

HÁSKÓLINN Í REYKJAVÍK
REYKJAVIK UNIVERSITY

ENGINEERING DEPARTMENT

VERKFRÆÐI X
T-620-ENGX

Notebook

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January 31, 2022

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Foreword

The textbook referred to in this notebook is *Product Design and Development* by Karl T. Ulrich, Steven nD. Eppinger, and Maria C. Yang. My group is made up of Aisha Regína Ögmundsdóttir (aishao18@ru.is), Gunnlaug Margrét Ólafsdóttir (gunnlaug18@ru.is), and Inga Kristín Kristjánsdóttir (ingak18@ru.is). My second group is made up of Bjarki Laxdal (bjarki18@ru.is) and Aron Ingí Sverrisson (arons18@ru.is). I will refer to my group members only by their first names since they will come up most often. If images or questions are not cited then they are by me, Lilja Ýr, the author of this notebook. The core CHILL-ICE team mentioned consists of Charlotte Roos Pouwels, Marc Heemskerk, Sabrina, Robert Heemskerk, Annelot, and Kevin McGrath. I have none of their emails.

1 Week 6

1.1 15.02.21 - ICE CHILL Concept Generation

Concept gen - ICE CHILL 15.02.21

- 4G box frí Siminn → worst case
 - ethernet wire - costs $\frac{1}{4}$ our budget
 - cellphone - connection outside of cave
 - will most likely need a wire into cave
 - radios - expensive!!!
 - Tetra - SUPER expensive!!!
 - Hey Phone - need permission
 - need to build ourselves
 - molephone
 - baby walkie talkies
 - (Húsafell, 13 km apart)
- text allowed between cave and mission control
voice between astronauts
keep as hands free as possible

Figure 1: Concept generation for the ICE CHILL project

1.2 16.02.21

First real day of working with the group!!! Here are some pictures:

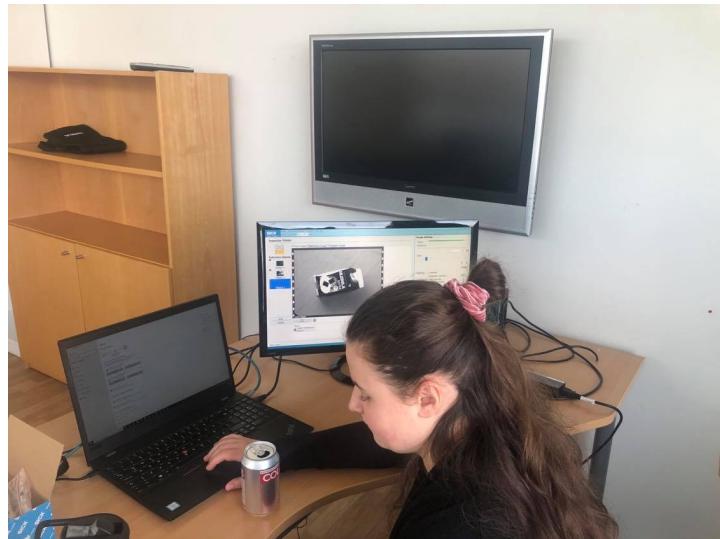


Figure 2: Inga setting up the SICK camera and playing around with the settings to get it to connect.



Figure 3: Inga, Aisha, and Gunnlaug moving the camera around to focus on a drink and trying to get the camera to recognize it.



Figure 4: Me working on the Screening Matrix to help determine which concept we will go with based on constraints compared to the SICK camera, image by Inga

Questions:

Breakout room with my project group, we came up with questions from the reading together and got:

- On page 137 one method is called identification of independent methods and it suggests the the team divides into sub-teams to pursue each concept. Would you consider this a valid method in the time span we have and if not how would we solve such an issue within the group.
 - Not worth it because we are a small group with limited time
 - Worth it once concepts are narrowed down to 2, we can then split into groups of 2 and 2 to pursue the two different methods to solve this problem
 - Helps avoid a loud leader who becomes a dictator of sorts
 - Divide and conquer when you can
- How is physical medium being handled in COVID?
 - We used a whiteboard and try to meet in person as much as we can
- Should the customer be involved in the concept generation?
 - No, easier to show one concept at a time
 - Customer cannot be trusted to make the best or smartest decision with too many concepts presented to them at a time

Here are some questions from others in the class:

- Why is concept analysis done twice? - Andrej
 - Because the funnel (see image ?? in section 5.3) is a wobbly funnel, never returns just one concept
 - Builds repository of ideas to be possibly pursued in the future
 - How to know what the reference concepts are in exhibit 8-7 in the book? - Ignas
 - Use screening matrix first (exhibit 8-5)
 - Concept-scoring - the bold threes are strange, no clear purpose that Foley can see
 - A is reference concept because it was not tossed to the side in the screening matrix or modified
-

1.3 17.02.21

At 16.30 today Bajrki and I met up with Eibhlin to run our current product concepts by her and get her input on whether or not we should continue to pursue that concept or if we should move our focus elsewhere. Eibhlin liked that we had a backup solution of walkie talkies. She said we had a pretty solid plan and asked us to provide her with a simple document with some basic deadline dates and some budget values to show the rest of the group. Which we will create later today. Here is an image of that meeting taken by Bjarki.



Figure 5: Meeting with Bjarki and Eibhlin and some concept testing

1.4 Analysis of Concepts - Freyja Chocolate

Problem: We needed to find a way to identify and alert if the chocolate didn't cover the licorice.

Look up Problem: We came up with a few different concepts:

