

country:

phone:

email:

Your master programme (only select the options that apply to you):

IDE master(s): IPD / ★ DfI / SPD

2nd non-IDE master:

individual programme: - - (give date of approval)

honours programme: Honours Programme Master

specialisation / annotation: Medisign / Tech. in Sustainable Design / Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Jasper van Kuijk — dept. / section: HCD

** mentor: Arjen Jansen — dept. / section: SDE

2nd mentor: Aquiles Carattino

organisation: Dispertech

city: Amsterdam — country: Netherlands

comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

TU Delft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair: Jasper van Kuijk — date: 22 - 09 - 2021 — signature: Digitally signed by Jasper van Kuijk Date: 2021.09.22 12:31:05 +02'00'

CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: 29 EC

Of which, taking the conditional requirements into account, can be part of the exam programme: 29 EC

List of electives obtained before the third semester without approval of the BoE

★ YES — all 1st year master courses passed

NO — missing 1st year master courses are:

name: C. van der Bunt — date: 27 - 09 - 2021 — signature: C. van der Bunt Digitally signed by C. van der Bunt Date: 2021.09.27 13:31:28 +02'00'

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **. Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: ★ APPROVED / NOT APPROVED

Procedure: ★ APPROVED / NOT APPROVED

comments: - no abbreviations in title

name: Monique von Morgen — date: 11 - 10 - 2021 — signature:

Initials & Name: M.C.H. Meijer 5269 — Student number: 4442628

Title of Project: Design of the UI/UX of Dispertechs nanoCET device

Design of the UI/UX of Dispertechs nanoCET device — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 14 - 09 - 2021 — 25 - 03 - 2022 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

Context

In the fast-growing market of nanoparticle applications for the wide spectrum of chemistry, energy, medicine and many more, the need for tools that can analyze these nanoparticles has risen as well. Dispertech has developed a nanoCET device that can measure the size, concentration and distribution of 20 nm particles, where other devices cannot measure them individually and not to this small size, see image 1. The technology tracks nanoparticles inside an optical fiber using elastic light scattering.

Stakeholders

Dispertechs nanoCET device is a table top sized box, see image 2. It's smaller than other available techniques, but it's not yet designed according to the use scenarios of the lab researchers. This innovative device which the start-up Dispertech is developing, is meant to serve lab researchers in universities and hospitals. Therefore the for now known stakeholders and user groups involved in this project are first of all PhD-students, post-docs and technicians, since they work on preparing the samples. They'll be the main users because they interact directly with the device. The second stakeholders are professors (principal investigators), as they decide whether to spend the budget on investing in this device. The third stakeholder is Dispertech itself, since the solution must fit to the current prototype already available.

Opportunities

The current user experience is suboptimal which creates the opportunity to adjust and optimize it regarding the stakeholders' use scenarios. Currently, the user must open the lid, place a cartridge with a fiber and then turn the knob to focus the microscope, causing practical constrains in the labs, like the device being far away from the computer screen while the screen should be seen while operating the device with the knob.

Other clear opportunities for now regarding the current prototype of the device, are optimizing the interaction between the user and the device and specifically looking into the interaction with the cartridges; how it should/could be used and packaged. Furthermore, there is a desire to work out better or even automatic fiber positioning. All this is done making use of the huge opportunity to prototype and test, as users and context are available.

Moreover, there is a lot of flexibility, since Dispertech is answering the questions of researchers, because they now have designed a researching tool, but work towards a diagnostic tool that requires a much higher level of usability.

Starting points for possible improvements of the current design are:

- the connection between the physical UI and the digital UI.
- research what should be a task of the user, what should be done by the device and what should already be prepaired in the production of the fiber.
- the wish to, in time, look into the sustainability/recyclability of the cartridges.

Limitations

As there is a big focus on the user interface/ user experience (UI/UX) of the cartridge, (how to handle, place, take out and dispose) there are safety concerns like the pointy fiber that can harm your fingers, but also physical restrictions like the tolerance of the fiber.

Another limitation is different users working in different contexts. Some use the device in dark labs while others need safe environments with fume hoods.

Furthermore, there is the already existing prototype that should be open for debate, for instance because of restrictions caused by mechanical mounting.

space available for images / figures on next page

introduction (continued): space for images

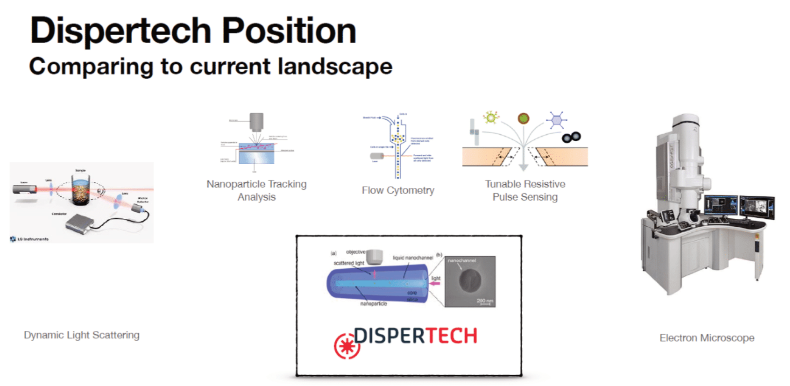


image / figure 1: Position of Dispertech among its competitiors: the current available techniques.

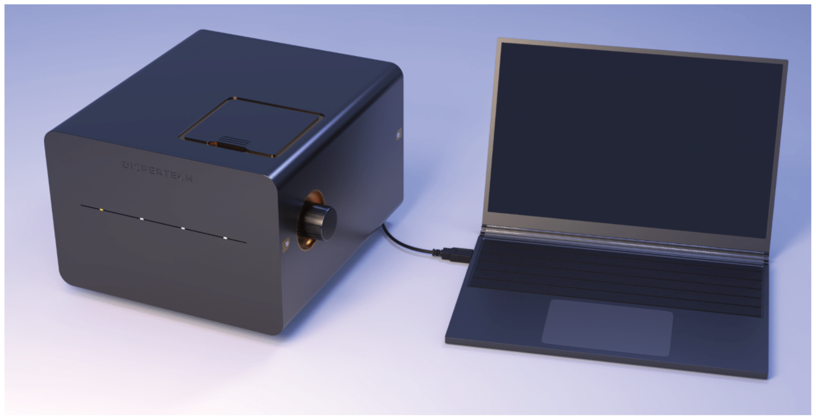


image / figure 2: Dispertech nanoCET device.

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

Problem statement
Users are unable to independently operate Dispertechs technical prototype of the nanoCET device, because of the under-developed UI/UX, which can cause harmful or inconvenient situations (like operating mistakes made by users).

Focus
It is essential to know how the stakeholders work and how they operate in the lab environment. Therefore the main focus lies on the PhD, post-doc and technician stakeholders: the ones who interact with the device. These users will be extensively involved in the research and validation phase of the project.

Solution space
With this approach, all issues experienced while operating and interacting with the device can come forward and can be integrated in the design of the interface.
Both the physical and digital UI can use this approach, so during the design research phase the connection and focus should be researched.

So, the solution of this project should enable a smooth user/fiber/device interaction, that lowers the friction of use and the number of mistakes made by users, keeping in mind that; the device tries to simplify tasks that up to now have only been available to extremely trained researchers, there is a variable context of use and there are boundaries in the manufacturability and costs.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Using the input of the users in the context, I will develop an interface design based on Dispertechs prototype of the nanoCET device, so the interaction with the device is clear and user friendly, causing a pleasant experience. This design should then support the stakeholders to independently operate the device.

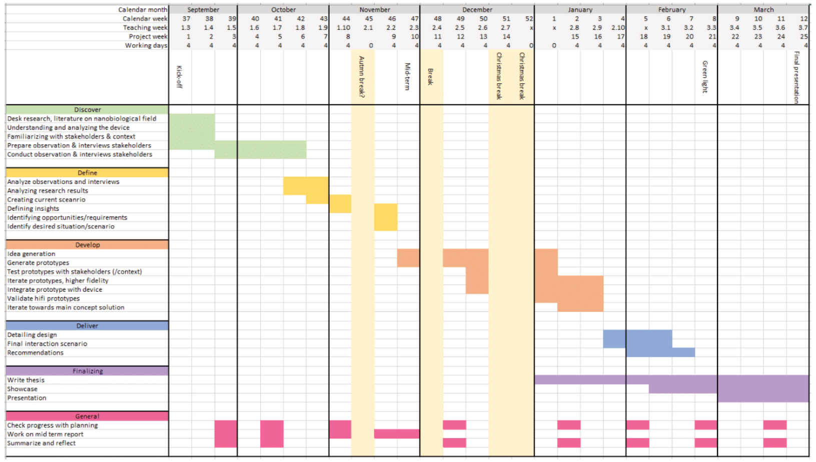
During the project, my activities will be:
- understanding the current device and company context trough desk research.
- understanding the user and the context through observing, interviewing.
- creating a scenario of the current interaction with the device (current tasks and required actions).
- using the research insights and opportunities to define a desired interaction.
- concepting into a series of testable prototypes.
- validating the prototypes with users (in the context).
- creating an experience prototype of the design.
- creating a presentation/communicative scenario of the interaction with the designed UI of the device.

The final result will:
- be an experience prototype of the user interface/device/software.
- include an explanation on how the physical UI is/can be integrated with the digital UI.
- enable users to operate the Dispertech device independently.

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 14 - 9 - 2021 25 - 3 - 2022 end date



This planning is based on the Design Thinking method 'The Double Diamond' containing the following phases:

Discover (diverge): embed in the context with the stakeholders to find out what's going on.

Define (converge): identify the insights gained into tangible points to work with.

Develop (diverge): look broadly in the given solution space for suitable directions.

Deliver (converge): select and validate the most promising direction.

Since the project requires quite some diving in, to fully understand the device and therefore a part of the context, I plan on spending a bit more time on the Discover phase. The Develop phase is extensive as well since it's important to take the time to create prototypes and validate them with users. Hopefully this will all be physically possible during the COVID-19 pandemic, otherwise some parts will be executed online.

I'll work on this project for four days a week since I'm still wokring at my previous internship company one day a week (see amount of working days at the top of the chart).

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

Finally, I've chosen for this project as my graduation project since I've always had an interest in biology as it was my second study choice.
Even more, because I'm intrigued by the potential of the technique and its social importance. I'm curious how the start-up will evolve and I'm happy to be able to contribute. I'm very excited that my design can immediatley be implemented and used. While I was visiting the Dispertech office, my hands were aching to start and I felt the excitement of the assignment! Furthermore, I think it's really interesting to work in such a small team where there is a lot of freedom and where I can fulfill the role of designer.
Besides all this, I think I'd like to work as a UI/UX designer in the future, so this project is a great opportunity to further develop myself in this direction.

Competences to prove:
- (Explorative) prototyping.
- Usability tests.
- Visual Communication (in the scenarios planned).