1. Nvidia Jetson

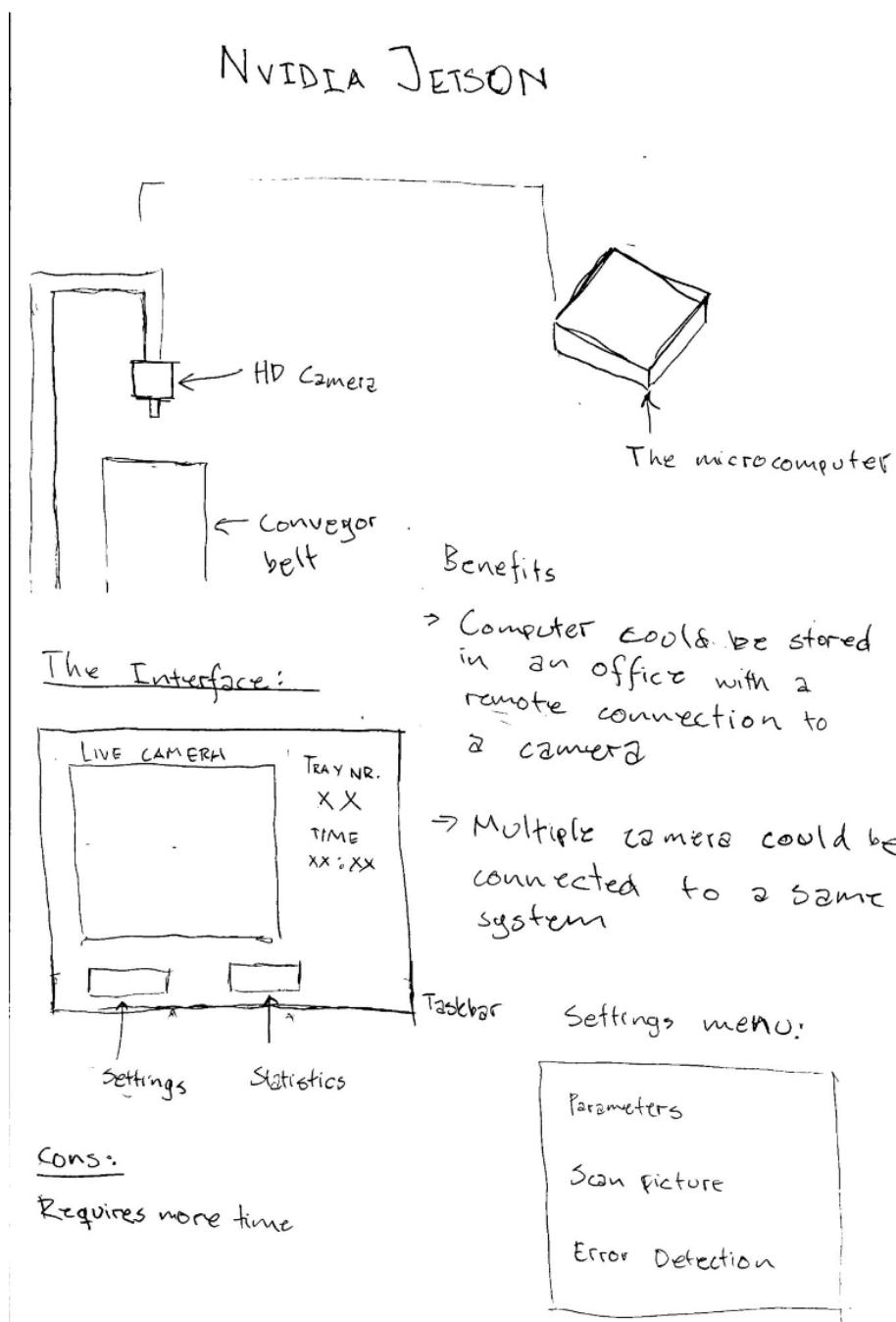


Figure 6: Nvidia Jetson

2. HUSKEYLENS

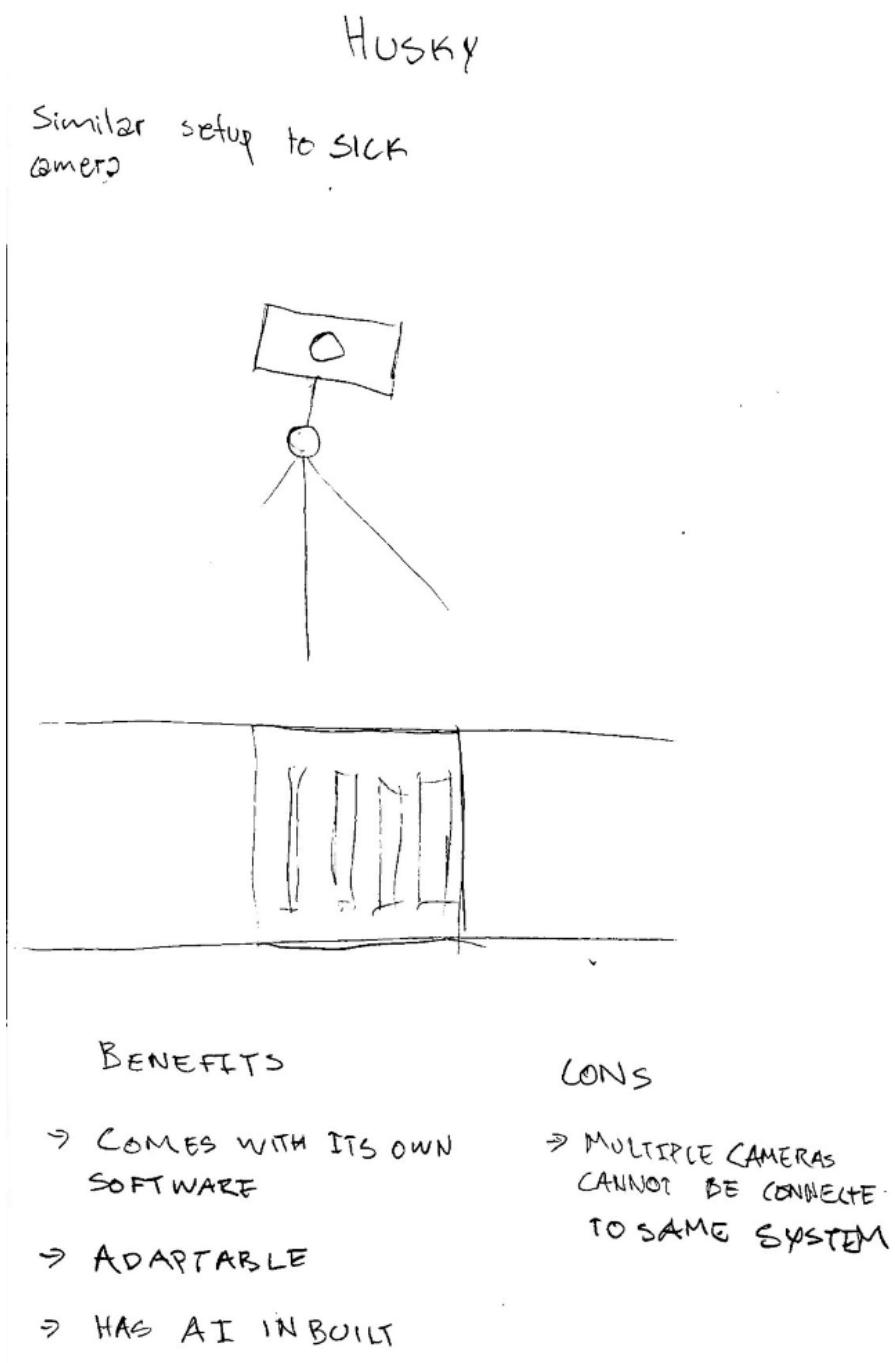


Figure 7: HUSCKYLENS

3. SICK

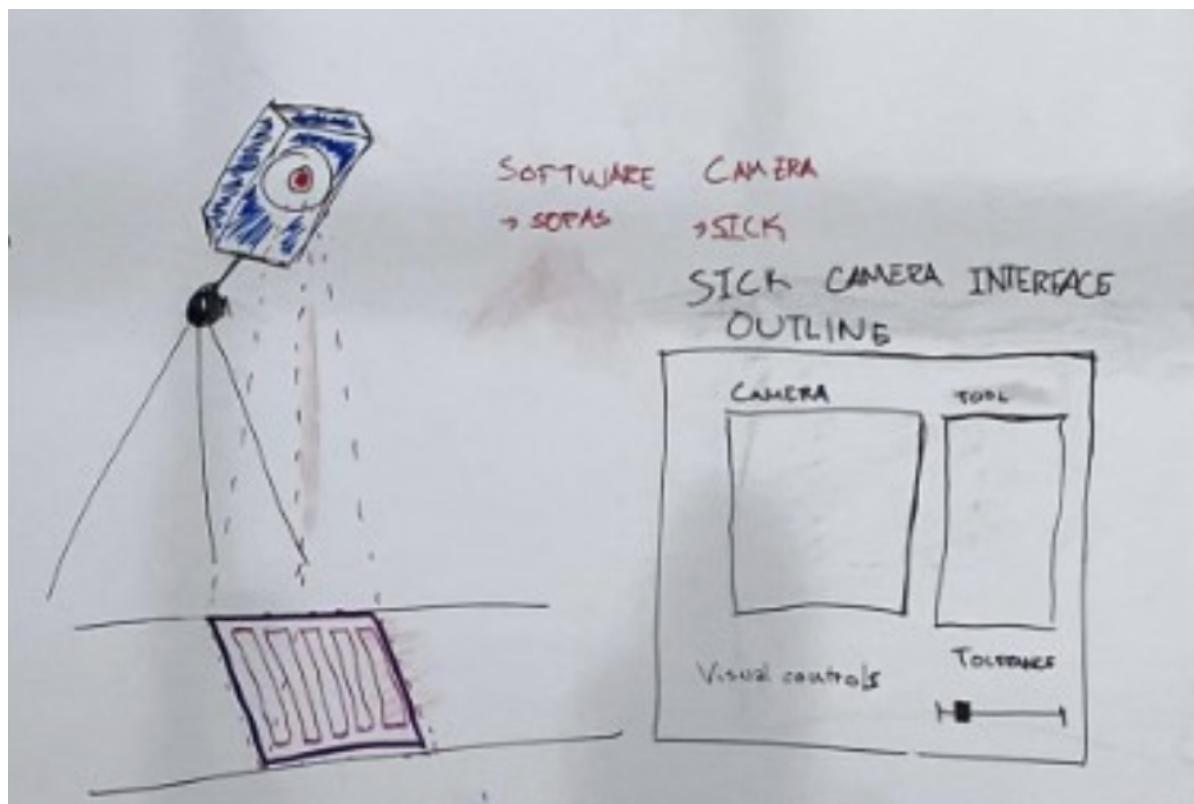


Figure 8: SICK

4. **Raspberry Pi** It would be set up similar to the Nvidia Jetson except on Linux software and Raspberry pi camera instead of USB ELP camera.

Propose solution: We will split the team into two and explore each concept better, divide and conquer

Results: We decided to try out both the SICK Camera (11) and the Nvidia Jetson (9) and see which one works best since we still don't know exactly how each one works. Once that is done we will decide, hopefully within the next week or two, which one works best.

1.5 Assignment 5: Chapter 7-8 - Freyja Chocolate

1. Develop at least 4 different concepts of your product based upon the metrics and requirements previously stated.

1. Nvidia Jetson

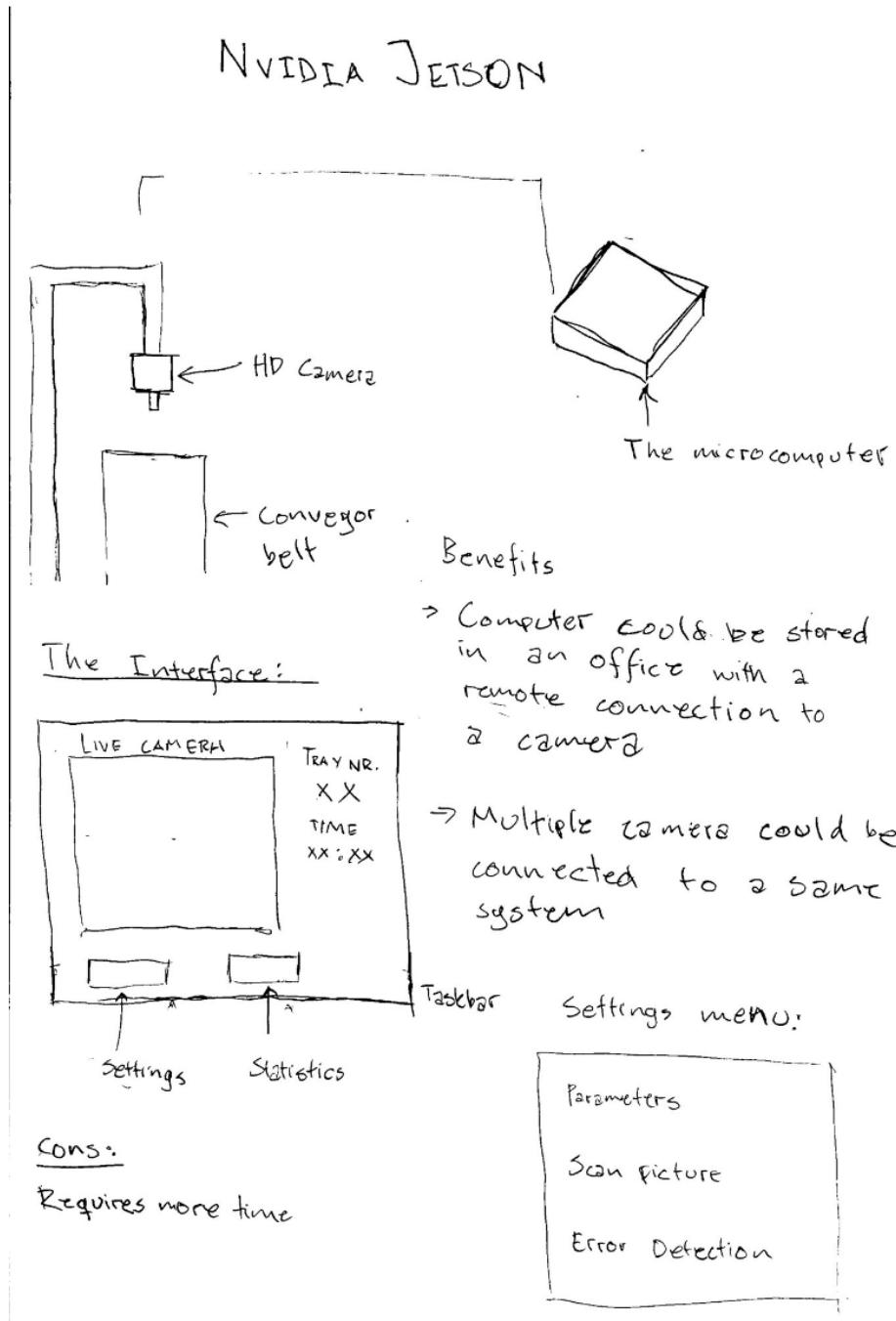


Figure 9: Nvidia Jetson

2. HUSKEYLENS

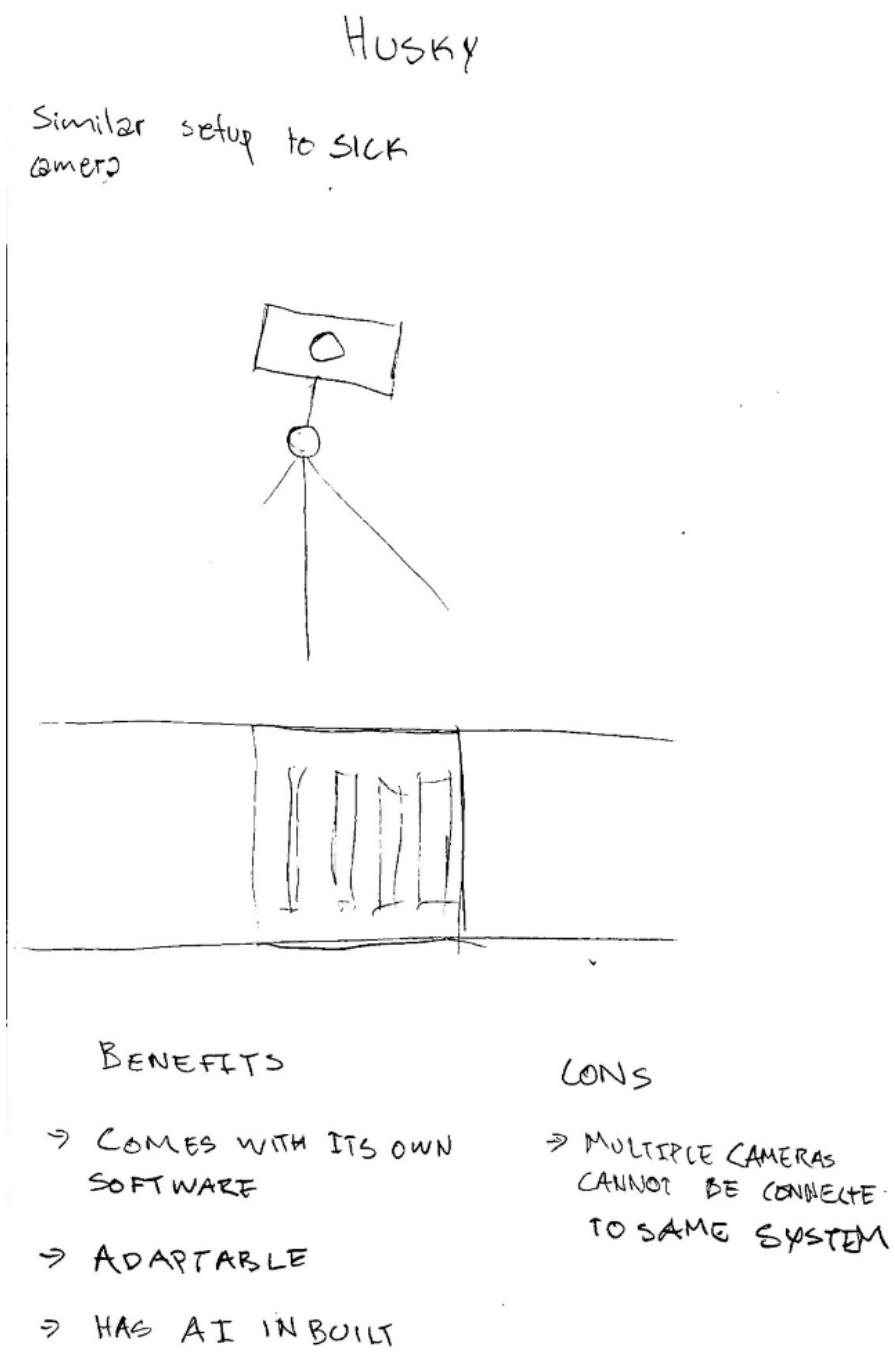


Figure 10: HUSCKYLENS

3. SICK

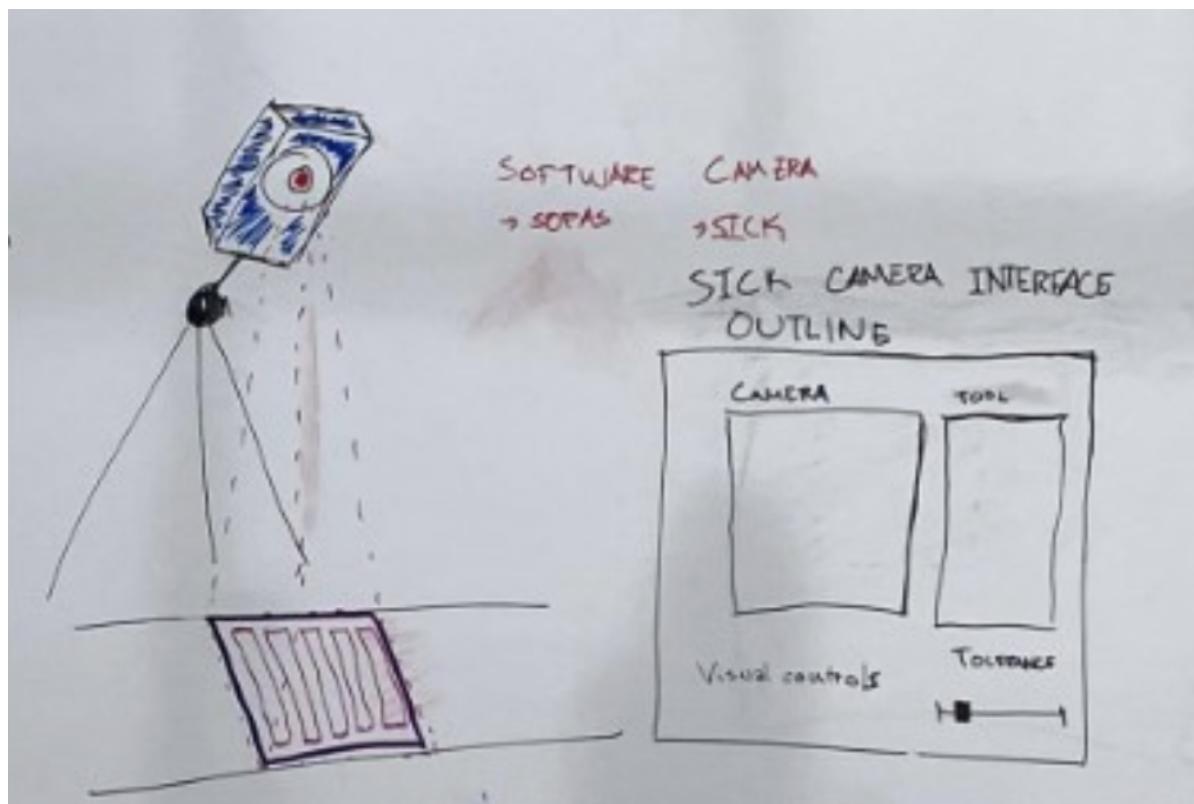


Figure 11: SICK

4. **Raspberry Pi** It would be set up similar to the Nvidia Jetson except on Linux software and Raspberry pi camera instead of USB ELP camera.