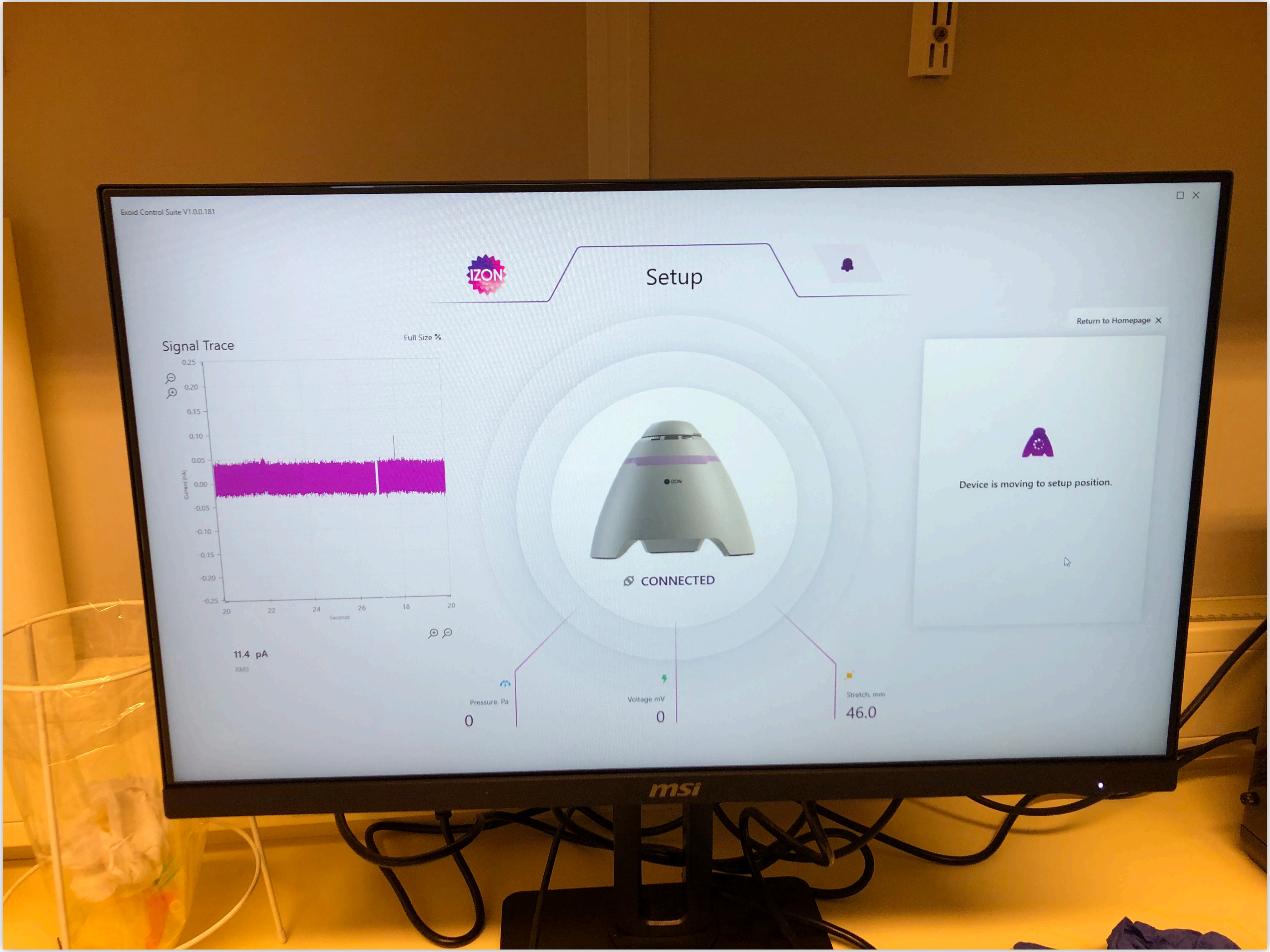
Competences to learn:
- Individually conduct and manage such a large project.
- Being the only industrial design engineer in a technical team.

Personal learning ambitions:
- Dive into the biological aspect to understand how the device works.
- Staying focused on certain aspects of the project, to be able to finish those aspects and deliver an integrated UI/UX desingn.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

Appendix D – Interface competitor product (IZON)



Appendix E - Topic guide: interview/observation questions

> User Experience

Current device(s)

- Do you feel confident working with the devices in the lab? Why? (& observation)
- What are the minimal skills you need to operate this device? Are these standard lab skills?
- What's your favorite device in the lab? Why? What's your least? Why?
- What kind of interactions are there? (observation)
- How do the interfaces look of the devices you're working with? (observation)
- Are you afraid you can break the device?
- Do you need to work very precisely? (Careful with the tools?) (And scientifically?)
- How do you make sure you're not making mistakes?
- What isolation method do you use?
- Is the device always used for the same purpose?
- Do you/ what kind of maintenance do you have to do? How often? By whom? How long does it take?
- How do devices communicate with you? (Status lamps, notifications, sound, etc.) (& observation) Is there sound and is that consequential or intentional?
- How is the digital part connected to the physical part?
- How do you experience the software that comes with the device(s)?
- Where do you store supplies needed for devices/measurements? Are they the same for different devices or are they specific for each device?
- Do you use different parameters? How do you know how to set them?
- Where/how do you store the data to be analysed? Where do you analyse?
- What's the oldest device in here? And the newest?
- What's the difference between the current devices and older ones? What evolution?
- How long does it take to set up the device? (Before you can start?)
  New devices/technologies
- How do you get to know a new device? Did someone explain the working of your device to you? Did you have to figure it out yourself?
- Can you use a new device immediately? On what does it depend?
- When do you feel a device is trustworthy?
- What's your experience with fibers?
- (Have you ever prepared a fiber? (Cutting the polymer off?))
- Have you ever focused a microscope?

Interaction

- Is there an on/off button? When do you use it?
- What is the most complex part of the measurement?
- What is your favorite interface? (Knob, touch screen, sliders, etc.)
- How do you remember the steps you need to take? (The interaction sequences?)

Sustainability

- What do you do with your consumables? What do you think of that?
- Are you concerned about the sustainability of the materials you use for the measurements?

> Measurement

Understanding

- Do you know what's happening inside the device you're using?
- Are you curious about what's happening inside the 'black box'? Would you like to know (more)?

Practicalities

- What are your preparations? What are your tasks to finish up the measurement?
- Do you (need to) wear safety equipment during a measurement?
- How often do you do these measurements?
- What is the goal of the measurement?
- Do other people use this set-up as well?
- How long are your measurements?
- How many measurements can you do in one day? On what does this depend?
- What is missing in your lab/ interaction?
- What improvement would you like for the measurements?
- Are your tasks repetitive? What are the (dis)advantages?

- Is the/this measurement always used for the same purpose?
- Do you (want to) do two (or more) measurements at the same time?
- Are there any safety concerns around the measurement?
- How big is your influence on the accuracy of the measurement?
- Do/would you need guidance during the process of your measurement? If yes, in what would you like guidance?
- Can you walk away from your measurement?
- Do you need to walk away from your measurement?
- Do you want to walk away from your measurement?
- What supplies do you need for a measurement?

> Device(s)

- What tasks are done by the device?
- What tasks do you need to do by yourself? (& observation)
- What tasks do you want to do by yourself?
- What tasks do you want to be done by the device?
- Do you use the device for other purposes? (Putting your cup on top etc.)
- Do you think the device is (ever) used for unwanted purposes? (& observation)

> Looks

- What do you think is the influence of the exterior of the device? What does it influence?
- What do you think is the influence of the color of the device? What does it influence?

> Cartridge

- Do you work with cartridges?
  If yes: what kind? How many? How often? What for? What do you want to have prepared in the cartridge? How do you put the cartridge in the device? How do you store the cartridges? How much is left for you to do? How are they packaged? Do you think a cartridge is a nice way to combine certain steps in the measurement process? How do you dispose them?
- If you would use a cartridge: what kind? How many? How often? What for? What would you want to have prepared in the cartridge? How would you put the cartridge in the device? How would you store the cartridges? How much would there be left for you to do? How would you like to get them packaged? Would you think a cartridge is a nice way to combine certain steps in the measurement process? How would you dispose them?

> Space & [cardboard box]

- How do you experience the interior of the lab?
- Is there freedom to adjust in composition? (& observation)
- Do you put devices in different places? Why?
- Why are things in places they are right now?
- Are devices always reachable or do you need to ‘set them up’? Are they stored then? Why? Where? How? (& observation)
- Where would you put this [the box] (the device)? If it needs to be attached to a socket and plugged into a laptop/pc?
- Would you use a laptop or PC to analyse the results of the measurement?
- Where would you leave the laptop/PC? (Left, right, on top?)

> Inclusivity

- Do you think your current device is appropriate for left- and right-handed people? Why (not)?
- Do you think your device is appropriate for color blind people? Why (not)?
- Dyslexia?
- Culture?
- Gender?
- Gimmicks?

Appendix F - Detailed description of field studies.

Participant 1

The figure on the next page gives an impression of lab visit 1. In this visit, I spend a whole day at Amsterdam UMC, accompanying participant 1: a PhD candidate with a background in engineering. The lab she works in has one wall with windows towards a corridor, desks and fridges/freezers all around the lab against the walls, and higher working tables in the middle of the lab. When the nCS1 was new in her lab, she was instructed by the company with two online live sessions. If she would have a NanoCET, she would place it at one of the high working tables in the middle.
There are a lot of things laying around in the lab, but there is a structure too, in where everything is placed and why. In terms of safety, we needed to wear a white lab coat and she should wear gloves during the measurement, but she did not. In terms of aesthetics, she didn't mind how the device looks: Participant 1: ***'It doesn't stand in your kitchen, so it doesn't matter'.*** Only loose cables hanging around a device would make her feel like a device is breakable. She's not very much concerned about sustainability: Participant 1: ***'If you reuse a cartridge, you always have contamination doubt, and you don't want that because you want to be sure.'***

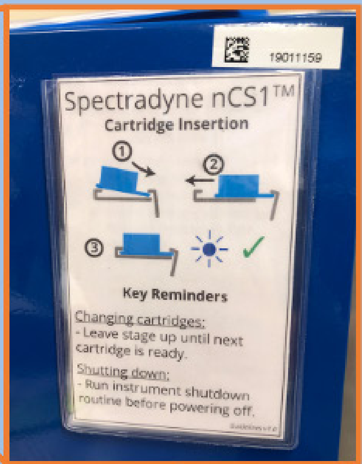
Her task for that day was conducting two measurements on different samples for a PhD-college that did not want to work with the nCS1 anymore, because her colleague found it too complex, and it caused her too many errors. The goal of the measurement was to compare the results of the nCS1 to the results of a device the lab usually works with; the Apogee, see the figure on the next page. This comparison is desired so they will know if the device is trustworthy and if the lab can trust what the company claims; Participant 1: ***'You're not trusting what the company claims, you want to test it yourself.'***
A big part of the sample preparations was done beforehand, so we could immediately start with the last-minute preparations.
Participant 1: ***'The time I spend on a measurement depends on the number of mistakes I make.'*** When a small thing would go wrong in any of the steps, she starts over again: Participant 1: '***I'm always really careful. When I'm hesitating, I redo it, even if it takes a lot of time.'***: she wants to be sure. After walking a lot across different labs to collect materials and to centrifuge the sample, we moved to a corner of the lab where the nCS1 was placed diagonally on a desk next to a computer, see the figure on the next page. After running a reusable cleaning cartridge, she could start a measurement. Next to the reusable cleaning cartridge, there are five different disposable cartridges, each for a different nanoparticle size, but mostly one type is used. Participant 1: ***'I'm quite happy with cartridges.'*** Participant 1 needs to insert the sample into a cartridge the size of a LEGO block, before clicking it inside the device. Then she enters the cartridge number and her measurement settings in the software.
Once the measurement starts, she stays next to the device and waits, because if something clogs, the device makes a sound, and she needs to press a digital button before the measurement continues: Participant 1: ***'During a 50-minute measurement, I don't do anything and wait, because if something clogs, I need to push a button.'***

nCs1 device

Context

nCS1placed diagonally

Device in corner of lab



Instructions on how to insert the cartridge placed on the device.

Measurement

Holding cartridge at eye hight to see if pipetting goes well.

Apogee device

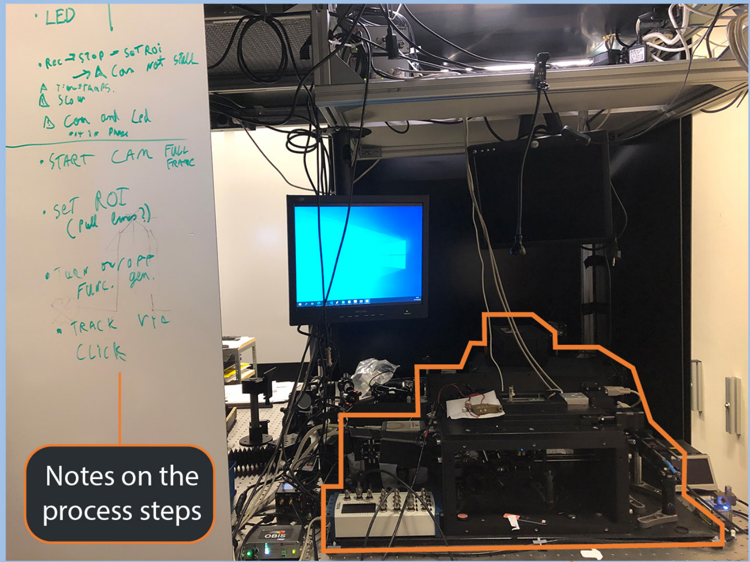
Medical device that can ana-lyse multiple samples at the same time.