2. Screen the concept using the matrix method in Exhibit 8-5 p156.

Selection Criteria	(reference)			
	Sick	Husky	Rpi	Nvidia J.
Lightweight	0	+	+	+
Compact	0	+	-	-
Easy to Integrate	0	+	+	+
Cheap	0	+	+	+
Fast Image Detection	0	-	-	0
Software	0	-	+	+
Adaptable	0	+	+	+
Sum of +'s	0	5	5	5
Sum of -'s	0	2	2	1
Sum of 0's	7	0	0	1
Net score	0	3	3	4
Rank	4	2	2	1
Continue	Yes	Yes	Yes	Yes

Figure 12

Select a final concept you will be exploring and justify the decision. You are welcome to use the concept-scoring matrix in 8-6 to justify the result.

Ultimately after the concept generation and multiple discussions of pros and cons in relation of our metrics for the project. The decision is to temporarily pick two concepts and use the method "Identification of independent approaches to the problem" mentioned in the book - Product Development by Karl T. Ulrich, it involves dividing the team into subteams to develop each concept. We opted for this choice since Samey provided all the technology required for the two concepts. The choices were the SICK concept due

to the fact that the customer wants to know more about the functionality. The other choice is to develop our own AI for the Nvidia Jetson to compare to the usability of SICK.

1.6 Assignment 5: Chapter 7-8 - CHILL-ICE

Develop at least 4 different concepts of your product based upon the metrics and requirements previously stated.

- Cell Phones
- Internet communication
- Radio system
- TETRA

Screen the concepts using the matrix method in Exhibit 8-5 p156.

		Concepts			
		A Cell Phone	B Internet	C Radio system (Reference)	D Tetra
Selection Criteria					
Ease of handling		+	0	0	0
Ease of Use		0	0	0	0
Durability		-	0	0	0
Affordability		+	+	0	-
Reliability		-	-	0	+
Sum of +'s		2	1	0	1
Sum of 0's		1	3	0	3
Sum of -'s		2	1	0	1
Net score		0	0	0	0
Rank		1	1	2	1
Continue?	No	Yes/combine	Yes/combine	Yes/combine	No

The reference is a radio base station system with a cable connecting the cave to the surface.

Select a final concept you will be exploring and justify the decision. You are welcome to use the concept-scoring matrix in 8-6 to justify the result.

After ranking the main concepts based on the concept-screening matrix, the Cell phone, Internet and Tetra methods all ended up in rank 1 with only the reference, radio system, in rank 2.

When deciding which method (Cell phone, Internet or Tetra) we concluded that Tetra would be best, if and only if we had the budget, but since Tetra is at the moment outside of our budget, the cell phone and internet methods are the most appealing methods.

We believe the internet method to be the most suitable, since it is most likely more stable than the GSM signal and can theoretically be used from the comfort of the cave rather than having to go outside to make a call to mission control. Additionally there is a good chance that with the internet method we would get 4G inside the cave and could ditch the cheap handheld radios in favour of a program like [Linphone](#), but in the worst case scenario it is possible to use cheap handheld radios inside the cave and the internet to connect to the control station.

1.7 19.02.21

I presented our collaboration with CHILL-ICE in the communications section for a school in France along with Marc Heemskerk, geologist and astronaut in the project. I presented the slides shown in Figures 13 and 14.

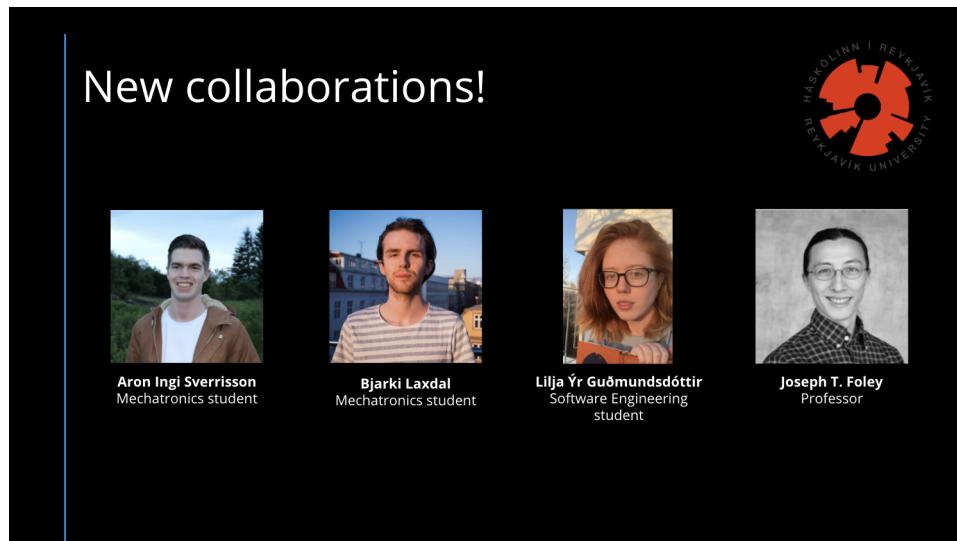


Figure 13: First slide of the presentation from a private file from CHILL-ICE

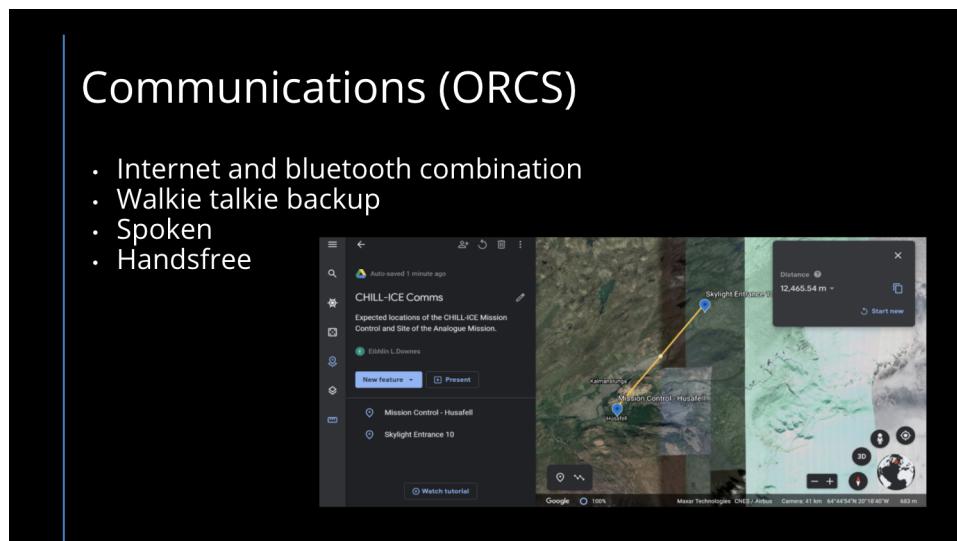


Figure 14: Second slide of the presentation from a private file from CHILL-ICE

I also saw Mars in the sky today as well as the northern lights and the orion constellation all at once!



Figure 15: Cool image I took of Mars and the northern lights

2 Week 7

2.1 22.02.21

Aisha, Inga, Gunnlaug, and I headed up to Samey to work on the project a bit more. Gunnlaug and I managed to connect the camera to the Nvidia Jetson!!! But then we got the following error message in Figure 16 when we tried to connect the AI to the camera which we need to fix.

```
[TRT] TensorRT version 7.1.3
[TRT] loading NVIDIA plugins...
[TRT] Registered plugin creator - ::GridAnchor_TRT version 1
[TRT] Registered plugin creator - ::NMS_TRT version 1
[TRT] Registered plugin creator - ::Reorg_TRT version 1
[TRT] Registered plugin creator - ::Region_TRT version 1
[TRT] Registered plugin creator - ::Clip_TRT version 1
[TRT] Registered plugin creator - ::LReLU_TRT version 1
[TRT] Registered plugin creator - ::PriorBox_TRT version 1
[TRT] Registered plugin creator - ::Normalize_TRT version 1
[TRT] Registered plugin creator - ::RROI_TRT version 1
[TRT] Could not register plugin creator - ::BatchedNMS_TRT version 1
[TRT] Registered plugin creator - ::FlattenConcat_TRT version 1
[TRT] Registered plugin creator - ::CropAndResize version 1
[TRT] Registered plugin creator - ::DetectionLayer_TRT version 1
[TRT] Registered plugin creator - ::Proposal version 1
[TRT] Registered plugin creator - ::ProposalLayer_TRT version 1
[TRT] Registered plugin creator - ::PyramidROIAlign_TRT version 1
[TRT] Registered plugin creator - ::ResizeNearest_TRT version 1
[TRT] Registered plugin creator - ::Split version 1
[TRT] Registered plugin creator - ::SpecialsSlice_TRT version 1
[TRT] detected model format - UFF (extension '.uff')
[TRT] desired precision specified for GPU: FASTEST
[TRT] requested fasted precision for device GPU without providing valid cal
[TRT] native precisions detected for GPU: FP32, FP16
[TRT] selecting fastest native precision for GPU without providing valid cal
[TRT] attempting to open engine for CPU
[TRT] loading...
```

Figure 16: Error message on Nvidia Jetson

Aisha and Inga worked on the SICK camera but it is becoming more and more obvious that that is not the solution we will pursue in the future.



Figure 17: Inga and Aisha working on the SICK camera

We also discussed with Haraldur a representative from Samey.



Figure 18: Aisha, Inga, Gunnlaug, and I talking with the customer

2.2 25.02.21

Foley talked about the rover coming to Iceland which is veeerrryyyy exciting! And we can poke it and try programming which would be amazing.

Aisha, Inga, Gunnlaug, and I also brainstormed some name ideas and came up with:

- No One
- Buddy
- Employee of the Month
- AEye
- The Chocolate Watch
- The All Seeing
- The All Knowing
- Accuture
- Computor
- Accuratep
- IAccurate
- Chocolate watcher
- AI Quality
- Freyja's Eyes
- Draumur's Dream
- A.I.R
- Emergency Processor Doodad
- ChocBot
- AccuBot
- Artifisight!
- Accurasight!
- CEDAI
- CADAI
- Cruinn
- Akrivis
- Tepat

We ended up choosing Akrivis

2.3 Assignment 6: Freyja Chocolate

1. Make a schematics of your product's design elements Exhibit 10-6p 198

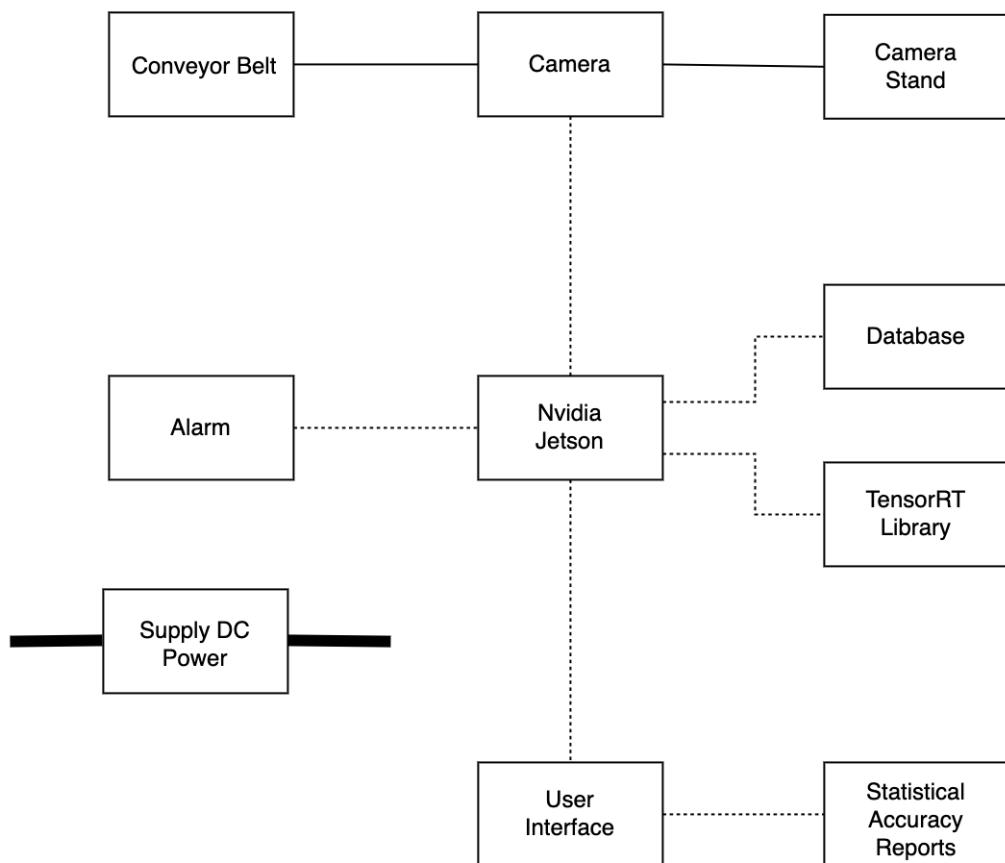


Figure 19: Schematic of Product Design

2. Cluster the elements into chunks: Exhibit 10-7
p.199

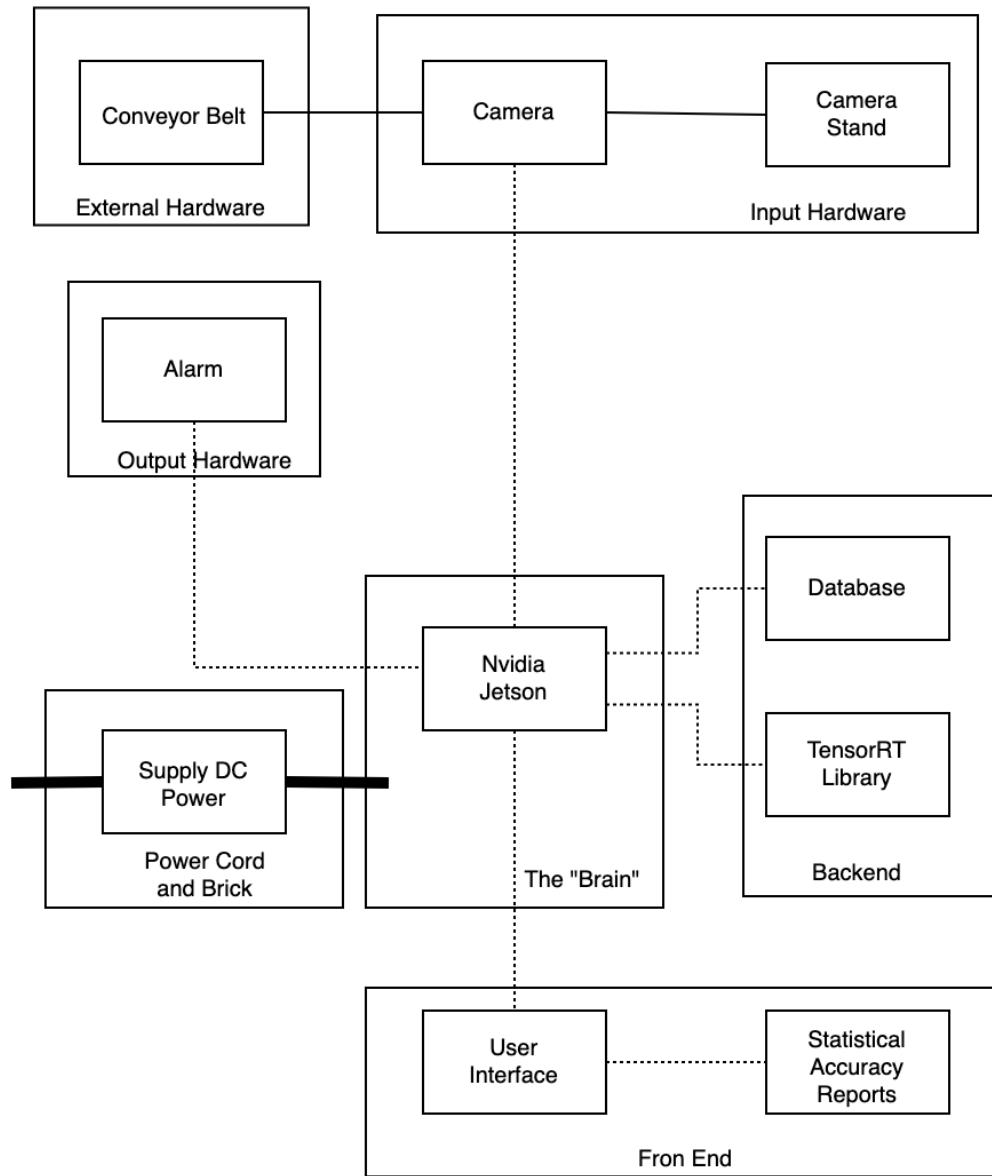


Figure 20: Elements clustered into chunks from schematic in Figure 19

3. Create an incidental interaction graph: Exhibit 10-9 p202.

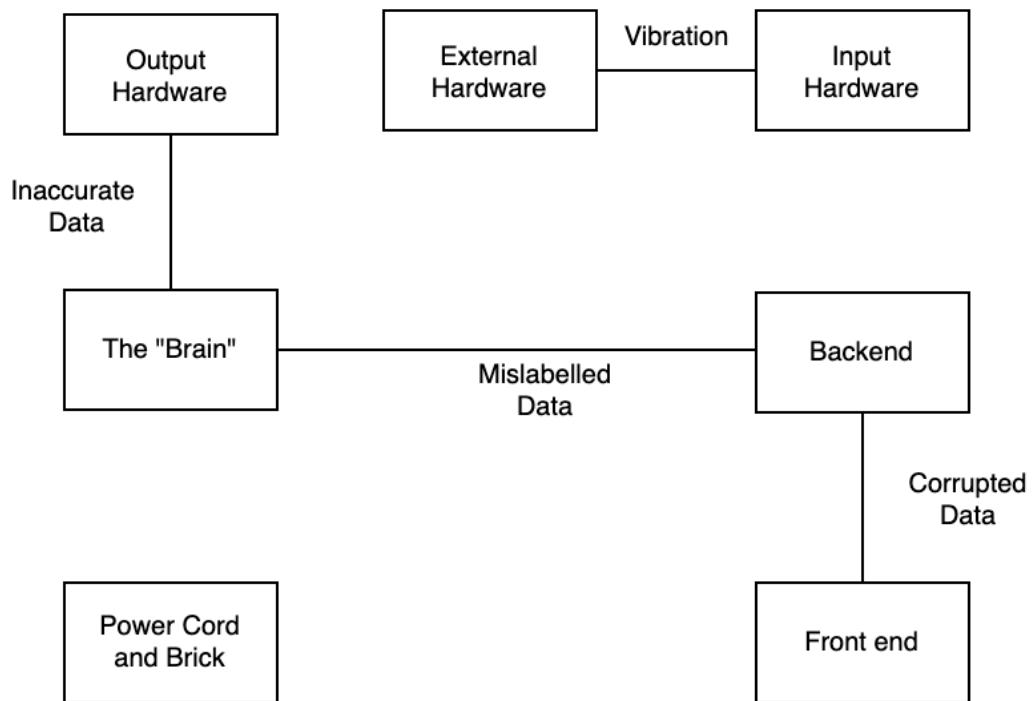


Figure 21: Incidental interaction graph

4. Assess the importance of industrial design in your product: Exhibit 11-3 p221

Needs	Importance					Explanation of Rating
	User experience					
Usability	Low	Semi Low	Medium	Semi High	High	
Usability					X	It is important that the user interface is as minimal as possible and simple enough that any employee that knows the functionality of the system is able to run it. Only displaying the necessary options to run it.