Participant 2

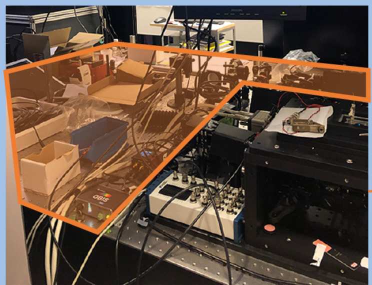
In the figure on the next page an overview of the lab visit with participant 2 is depicted. Participant 2 is a PhD-candidate working in a university lab of Utrecht University with a background in physics. Her lab is crowded with experimental set-ups on optical tables (vibration-proof tables) and wires going everywhere. The set-up she works with works the same way as the NanoCET, only the NanoCET is developed into a product. Her NanoCET set-up is larger, more open, and experimental. You could see she was able to interact with the set-up fluently because of its open character. If participant 2 would have a NanoCET, she would place it at the orange field depicted in the figure on the next page, where she has ***'a lot of space'***.
The windows are blocked from sunlight and a chemistry table where she makes her own disposable cartridges out of two glass pieces and some tape, is separated from the optical tables with a curtain. To keep the cartridge aligned with the set-up, she uses a golden 3D printed clamp. The only safety regulations in this lab are footprint stickers on the floor, to avoid dust coming into the lab.
The measurement she showed me, was for her professor. He is the one who build the NanoCET set-up and developed the technique and therefore the one who instructed her on how to work with the set-up. The goal of a measurement with this set-up is the same as for the NanoCET. During a measurement, she stays with the device and looks at the computer screen to see when particles stop passing by so she would know the measurement is done and the camera can be stopped. Participant 2: ***'After I started my measurement, I wait a bit to see if no errors occur (5-10 min).'***

In a different lab in the same building, there was another device, the Zetasizer (the figure on the next page), that has a similar purpose. It also works with cartridges, but this time in a rectangular shape. The cartridge can easily be compared to the image shown on the Zetasizer lid, to check the proportions of the ingredients.

NanoCET set-up



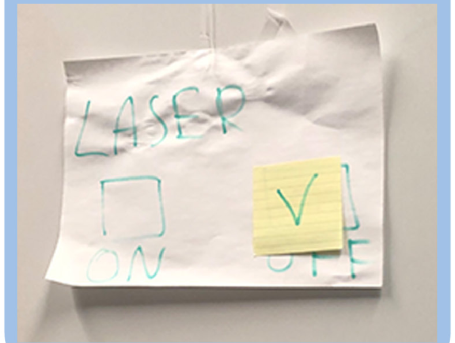
Notes on the process steps



'We're not interested in portable devices, there is no purpose.'

'I have a lot of space.'

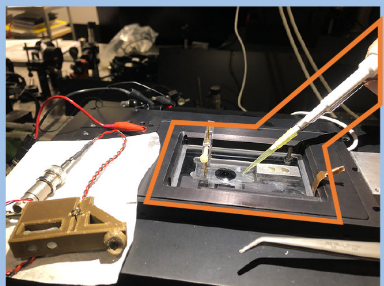
Context

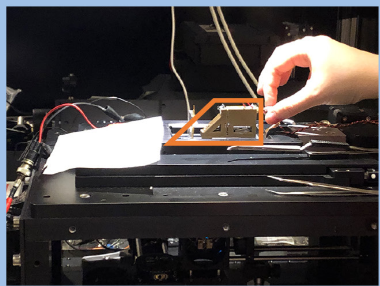


Preparations

She makes her own cartridges of glass and tape.

Measurement





Zetasizer device

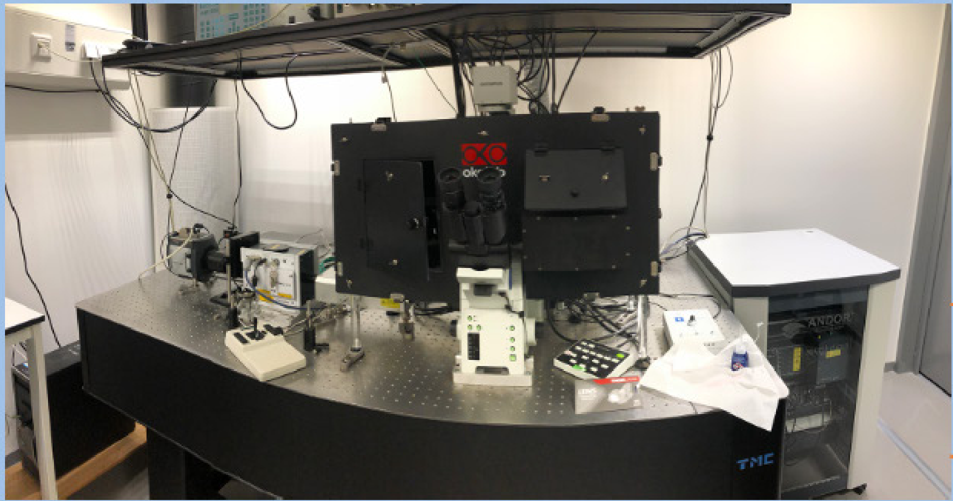
'Zetasizer is nice to open with the knob. It's easy to have a picture for the proportions: really easy and user friendly'.

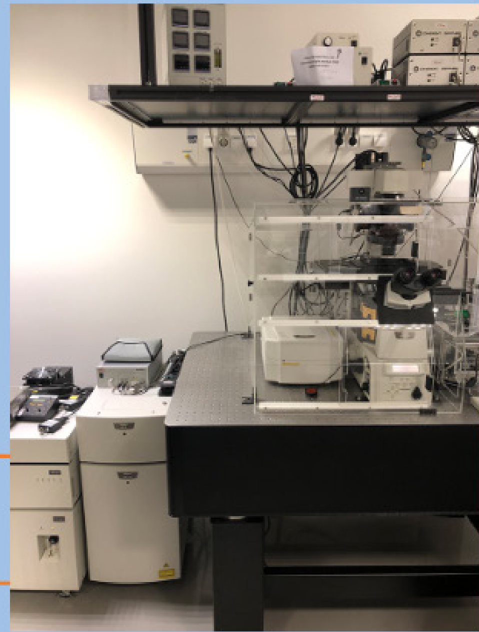
Participant 3

The figure on the next page illustrates the impression of the lab visit in the university lab at Delft University of Technology. Participant 3 showed me around several small rooms without windows where microscopes were set up on optical tables. Usually, researchers working with microscopes work in the dark. Although these labs are visually least comparable to the other lab visits, all the labs in Delft contain similar elements like optical tables, bins, a high working table, and a computer. If participant 3 would have a NanoCET he would put it on a high desk, next to a computer.
Since a lot of different people use the same facilities, many notes and instructions were left around the set-ups. As for safety regulations, we needed to wear lab coats: participant 3 was wearing a white one and as a visitor, I needed to wear a dark green lab coat.

Participant 3 is a technician with a background in microscopy, so he is specialized in the set-ups. As a technician, he conducts measurements for others, instructs students on how to work with microscopes, maintains the set-ups and experiments with the set-ups himself. Participant 3: *'I perform measurements for others when they don't dare to put their hands in the device. Or when they don't like to do it, they just want results.'* In his role as a technician, he comes across considerations like how much training effort it's worth for someone to conduct a measurement themselves or for him to take over. Furthermore, he always mentions to his students they should tell him if they are making a mistake because it is okay if it happens, but he needs to know to protect the set-ups. Only sometimes does he finds out students still try to hide their mistakes.

Context

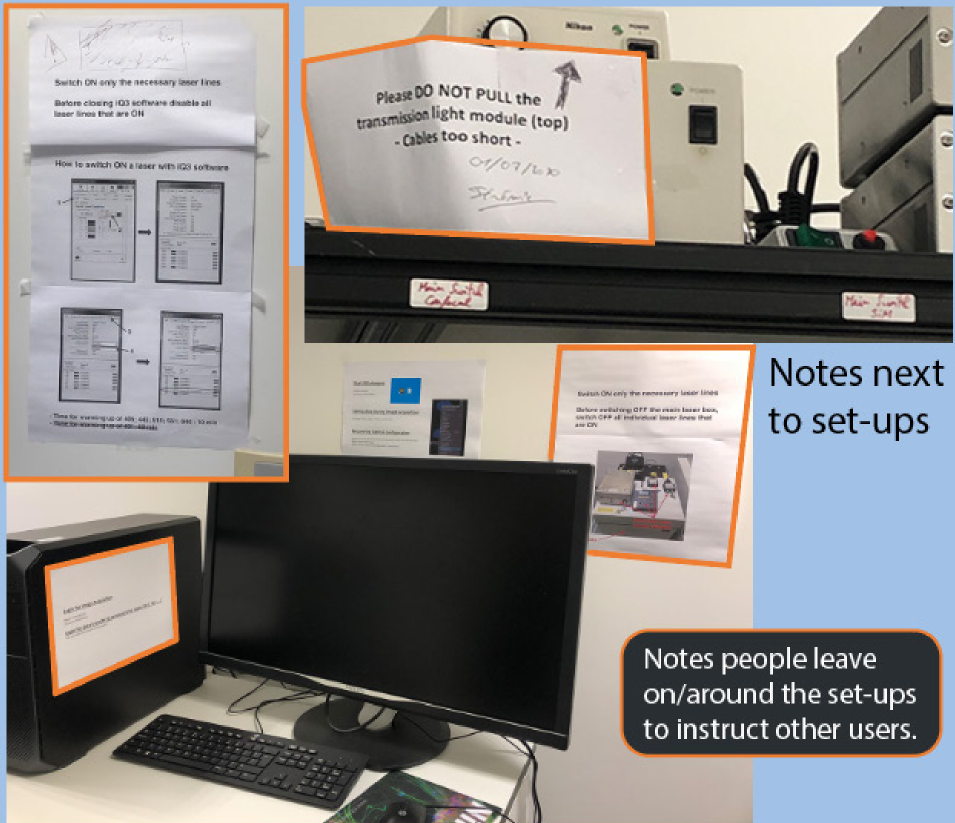




Black boxes around microscopes for protection and to keep light out.

All microscopes placed on optical tables.

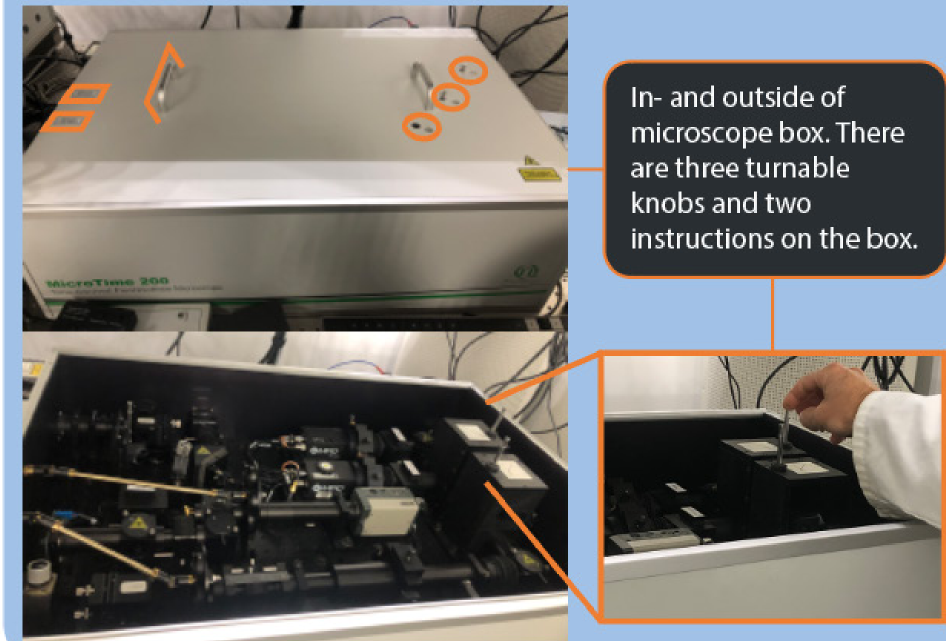
See through boxes around microscopes for protection.



Notes next to set-ups

Notes people leave on/around the set-ups to instruct other users.

Microscope set-up in box

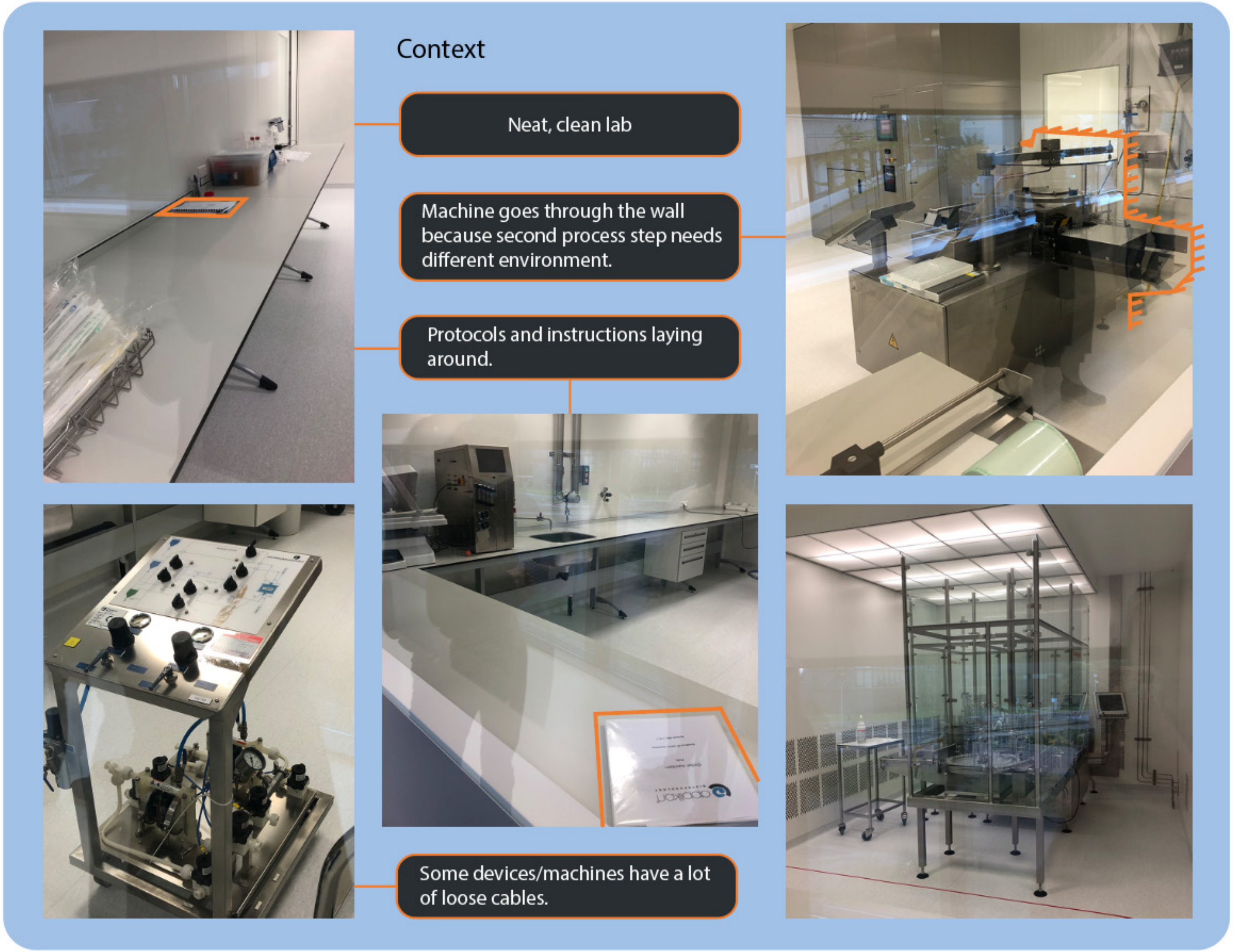


In- and outside of microscope box. There are three turnable knobs and two instructions on the box.

Participant 4

Participant 4 gave me a tour around the training facility at Leiden University as shown in the figure on the right. This clean and neat environment is meant to train people with any kind of background to be able to work in a lab environment. At the moment of the visit, no one was working in the labs.

The facility has a lot of different labs, each having its properties and various devices. All pictures of figure 11 are taken from the corridor through a window, so only indirect light comes into the lab. Safety regulations are strict to teach trainees how it should be done, and protocols are laying around everywhere.



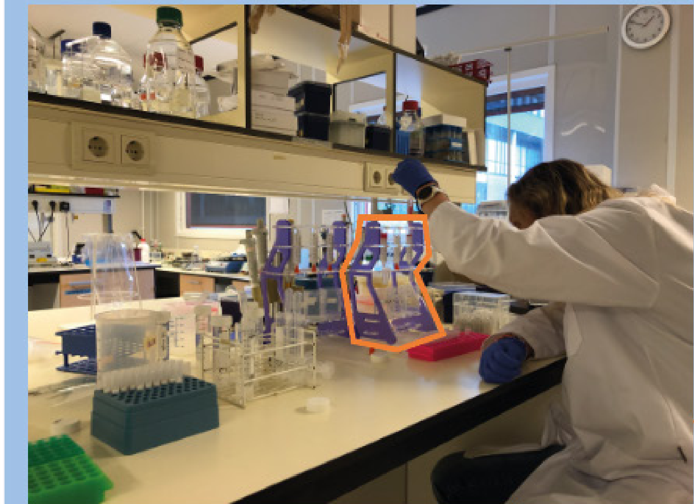
Participant 5

Participant 5 is a technician with a background in biology, who conducted an EV isolation method for a postdoc who was in Germany, see the figure on the next page for an overview of the visit. She has a lot of working experience in different labs at universities, but also for companies.
Participant 5: ***'Science isn't friendly for the environment, there are a lot of disposables in a lab.'***
She is concerned about the sustainability of the materials she uses, but above that, she wants to be able to trust her results. Just as she wants to trust the company that provides her devices. The IZON devices sometimes make her doubt the quality of the device, because they have a big focus on aesthetics. The quiet lab at VUmc has a lot of devices standing around and similarly to the other lab in Amsterdam (of participant 1) working tables in the middle and desks all around, against the walls. If she would have a NanoCET she would place it on such a low desk, next to a computer. She has seen the NanoCET at Dispertech and from her memory, she notes: ***'It'd be nice to have a clear sample spot.'***
There were windows with sun curtains on one side and a lot of fridges and freezers on the other side. All elements like sample racks have a place or cupboard to be put if they are not used.
As preparation for the EV isolation, we walk to another lab to centrifuge the samples she already put out of the freezer in the morning, so they would thaw. Back in her lab, she needs to make columns to put the samples in. She uses a panty from HEMA as a filter at the bottom of the column, see the figure on the next page. She needs to keep an eye on the top and bottom sides of the column at the same time, so she could not walk away from her set-up. Only during lunch break, she inserts orange caps to 'pause' the gravity force on the column. She also has the IZON AFC device to do the EV isolation automatically, but you need specific cartridges for that, and she did not have them. Therefore, she uses the, for this method specifically designed, purple racks by IZON.
Participant 5: ***'I prefer functionality over aesthetics.'*** Before these racks existed, she needed to create a complex spirit level set-up with tripods. Inside the lab, she wears a lab coat and during the EV isolation, she wears gloves.
Participant 5 still waits for the IZON Exoid, see table 1 in chapter 3, for which she will have a two-day training of someone coming over from France.
Participant 5: ***'A device that is usable, so you don't need to be trained for a month.'***

Context

EV isolation method

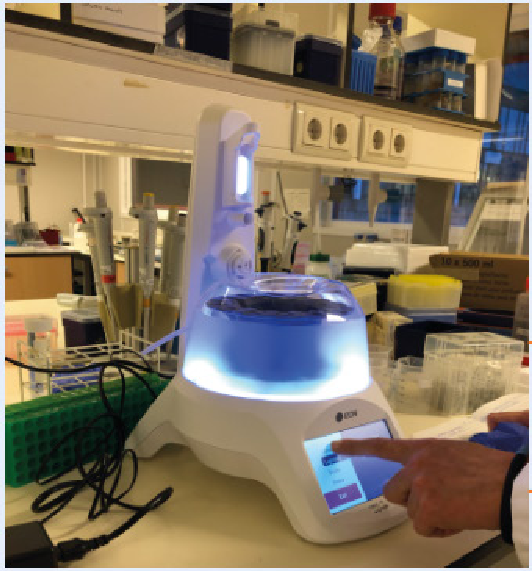
Using a HEMA panty to make a filter.



Special purple IZON racks for isolation method with columns.

Body posture during sample insertion.

AFC device of IZON



'If it looks too cool, I doubt: but does it work?'

Shiney lights: gimicky device with touch screen.

'Because it's research you've got more freedom than in diagnostics or with companies.'

Appendix G - Field research data analysis table

Elements	Participant 1 Extended observation, interview & tour (@Amsterdam UMC)	Participant 2 Extended observation, interview & tour (@Utrecht)	Participant 3 Brief observation & tour (@Delft)	Participant 4 Brief observation & tour (@Leiden)	Participant 5 Extended observation, interview & tour (@VUmc Amsterdam)	Horizontal findings (per element)
Device(s)	Ncs1 placed diagonally on desk. *Another flow cytometer is available in that lab as well.*	NanoCET set-up, see figure 9. *Zetasizer (she once looked over the shoulder while a colleague used it)*	Different set-ups, all microscopes.	Different (general) lab devices.	Set-up from IZON to isolate EVs: step before using another device.	Labs have multiple set-ups that perform similar tasks.
Lab context	Quite big, semi-chaotic lab with windows surrounded by corridors.	Chaotic, full lab. The set-up consists of separate devices constructed together.	Small lab rooms without windows, mostly they all work in the dark because they're working with microscopes.	Training facility: extremely clean lab, as if just delivered. Only windows to corridors.	Quite big, semi-chaotic lab with one window with sun protection.	The physical lab spaces are quite different, but most of them don't have fresh air windows.
Social context	Doing measurement for college, because colleague doesn't like working with the device (: too complex, too many errors).	Working on the set-up of her supervisor.	Maintain set-ups, train people, experiment, and conduct measurements for others.	Train/educate people that want to work in laboratories.	Technician doing the isolation for a postdoc in Germany.	Often people conduct measurements for others.
Safety	Semi-strict. Wearing lab coats, no phones on lab table allowed. Always	Semi-strict. Stickers on the floor for footprints. Clean labs themselves. Keep the set-up dust-free as	Quite strict. Visitors need to wear green lab coats instead of white ones.	Very strict because they get trained to work in labs.	Not so strict. Wearing gloves and a lab coat (only inside the lab) when conducting measurements. Often	In general, there are strict safety regulations, but it depends per context on how