Ease of maintenance				X		The device must be durable enough to be able to use in a factory setting, its modularity enables the buyer to replace parts if damaged.
Complexity of user interactions			X			The primary user interaction is turning the product on and off.
Familiarity of user interactions		X				The process of running a system should be as familiar and simple as a press of a button. There are at most two user interactions with the system otherwise it should be mostly automated.
Safety	X					It is important that the system safely stores the information stored on the database, allowing only certain employees access to the database

Aesthetics					
Product differentiation	X				The product is business to business product and does not need to be identifiable to the average consumer.
Pride of ownership, fashion, or image	X				The ownership value depends mainly on the functionality of the product not the look
Team motivation				X	A unifying goal is to have a system that uses color to detect errors resulting in a more visually pleasing interface opposed to gray-scale video feed.

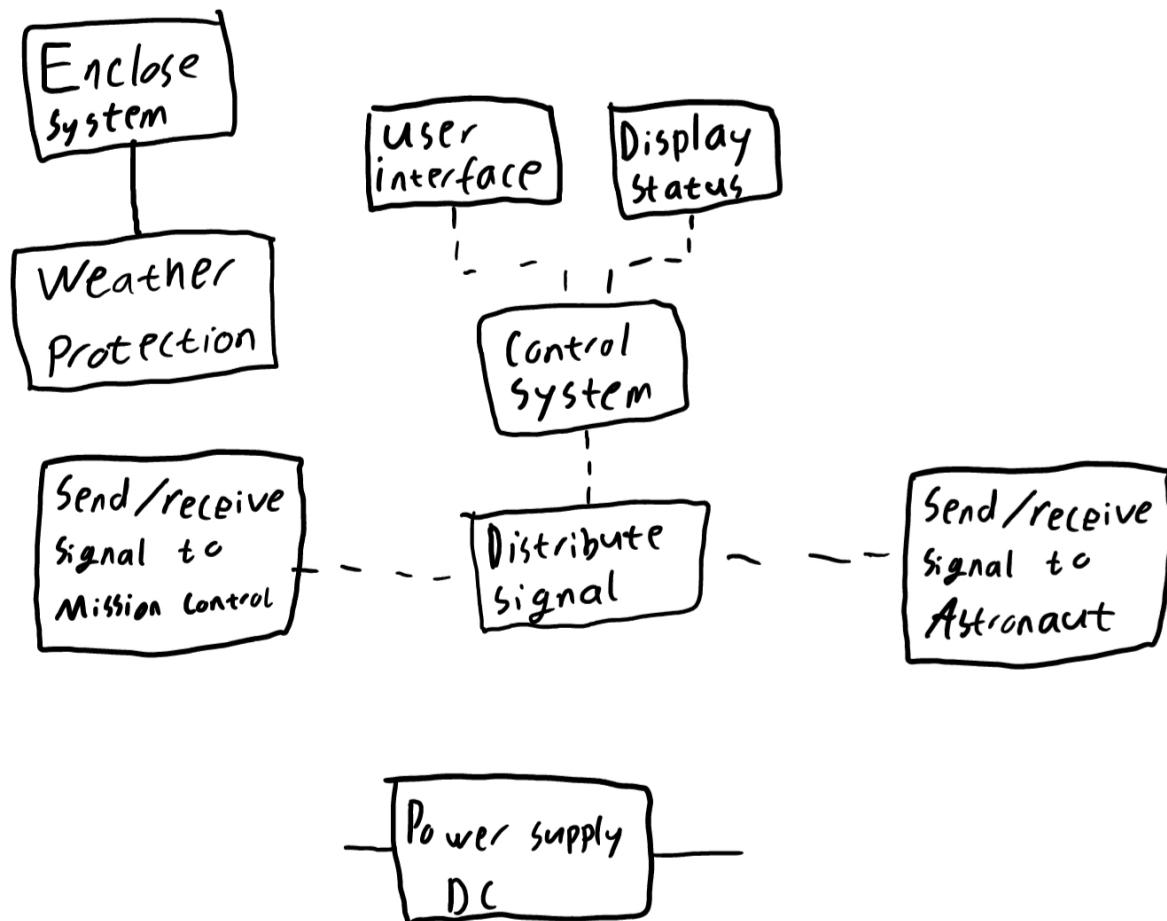
Table 1: Table assessing the importance of Industrial Design

5. Explain how industrial design might improve the interaction, approach-ability, or aesthetics of your product.

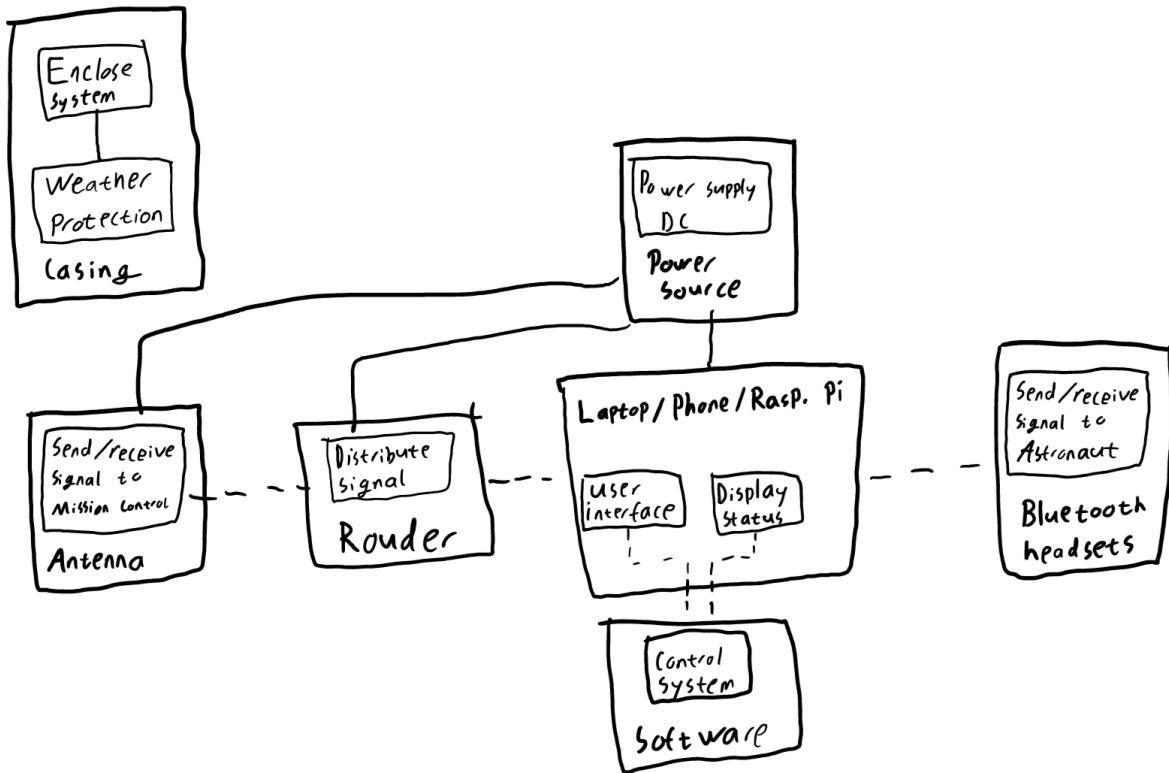
Industrial design improves the interactions of the internal hardware being setup to accommodate for the external hardware. The system will receive better input if the vibration is solved with a stabilizing tripod. The industrial design improves the applicability of the software by emphasizing the requirements of having a minimalistic interface that should simply power on and power off. The aesthetics of the interface should also be improved by giving a cleaner visual by minimizing number of controls of the device.

2.4 Assignment 6: CHILL ICE

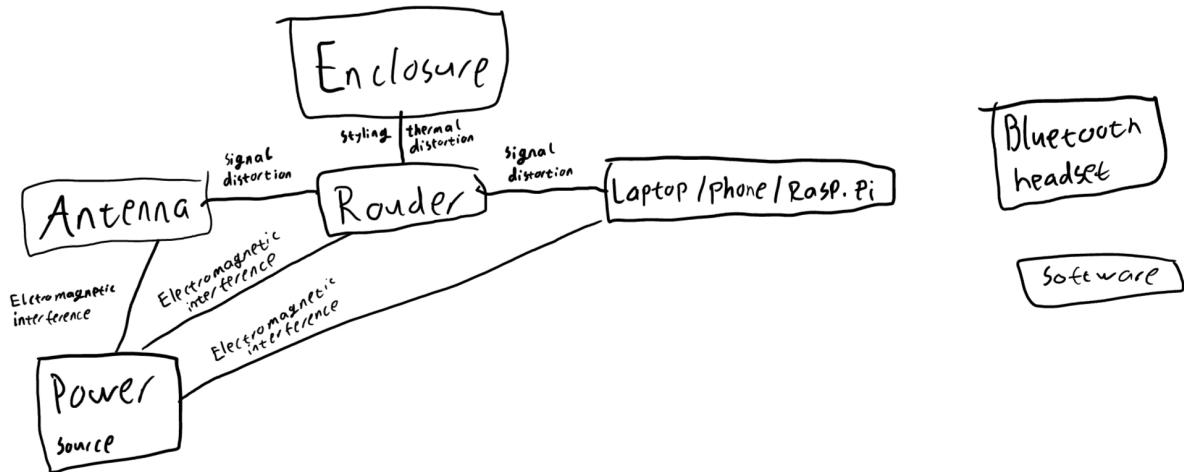
Make a schematic of your product's design elements Exhibit 10-6 p 198.



Cluster the elements into chunks: Exhibit 10-7 p 199.



Create an incidental interaction graph: Exhibit 10-9 p 202.



Assess the importance of industrial design in your product: Exhibit 11-3 p 221.

Needs	Level of Importance	Explanation of Rating
User Experience		
Usability	7	This product should be easy to use by most people that are familiar with Bluetooth and 4G.
Ease of Maintenance	9	Once set up, the Bluetooth headset must be charged every now and then, but besides that, no maintenance is required.
Complexity of User Interactions	5	Primary user interactions are general computer interaction and headset usage.
Familiarity of User Interactions	3	Although all components are well understood by most people, using them together in this way may be a new experience.
Safety	7	The products are not a threat to anyone but setting them up requires a power source and power cables that should be handled with care.
Aesthetics		
Product Differentiation	1	This is a solution made from other well known parts. There is nothing unique in its appearance.
Pride of Ownership, Fashion or Image	1	This is a specially designed solution for a very small group of individuals and done on an extremely low budget so it may not be appealing to most.
Team Motivation	5	A unifying and exhilarating goal of the LSCS team was to create a design that would appeal to the CHILL-ICE group

Explain how industrial design might improve the interaction, approach-ability, or aesthetics of your product.

Should industrial design be a major factor in our product, it could be used to improve the interaction by having a dedicated and fleshed out interface for ease of use and ensuring good communication of its technological capabilities to its user. The approach-ability by creating a chassis or body that is aesthetically pleasing with a luxurious appeal, this would be done with a sleek and minimalistic look, smooth round edges, with no hard angles and an cheap but expensive feeling material choice.

3 Week 8

3.1 02.03.21

Questions

- (Lilja Ýr Guðmundsdóttir) exhibit 10.6 - 198 - if you are making a software then is it all data or are there different lines? There is only one kind of line, it looks a bit different than when there is a physical product.
- (Lilja Ýr Guðmundsdóttir) 196 - responsibility of detail design for each chunk - how many people for each chunk? 2 and 2 as stated before
- (Lilja Ýr Guðmundsdóttir) 202 - 10-9 - incidental diagram - how to id incidental interactions? - look at the environment and deduce what could affect the final result - those lines are representing constraints which turn into incidentals, a lot of them are negative, what can cause you trouble, figure out where you are going to have trouble, looking for sources of noise, only physical interactions, not functional interactions
- (Ignas Urbonas) 11-3 - 221 - team motivation under aesthetics, why and what is it? - the feeling (eða anda í hópnum) creates the aesthetic
- What kind of products benefit from industrial design - technical products overlook industrial design often, processed food has a certain element of industrial design, most products benefit from industrial design
- (Sigurður Ágúst Jakobsson) Can industrial design lower cost? - Industrial design can reduce design cost but not product cost
- (Andrej Shoykhet) Is industrial design important in tech or user products? matters more in user driven products because it is more flaky
- (Eyjólfur Emil Jóhannsson) How to study industrial design? Many ID schools around the world, mostly at art schools at least in the US, not much at engineering schools

Aisha, Inga, Gunnlaug, and I also met up at Aisha's and took a small break after working on the project and played around with a Portable EEG from [Next-Mind](#)



Figure 22: Inga, Aisha, and Gunnlaug moving the camera around to focus on a drink and trying to get the camera to recognize it.

Aisha, Inga, Gunnlaug, and I also started on the presentation. I found a template for both the Freyja Chocolate presentation and the CHILL-ICE presentation.

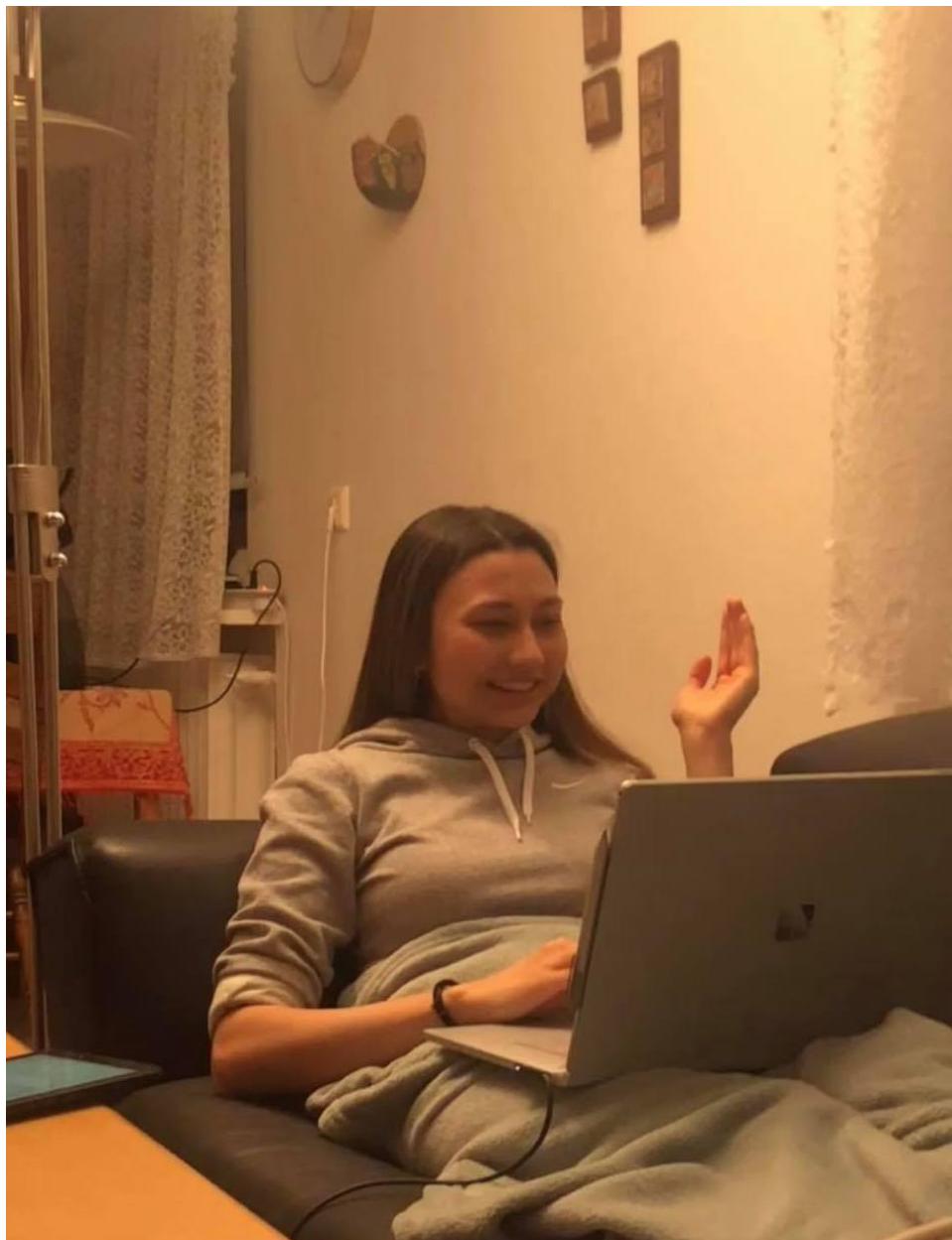


Figure 23: Aisha and I working on the presentation

3.2 03.03.21

Aisha, Inga, Gunnlaug, and I met up at Aisha's to work on the presentation. I also worked with Aron and Bjarki over the internet to work on the other presentation.