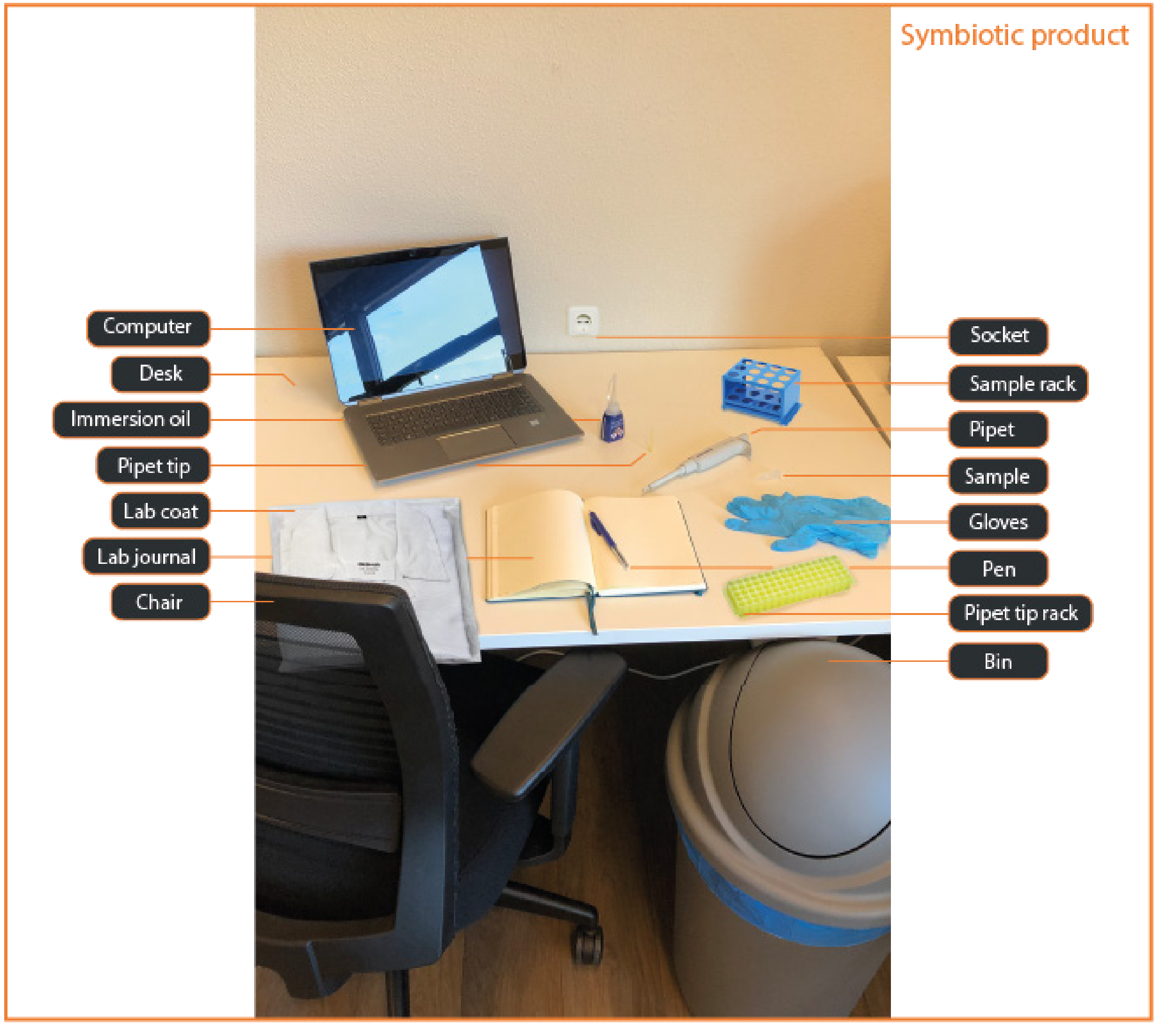
	wash your hands when you go out.	much as possible. Wearing gloves.			wash hands when leaving the lab.	strict they are followed.
Cartridge	Five different sizes, but mainly one is useful and there is a reusable one to serve as a 'cleaning cartridge'. Complex interaction to insert the cartridge.	Home-made cartridge with tape and glass plates: a messy job. *Zetasizer has squared tube cartridges.*	-	-	-	Other devices/set-ups use a form of the cartridge as well. The aesthetics or form of the cartridges differ quite a lot, but they are all meant to insert the sample.
Aesthe-tics.	Aesthetics don't bother her that much.	Open: reachable, so she can explore. The set-ups are a combination of stock devices. Otherwise, the user perceives aesthetics as irrelevant.	Quite open, reachable, some set-ups are protected by boxes that can be taken off. Otherwise, the user perceives aesthetics as irrelevant.	No preferences were mentioned.	IZON devices are gimmicky. Some labs color code their materials. Participant 5 prefers functionality over aesthetics.	Aesthetics differ quite a lot between devices, but they don't matter that much and are not so gimmicky.
Streng-ths	Device checks the info you give them: e.g. software checking if you got the right cartridge. Live tracking of the number of particles the device is tracking during a measurement. It's	Open, adjustable. Possible to explore with voltages and other things, because it's an 'open' cartridge (compared to a fiber).	Technician (participant 3) can help conduct measurements.	Tailored training per company can be offered. A wide variety of devices is available.	Multiple samples isolated at the same time: mostly two, sometimes three.	Transparent device > user communication: seeing what the device/set-up does.

	possible to track the progress of the device.					
Measure ment	Stops measurement at a random moment.	Measurement stops when particles have run by.	-	-	Concentrated to see when the sample gets to a certain level in the column: then the measurement is finished.	The time span of a measurement is not set.
Inter-action user > device	Standing and walking (also to other labs) a lot, only sitting during device interaction.	Standing during measurement (optical table), possible to sit during cartridge preparation.	Quite high (optical) tables, standing a lot. Clipping boxes open, maintaining set-ups (cleaning).	-	Waiting concentrated for the sample to go through the column, inserting the samples, moving small tubes. Walking around a lot.	Lab work can be quite intensive (standing and walking a lot, doing a lot of actions).
Commu-nication device > user	LEDs on nCS1 are without text. The device makes a sound that isn't understood.	The laser can be seen, because of the open construction. Furthermore, there are no knobs/buttons: it's not a device.	A lot of different knobs, buttons of microscopes, or other separate devices.	A lot of different kinds of knobs, buttons, wires on different devices.	The user needs to observe the setup to see at what level the liquid sample is. A nice user-friendly rack designed for the isolation method.	Not one clear 'line of thought' for interaction styles between similar interactions.
Instruc-tions on device usage	Two online sessions were provided by the company.	The supervisor instructed/showed her.	Participant 3 gives the instructions/ showcases.	Participant 4 gives the instructions/ showcases.	Training by IZON: for the new device someone will come over from France for a two-day training.	Instructions on (new) devices are given in person (not read or watched).
Vertical findings	Device-software flow sequence is	Creative and free approach and lay-	Knowledge of participant 3 goes	Clean and educational environment. Strict	Quite a lot of concentration was	Own idea/knowledge

(per partici-pant)	disrupted. The participant likes to think for herself and to have knowledge beyond the device.	out: experimental and explorative mindset and set-up.	beyond the task of a technician. Educational environment.	and straightforward layout.	asked for a simple task. Participant 5 has a lot of working experience in different labs. Interacting quite casually with set-up because of experience. Creative and explorative mindset: e.g., using a HEMA-panty as column filter.	has quite an influence on approach, behavior, and attitude. Every lab has the same ingredients and a similar goal, but they cook different meals because of different knowledge/identities in different environments.

Appendix H – The ecosystem of the NanoCET


Extended product
NanoCET packaging
Cartridge packaging
Protocol


Symbiotic product
Computer
Desk
Immersion oil
Pipet tip
Lab coat
Lab journal
Chair
Socket
Sample rack
Pipet
Sample
Gloves
Pen
Pipet tip rack
Bin

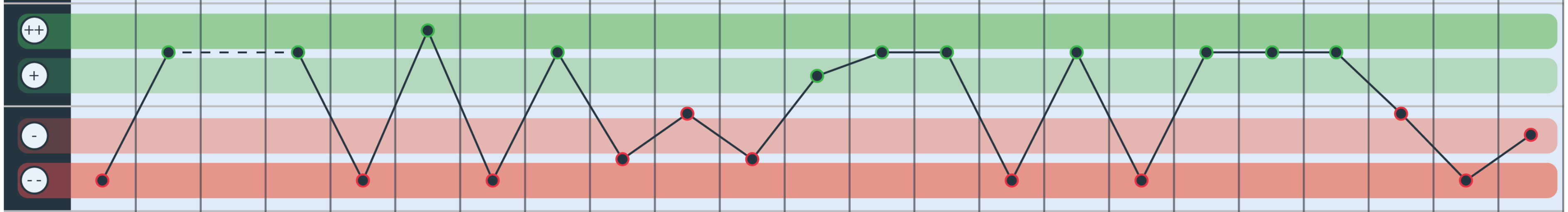
Appendix I – Functional Analysis

Part	Function
Device	Measure size distribution and concentration - thing
Device legs	Damp vibrations-thing
	Decrease contact surface-thing
	Provide grip-thing
	Stabilize device-thing
Housing	Keep the light out-thing
	Hold everything together/package-thing
	Protecting-thing
Front panel	Branding-thing
	Progress indication-thing
	Communicating inside to outside-thing
Lid	Keep the light out-thing
	Support perpendicular LED-thing
	Create an opening to the hole in housing-thing
	Create closing to the hole in housing-thing
Knob	Focus the microscope-thing
On/Off button	Turning on the device-thing
	Turning off the device-thing
Cartridge	Holding the fiber-thing
	Indicating a grip-thing
	Carrying coverslip-thing
	Fiber positioning-thing
	Eliminate fiber preparation-thing
	Receive sample-thing
Fiber	Aligning the particles one by one -thing
	Guiding the particles-thing
Sample	Containing the particles-thing
Laser	Enlightens the fiber-thing
Camera	Capture scattered light-thing
	Capture the particles-thing
Microscope	Focus on fiber-thing
	Enlarge fiber-thing
	Enlarge particles-thing
Particles	Scatter laser beam-thing
	Carry the desired parameters-thing
Clamp	Keep fiber positioning-thing
Software 1	Inserting parameters-thing
	Communicate to user-thing
	Showing the particles-thing
	Selecting the relevant camera frames-thing
	Collect/save the data-thing
Software 2	Analyse data-thing
	Communicate to user-thing
	Prepare raw data-thing
	Create graph-thing
	Remove noise-thing
Computer	Run software-thing
	Direct device-thing
Computer screen	Show camera footage-thing
	Show software interface-thing

Appendix J - Results of usability inspcetion.

Measurement

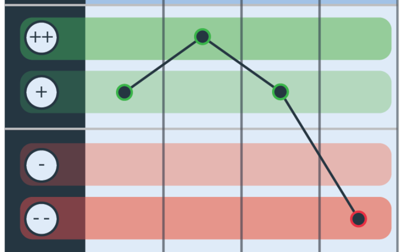
Task	Open lid	Open clamp	Unpack-age cartridge	Lift cartridge	Place cartridge	Close clamp	Insert immersion oil	Close lid	Turn knob	Laser alignment	Insert para-meters	Open lid	Put pipet tip on	Fix pipet volume	Open sample	Pipet volume	Insert sample	Dispose pipet tip	Close lid	Start measure-ment	Select frames (ROI)	'Start movie'	'Stop saving'
NanoCET	●	●			●	●	●	●	●	●		●					●		●				
Lid	●							●				●							●				
Clamp		●			●	●				●													
Cartridge			●	●	●	●	●			●							●						
Knob									●														
Computer											●												
Pipet													●	●		●	●	●					
Sample															●	●	●						
Bin																		●					
Software 1											●									●	●	●	●



Painpoint	Lid falls back, grip doesn't feel too nice	Too close to wall		Feels like cartridge can tilt between fingers	Hard press, afraid to break, clicking is hard	Quite smooth, but magnet is strong	Sticky fingers, danger-ous oil, stayed @ 1 side		Bit tough: needed oil	Should be notifica-tion when done	You need know-ledge/ protocol				Slippery hands		You need support for your hands, you shake	Sustain-ability?			Right mouse click, then click 'apply'	No feed-back: did I start the movie?	Press when you don't see particles
Note	Left hand!		Not designed				Step can maybe left out		Should be done by 1 finger	Automa-tised	UI is not friendly		Know-ledge/ protocol		I could hardly open it		It's hard!			Automatic		Be fast: particles run out	

Setting up

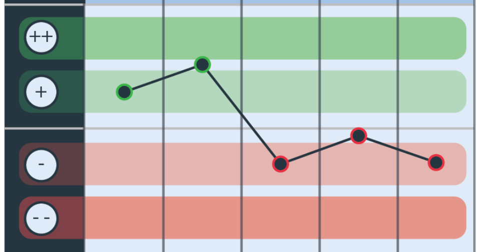
Task	Switch on device	Switch on computer	Start software	Split screen
Touchpoint	NanoCET	Computer	Software 1 & 2	Software



Painpoint	You must know where button is		Enter data in coding screen	
Note	Button not there (yet)	How fast is computer?		

Cleaning up

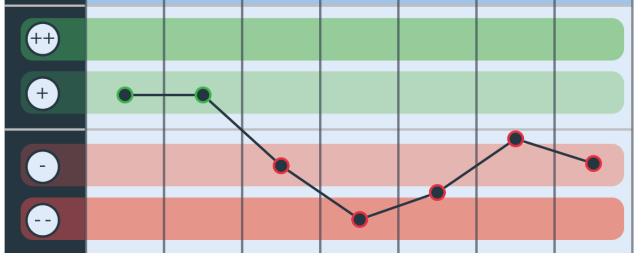
Task	Open lid	Open clamp	Remove cartridge	Dispose cartridge	Reset pipet volume
Touchpoint	Lid NanoCET	Clamp	Cartridge	Bin	Pipet



Painpoint				Sustain-ability?	Don't forget! Spring should rest
Note					Don't stretch spring

Analysis

Task	Open analysis software	Open file	Select frames (ROI)	Follow button row	Remove back-ground & noise	Apply binary masks	Final data
Touchpoint	Software 2	Software 2	Software 2	Software 2	Software 2	Software 2	Software 2



Painpoint		Change orienta-tion... Files can be large > slow		Unclear iconogra-phy Actions seem overrated	Essential but easy to forget	You must under-stand what & why	Unknown what desired data is
Note	Made in 2 days		Done before				

Appendix K - Streamlined walkthrough

This walkthrough is focused on interactions with the system of supplies (for instance, switching on the computer was not included).
Cleaning up the NanoCET is not included in this method as most tasks are already incorporated in setting up or in conducting a measurement.
The data analysis is not included in this method as well since the software is not developed enough to be able to be analysed.

Setting up the device	
Putting on the computer	
Opening the software	
Turning on the NanoCET	Feedforward: yes, it might take some time to find the ON/OFF at the back.
	Feedback: yes, the LEDs at the front panel of the device turn on.

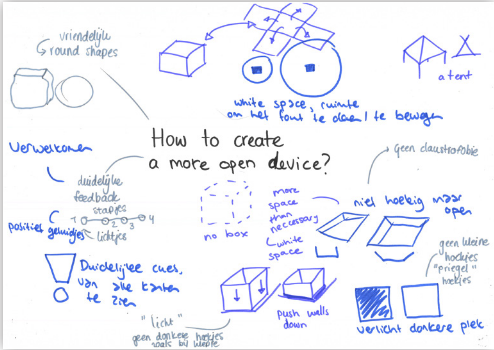
Measurement with the NanoCET	
Open lid NanoCET	Feedforward: yes, there is an orange rectangle emphasizing parting lines indicating a lid. There are indentations and grip lines to indicate a handle.
	Feedback: yes, the lid is opened. But sometimes it falls back again when your hand touches the lid.
Open clamp	Feedforward: no, everything is black and there are no clear handles/use cues/instructions.
	Feedback: yes, once the clamp is open it'll stay open.
Unpackage cartridge (current prefab packaging idea)	Feedforward: yes, there are extended material pieces indicating handles.
	Feedback: yes, the packaging is opened, and the cartridge can be taken out.
Lift cartridge	Feedforward: yes, it's clear that after unpacking the cartridge, you want to take it out. However, the cartridge has extended material as an indicator for a grip, which could cause users to hold the cartridge a bit more at the back at the indentation.
	Feedback: no, there is no feedback if a user is holding the cartridge in the right way, but they will achieve the goal of lifting the cartridge anyway.
Place cartridge	Feedforward: no, everything is black and there are only screws and indentations. Only the groove visible once the clamp is opened might indicate that the fiber should be positioned in there which gives a clue on how the rest of the cartridge should be positioned.
	Feedback: yes, the fiber fits perfectly in the groove, and the 'legs' of the cartridge 'click' in the 'arena'.
Close clamp	Feedforward: yes, the user already opened the clamp, so they will be aware it can be closed again.
	Feedback: yes, a little 'click' indicates the magnets touching.
Insert immersion oil	Feedforward: no, there is no clear indication that the oil is necessary at all or where it should be entered unless the knowledge of the function of the oil is known by the user.
	Feedback: no, there is no feedback if the oil is applied in the right way.

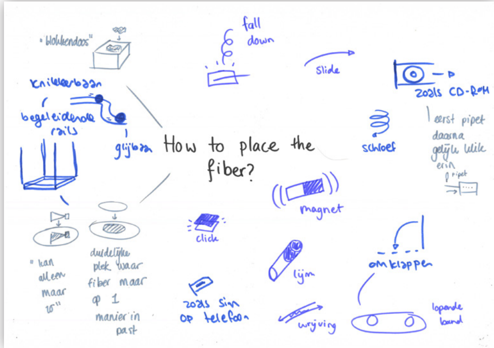
Close lid	Feedforward: yes, the lid is clearly still open.
	Feedback: yes, the lid will be closed.
Turn knob	Feedforward: yes, there is an orange circle around the knob and it physically sticks out on the side of the device. Furthermore, there are grip lines around the knob and an indentation to put your fingertip. Since the knob is circular, it suggests it can be rotated.
	Feedback: yes, the user can see on the computer screen if the camera is sharply focussed on the fiber.
Laser alignment	Feedforward: no, because the laser alignment is done automatically but should be triggered by the user via the software.
	Feedback: maybe yes, because the laser alignment makes a sound, but maybe not because the user doesn't understand this consequential noise is used as communication by the device for the user.
Insert parameters at Software 1	Feedforward: yes, some boxes indicate where to insert parameters. It could be that the users miss knowledge on what parameters to put there.
	Feedback: yes, you still see the parameter you typed. However, there is no indication if the parameters are suitable for the measurement.
Pipet intermezzo	
Insert sample in NanoCET	Feedforward: no, there is a small black hole in the cartridge where the sample is supposed to go, but the hole is small and everything is black.
	Feedback: maybe, but there is a chance the sample is inserted at the wrong place on the cartridge or leaks to the wrong place.
Start measurement	Feedforward: no, the sample automatically runs through the fiber.
	Feedback: yes, the user will see particles coming by on the computer screen.
Select frames (ROI)	Feedforward: no, the function is 'hidden' in the software underneath the right mouse click.
	Feedback: yes, because the user selected the right frames around the sample.
Start movie	Feedforward: yes, there is a button stating 'Start Movie'.
	Feedback: no, the user cannot see that the movie is being made.
Stop saving	Feedforward: maybe, if the user has experience. Maybe not, because the only indication to stop the movie is if you don't see any particles running anymore.
	Feedback: no, because the user cannot tell if you stopped the movie.

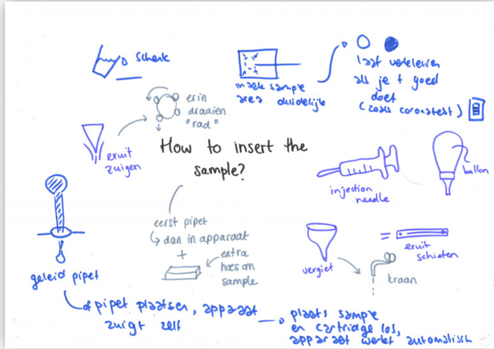
Appendix L1- How to's creative session 1

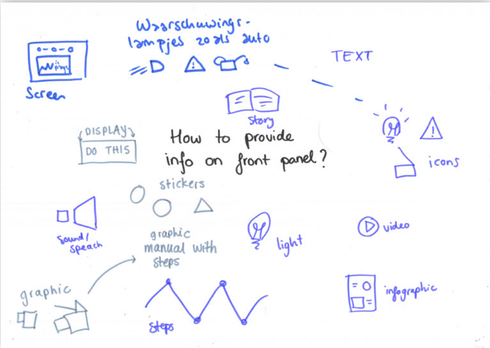
- How to create a more open device?
- How to place the cartridge (fiber) in the 'arena'?
- How to provide use cues?
- How to create a workflow?
- How to integrate the software and the device?
- How to guide users in the process?
- How to insert the sample?
- How to position the cartridge in the device?
- How to protect the fiber and the coverslip?
- How to communicate the measurement steps?
- How to make the software more guiding?
- How to provide information on the front panel?
- How to use sound as a communicative element?

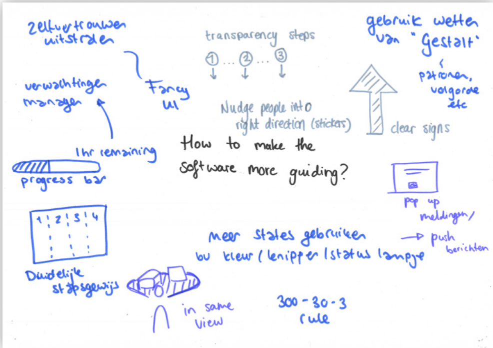
Appendix L2 – Results creative session 1

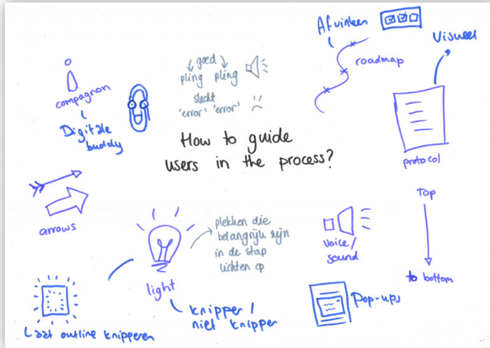


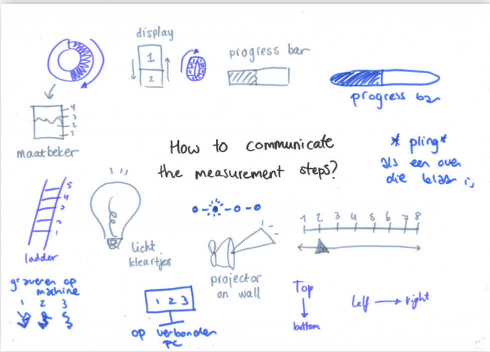


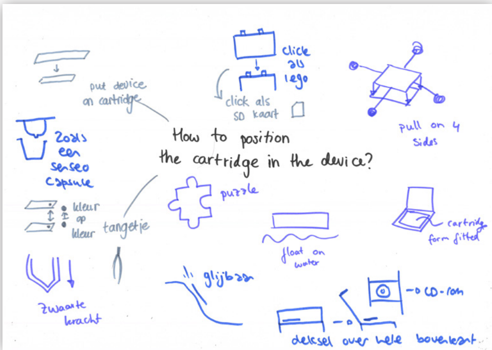


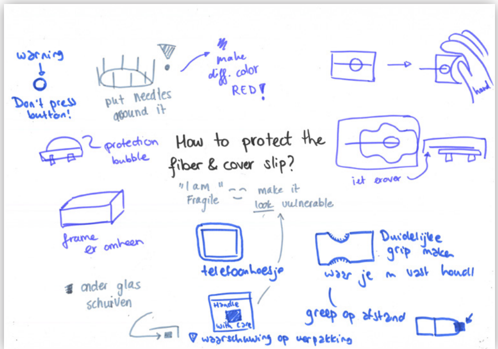












Appendix M1- How to’s creative session 2

Questions:

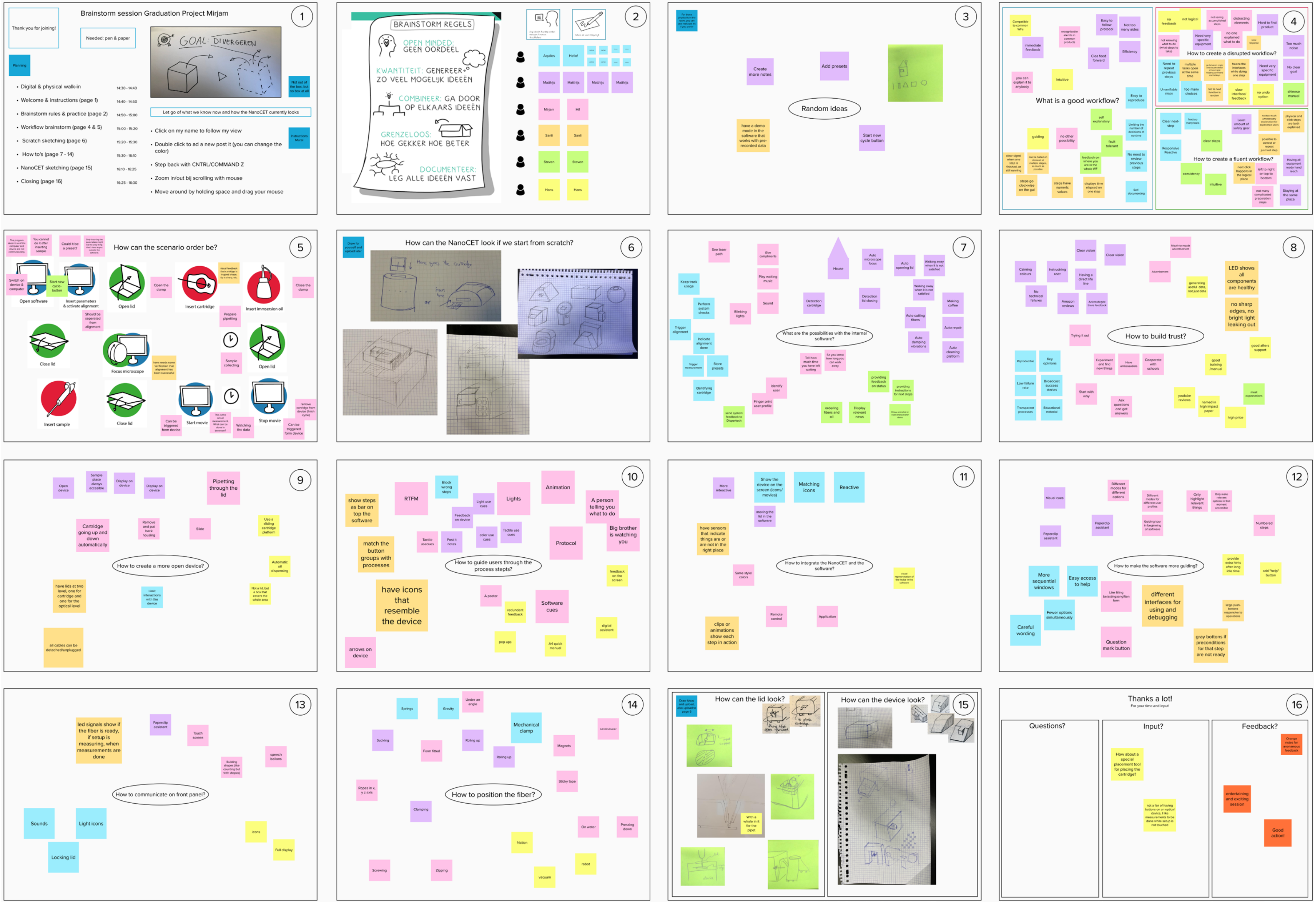
- What is a good workflow?
- What can be the order of the scenario?
- How can the NanoCET look if we would start from scratch?
- What are the possibilities with the internal software?
- How can the lid look?
- How can the device look?

How to’s

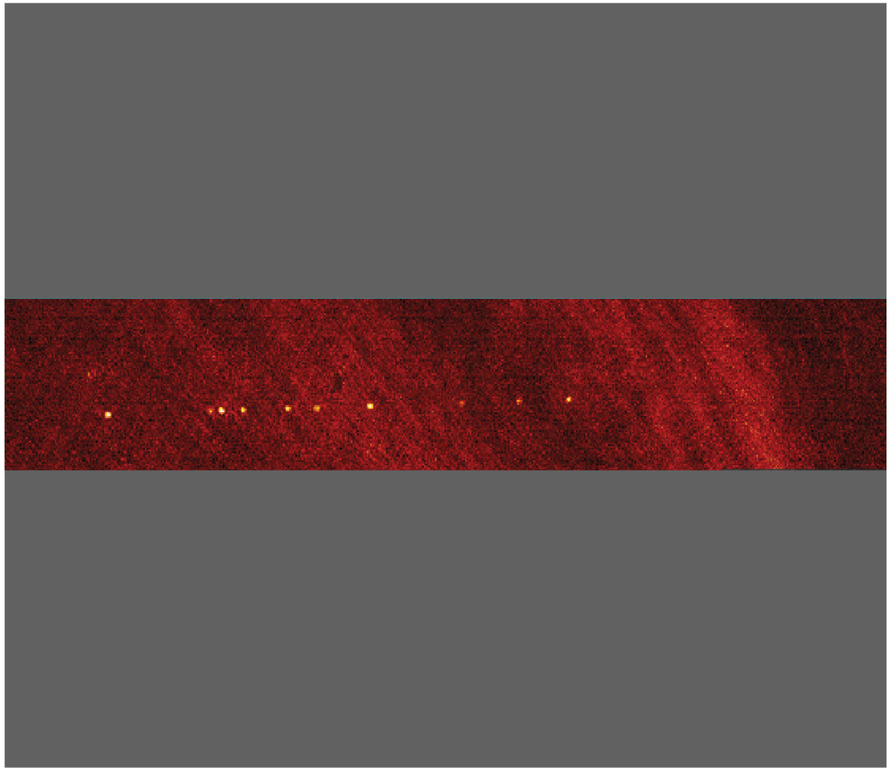
- How to create a disrupted workflow?
- How to create a fluent workflow?
- How to build trust?
- How to create a more open device?
- How to guide users through the process steps?
- How to integrate the NanoCET and the software?
- How to make the software more guiding?
- How to communicate on the front panel?
- How to position the fiber?

Appendix M2– Results creative session 2

To see the results more clearly: https://app.mural.co/invitation/mural/graduationproject9178/1640161382560?sender=uc61d6ff0fc3187c2b06e9755&key=8231c8d4-ae78-4320-ad5b-e1ba47c8ed65



Explorative prototyping – user testing
6.



7. Align laser.

8. Date of today:

12. Crop the image shown above at six so you only have the red part left (and the grey part is gone).

13. Start movie.

14. Stop movie.

Appendix O – Explorative prototyping results

Step 1: place the current NanoCET elements on the device in your desired configuration.

- Knob on the front.
- Power LED separated from other LEDs *'I think 4 LEDs in a row is too much'*.
- Lid in the middle: *'I think I want the lid in the middle and closer to me.'*
- ON/OFF on the side: *'Normally it's in the back and it's hard to reach'*.
- LEDs placed vertical: *'Then I know what order.'*

> She did place the LEDs in the correct order.

Step 2: Follow the written scenario and complete the steps.

- She expects the sample should be inserted directly after the immersion oil.
- When 'inserting the parameters' she pulled the screen closer: *'I need to be closer.'*
- After closing the lid before shifting to the computer the waited a bit and ticked with her fingers on the table.

> She forgot to touch/turn the knob while looking at the screen.

> She cannot find how to 'select the ROI frames' (> crop the image: also hidden under right mouse click).

> She couldn't tell if the laser was on. *'Is the power for laser on?'*

Step 3: Reflect on your configuration of the elements on the device, how did you experience this?

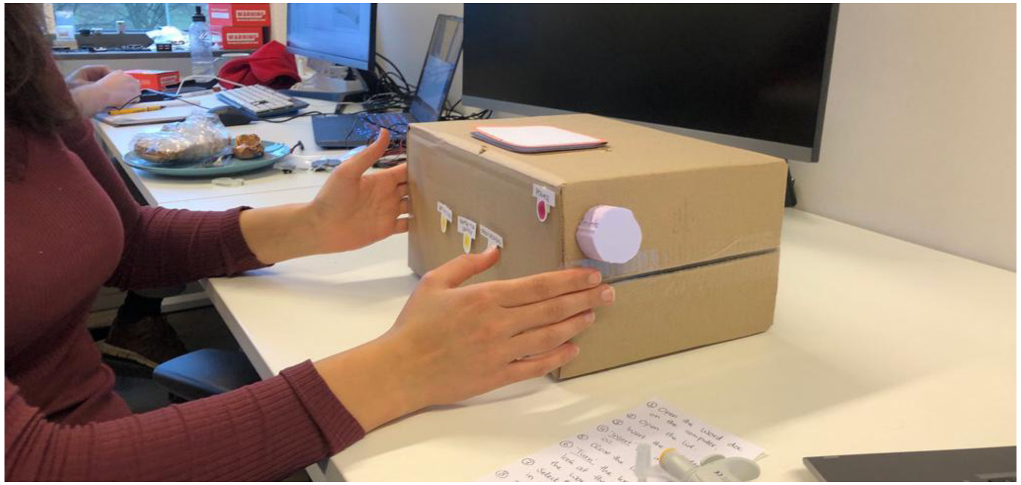
Would you do something different?
'A damper on the lid, so the alignment isn't damaged by closing the lid.'
'The color of the LEDs, that each LED has a different color like the nCS1.'
'If it's not a box shape it's unusual.'
'Maybe I when I align the laser, I can also crop the ROI.'

Would you like to add something? (button, knob, LED etc.)
'I think it's better to have focus on the device than on the software.'
'Closing the lid should be on the device, in case the software crashes. I feel better when I would have control on closing it, like a button.'

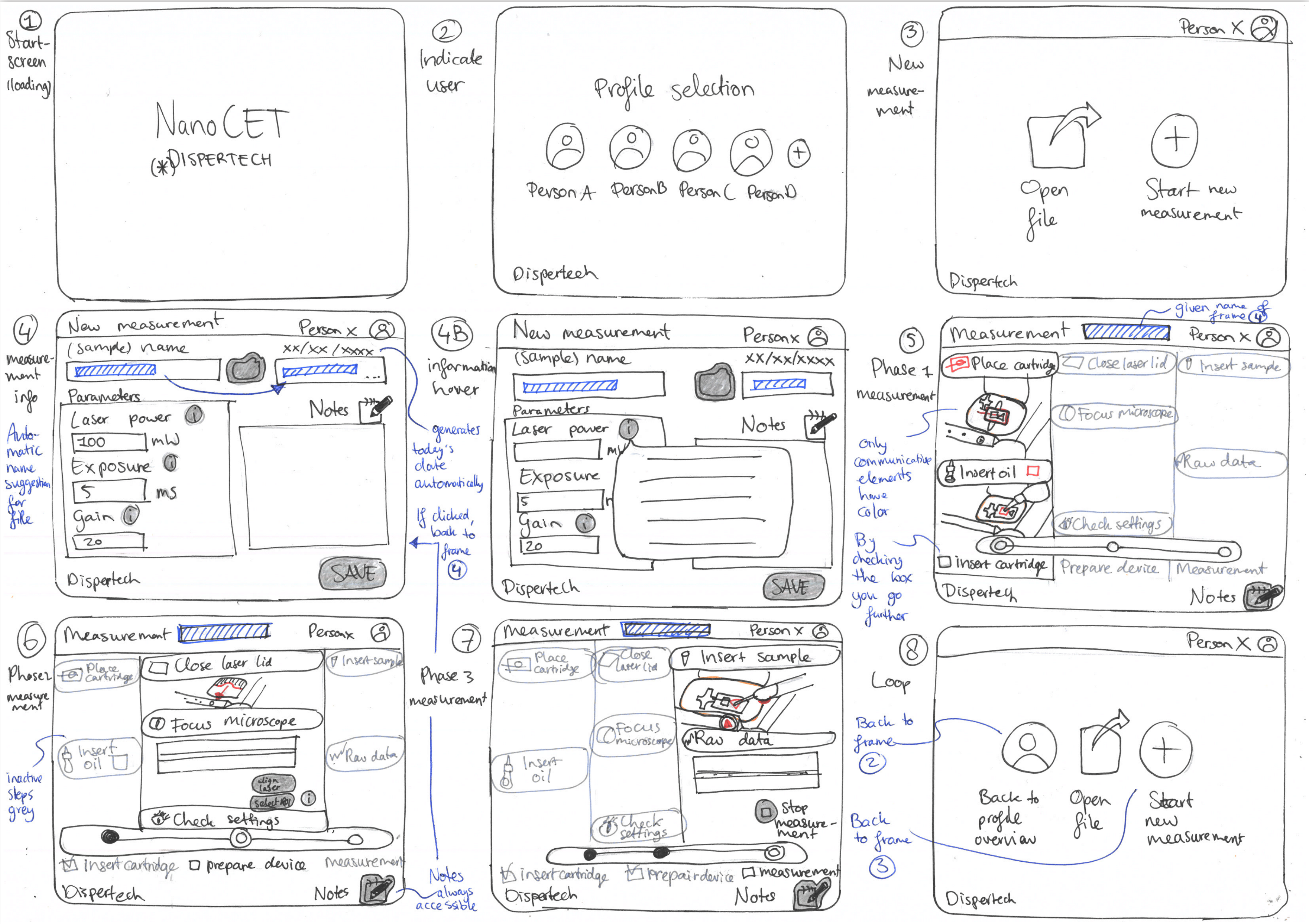
Would you like to remove something? (button, knob, LED etc.)
No.

Step 4: Make another different configuration of the elements on the device.

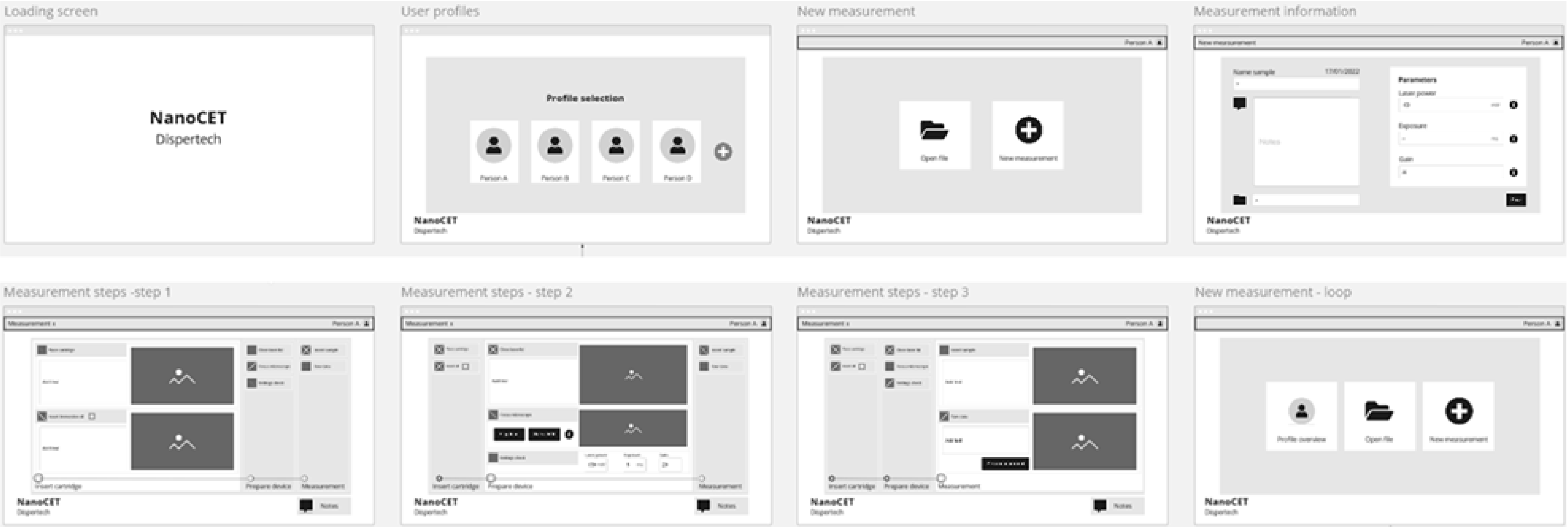
- Knob on the side.
- Power LED still separated from other LEDs.
- Lid is still in the middle.
- Different orientation: *'Could be like this, but I liked the other orientation better.'*



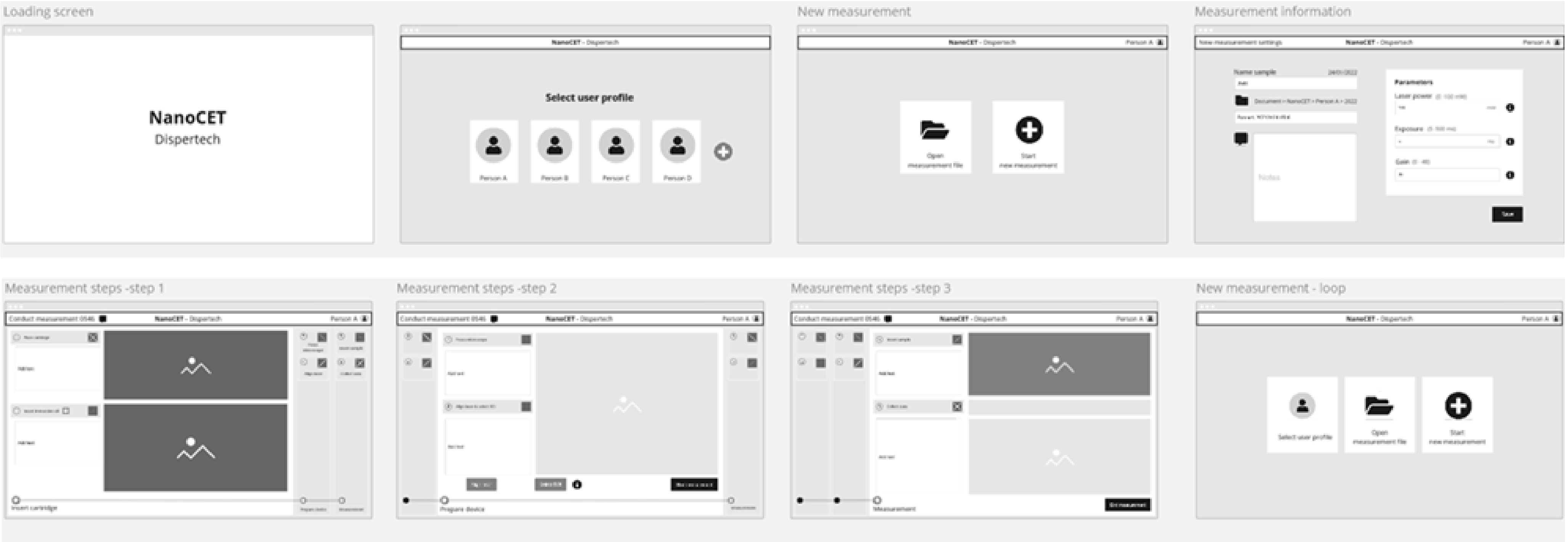
Appendix P1 – Software development process: wireframing



Appendix P2 – Software development process: wireframing



Appendix P3 – Software development process: wireframing



Appendix Q – Interview questions user tests

Right after the user test;
How did it go?
What could have been better?
What would you change about the device/software?
What do you like about the device/software?
Do you think functions are missing? Why?
Do you think there are overrated functions? Why?
Is there a function you would like to add?
Do you think a measurement with this NanoCET is reproducible?
[Questions based on notes during the test]

Workflow
How do you experience the workflow?
These are the tasks you did [show cards] in the user test, what do you think of the order?
Would you switch things around?
Would you prefer inserting the immersion oil in- or outside the device?

Practical questions
How often would you need to conduct measurements with this device?
How would you experience the NanoCET if you'd use it that number of times?
How did inserting the cartridge go?
How did inserting the sample go?
[in case they use pipet guidance] What do you think of the pipet guidance?
When did the device start recording the measurement?

SUS:
Then participants answer the system usability scale statements (scale 1-5);
The system is the device + software.

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

Additional scale questions:
I felt guided by the software. (Scale 1-5)
I felt guided by the device. (Scale 1-5)
I think the device delivers trustworthy results. (Scale 1-5)

Statement	Strongly disagree 1	2	3	4	Strongly agree 5
I think that I would like to use this system frequently.					
I found the system unnecessarily complex.					
I thought the system was easy to use.					
I think that I would need the support of a technical person to be able to use this system.					
I found the various functions in this system were well integrated.					
I thought there was too much inconsistency in this system.					
I would imagine that most people would learn to use this system very quickly.					
I found the system very cumbersome to use.					
I felt very confident using the system.					
I needed to learn a lot of things before I could get going with this system.					
I felt guided by the software.					
I felt guided by the device.					
I think the device delivered trustworthy results.					

Appendix R – User test plan details

Props needed

- Physical prototype of NanoCET
- (My) laptop
- Laptop charger
- Computer mouse
- Desk
- Chair
- Phone
- Phone charger
- Arduino cable
- Pipet
- Pipet tips
- Pipet tips rack
- Sample
- Sample rack
- Cartridge
- Cartridge packaging
- Desk bin (pipet tips)
- Post-it's
- Pen
- Gloves
- Immersion oil
- Tissues
- Think out loud – sign
- Person A name tag
- Tripod
- Thanks for participating chocolate

Resetting the test set-up

o Put the software on the first screen.
o Put the software on full screen (fn f11).
o Put all props back into place (see drawing).
o Check: show hotspots when clicking > off.
o Check: disable keyboard functions > on.
o New consent form.
o Check phone battery.
o Prints: consent form & SUS questions.

Script

First of all, thank you very much for participating! Are you okay to do the test in English? [If not we can continue in Dutch, and quotes will need to be translated. The consent form is in English, but I can help translate the form].

I'm doing my graduation project at TU Delft on the master's Design for Interaction. I'm redesigning the NanoCET device of Dispertech focused on the user experience while working with the device. My goal is to get an impression of the quality of the interaction and improve the design further.

Instructions
I'm not testing you, you are actually testing the prototype. So there is no right or wrong in your actions. It's just that your opinion is valuable for me and the design.

This is a prototype focused on letting you experience the design. It means not all functions might completely be there in the way they would in the actual design of the product. For instance, the digital part of the prototype doesn't allow to type text in text fields, so when you click on a text field the text will appear. You also don't have to actually insert the immersion oil and the sample, but you can act out the action of doing it.

You can help me by telling me all that you think and experience. Therefore, I would like to ask you to think out loud. Say everything you think out loud, so I can follow your thoughts and decisions. [Place think out loud sign]. Sometimes I might remind you to think out loud because it's easy to stop doing that.
I want to film the test, so I can analyse your interactions afterwards. I'm using two angles for that, one focused on facial expressions and one over your shoulder to follow your actions.

Now to officially regulate everything, I have an informed consent form for you. Do you have any questions about anything so far?

Consent form

[Sign consent form]
[Give copy]

Assignment

Okay, now we can start the actual test. Let me start the cameras.

[start recording on laptop]
[start recording on phone]

You're Person A [give name tag with Person A on it]. You're conducting a measurement for Person B who is abroad. You will conduct a new measurement with sample 0546 using the NanoCET. Your cabinet with supplies is over there [point]. For this sample, you need to wear gloves. You start with the device off and the screen on white.

[click on the remote control when switching software parts].

M: make notes of remarkable things, so I can also ask questions about that in the end & click on the remote control knob to manipulate the LEDs of the device based on the software status.
> Check if participants use the pipetting support.

Interventions

No interventions whatsoever*. If a participant is really stuck, ask a question.
*Only interventions when a participant forgets to think out loud.

Appendix S – System Usability Scale scores table

Participant	1	2	3	4	5	6	7	8		
1) I think that I would like to use this system frequently.	4	4	5	4	4	5	5	4		
2) I found the system unnecessarily complex.	2	2	1	1	1	1	1	1		
3) I thought the system was easy to use.	3	4	5	4	5	5	5	5		
4) I think that I would need the support of a technical person to be able to use this system.	5	4	2	2	1	2	4	2		
5) I found the various functions in this system were well integrated.	5	5	5	4	4	4	5	4		
6) I thought there was too much inconsistency in this system.	1	3	1	1	1	1	1	1		
7) I would imagine that most people would learn to use this system very quickly.	5	5	5	4	5	5	4	5		
8) I found the system very cumbersome to use.	1	2	1	1	1	2	1	1		
9) I felt very confident using the system.	3	4	5	4	3	5	5	4		
10) I needed to learn a lot of things before I could get going with this system.	3	1	1	2	2	1	2	1		
Score odd numbered questions	15	17	20	15	16	19	19	17		
Score even numbered questions	13	13	19	18	19	18	16	19	Average	Standard Deviation
Average per participant	70	75	97,5	82,5	87,5	92,5	87,5	90	85,3125	9,106267465
									76,20623254	Min average
									94,41876746	Max average