Figure 24: First slide of the Freyja Chocolate presentation

3.3 04.03.21

Presentations were today. Aisha, Inga, Gunnlaug, and I presented first and I believe it went alright. Then I presented with Bjarki and Aron. Nothing went wrong and I think our presentations were by far the most interesting presentation wise (not by the content, there were a lot of interesting projects being presented).

The problem that I had with the other presentations was that a lot of them were just big old info dumps. Which is never fun to listen to and especially not suitable for investor meetings as this was supposed to imitate. A lot of these presentations had ALL of the information and tables used to research and find the best product instead of just going lightly over that and then presenting the solution you are aiming for as the main thing of the presentation. Quite a bit of a snooze fest looking at table after table of stuff that no one except people working behind the scenes needs to know.

Overall the concepts were interesting and the execution was dull. Maybe something to work on (always a work in progress to make presentations as interesting as possible, I'm sure our presentations needed some work as well, far from perfect).

Here are the first slides of each presentation in Figures 25 and 26, templates gotten from [SlidesGo](#).



Figure 25: First slide of the Freyja Chocolate presentation



Figure 26: First slide of the CHILL-ICE presentation

3.4 Assignment 7: Freyja Chocolate

1. Disassemble a simple product, such as a ballpoint pen. Suggest two ways to reduce its environmental impacts.

Environmental impact of ballpoint pen can be reduced by:

1. Usages of refillable cartridges

- It is possible to increase a life of a ballpoint pens with removable cartridges. If that is done the ballpoint pen can be reused many number of times, thereby reducing its impact in environment

2. Made from recycled plastic

- Since the cap, barrel, and ink tube of a ballpoint pen are made of plastic, and plastics are made from oil. By using recycled plastics to produce pens, companies could use less oil¹ and therefore contributes to preserving our natural resources.

2. Compute the environmental impact score for your product using any LCA (Life Cycle Analysis) tool available to you.

DFE Assessment Factor	Product Score	Factor Weight	Weighted Score
Material Chemistry	70%	40%	28%
Recycled Content	60%	12.5%	7.5%
Disassembly	90%	35%	31.2%
Recyclability	60%	12.5%	7.5%
Overall Score		100%	74.2%

Table 2: LCA

The team used Herman Miller's DFE assessment tool to calculate the environmental impact score for our product. Herman Miller's DFE assessment tool uses a scale from 0 to 100 percent. The team's product, Akravis achieved a rating of 74.2% as can be seen in table 2. The grade the team's product scored is good but can be greater. In the material chemistry part the materials used for our product are mostly environmentally friendly. The Nvidia the company that is producing the Nvidia Jetson Nano is environmentally friendly company. The company is dedicated to keeping technology products out of

¹<https://www.staplesadvantage.co.uk/get-inspired/sustainability/being-more-green-and-respecting-our-environment-how-to-succeed-following-these-resolutions/>

landfills, as they contain chemicals that can be harmful to the environment². The Nvidia Jetson Nano consist mostly of printed circuit board which contains copper, glass fibers and other metals. The copper part of the board is completely recyclable as a metallic material³ and is the only thing of the circuit board which has any value. The printed circuit board also contains FR4 material which is a thermoset plastic are made with chemical reaction and can not been broken down once it has been made. This makes it a strong plastic but however it is almost impossible to recycle⁴. Most of the camera the team is using for their product is made from aluminium which is good since aluminium is one of the most environmentally friendly metals on the planet and can be recycled infinitely to make exactly the same product⁵. The only harmful material that could be found through a lot of googling was plastic material both in the circuit board and the micro SD card.

3. Use DFM techniques to estimate the manufacturing cost of your product

Component costs

Assembly costs

Overhead costs and supplier profit

Logistics costs

Component costs	
Raw Materials	40.932 3.4
Equipment & tooling	30.000 ISK
Labor (40 hours)	400.000ISK
Assembly costs	
Labor (2 Hours)	10.000ISK
Overhead costs and supplier profit	
Maintenance (4 hours a year)	20.000ISK
Supplier Profit	20.000ISK
Logistics costs	
Shipping	6.363ISK
Taxes & Import Fees	21.326ISK

²<https://www.nvidia.com/en-us/csr/product-recycling/>

³<https://www.intercotradingco.com/recycling-printed-circuit-boards-pcb/>

⁴<https://custommaterials.com/what-is-fr4-material/>

⁵<https://origin-global.com/advice-centre/is-aluminium-environmentally-friendly>

4. Create a Bill of Materials for your product: Exhibit 13-6 p270

Part Nr	Description	Rev
1	Micro Computer	A
2	Usb camera	A
3	SD card	A
4	Power cable	A
5	HDMI cable	A
6	Ethernet cable	A
7	Tripod	A

^a<https://amzn.to/2PJDmPT>

^b<https://amzn.to/2N1s1K6>

^c<https://elko.is/kingston-32gb-micro-sdhc-canvas-select-sdcs232gb>

^d<https://amzn.to/3qB5LEC>

^e<https://www.tl.is/product/hdmi-kapall-2m-4k-hec-arc-3dethernet>

^f<https://www.tl.is/product/netkapall-2m-cat5e-graenn>

^g<https://bruartorg.is/vara/velbon-m47-thrifotur/>

3.5 Assignment 7: CHILL-ICE

Disassemble a simple product, such as a ballpoint pen. Suggest two ways to reduce its environmental impacts.

There are many different ways to reduce a ballpoint pens environmental impacts, e.g.

- Using recycled plastics to produce the pens.
- One way is more user based and that is to have the user refill the ink in the pen instead of buying another one, this could be done by selling an ink bottle alongside the pen for refills, and then selling ink bottles separately when the one that comes with the pen runs out.
- Using materials that are recycling-compatible, i.e. all the materials in the pen are easily recyclable (the pen is all made of the same material apart from the ink obviously.)
- Increasing the ink volume of the pen to increase if life cycle, making people have to buy new pens infrequently.

Compute the environmental impact score for your product using any LCA (Life Cycle Analysis) tool available to you.

We did not manage to find any information about how the raspberry pi, Huawei router, or Síminn 4G router are manufactured nor what type of plastic, solder etc. were in them. Additionally we know that they will require electricity but if that electricity will be generated from solar power or diesel generator is still to be determined. On another note, due to the fact that our product will only be used in two 48 hour missions and then after be recycled, reused, or repurposed in other projects, we feel like the environmental impact score will be relatively low due to the life cycle being extremely short.

Because of the reasons listed above we did not manage to compute an environmental impact score.

Use DFM techniques to estimate the manufacturing cost of your product.

Due to the fact that our product is a service rather than a manufactured product, we have no manufacturing costs.

Only possible manufacturing cost would be personal labour time, but since this is a school project we would not charge for that.

Create a Bill of Materials for your product: Exhibit 13-6 p270.

Part nr	Rev	Description	Unit cost	Qty	Total cost
1	A	Cat e5 chord	104kr/m	60m	6.240kr
2	A	Raspberry pi Zero	1.667kr	3	5.000kr
3	A	New bee bluetooth headset	4.000kr	3	12.000kr
4	A	Huawei B535 4G	15.990kr	1	15.990kr
5	A	Síminn 4G Loftnet	24.990kr	1	24.990kr
Net cost:					64.220kr

When creating the table Material, Unit var. cost, tooling cost, tooling life and unit fixed cost were excluded. Unit var cost was excluded since none of the required items will be mass produced and therefore the cost will not change. Since no manufacturing occurs, we have no tooling cost or tooling life thus those columns were also excluded. Finally, since only pre manufactured items are used and are simply plugged together, there is no need for the material column.

4 Week 9

4.1 09.03.21

Questions

- (Inga Kristín Krisjánssdóttir) How do we make a software more environmentally friendly? - You don't
- (Inga Kristín Krisjánssdóttir) Bill of material, do we need to estimate our time as material or do we just estimate the physical items? - Shouldn't be in bill of materials but should be in final cost.
- (Inga Kristín Krisjánssdóttir) If making the product more environmentally friendly induces the cost by 50% is it still a good idea? - It depends on the original price, if it costs 1\$ and not cost 2\$ it might not be so bad but if it goes from 1000\$ it might have a bit impact on whether this is a good idea or not
- (Lilja Ýr Guðmundsdóttir) What is LCA? It is used to calculate the environmental impact of the product.
- (Lilja Ýr Guðmundsdóttir) What is Tooling Life in exhibit 13.6? - consider labor or only the parts themselves.
- (Andrej Shoykhet) Optimization when? - develop reasonable requirements before optimization (axiomatic design), otherwise it is like shooting a bow and arrow without seeing the target.
- (Ignas Urbonas) Can you use software for optimization? - optimization software good to check out, nobody in that phase with current projects, make sure tolerances or metrics are reasonable.
- (Fynn Samuel Sudermann) How to come up with good factor weights without influencing/biasing results (exhibit 12-12)? - company gives what is priority and that gets extra weight, makes comparing two companies very difficult.
- (Sigurður Ágúst Jakobsson) - How big does a company need to be to have a designated DFC team? - There are companies to do this for you to assess lifecycles (done in smaller companies), this matters more in Europe (they care about the environment) unlike in USA, Environmental motivation to do the right thing, for instance lead solder nicer to work with but is more toxic, could be forced to design for environment because of regulation or people stop manufacturing with certain materials or components you might need, consider these elements for longevity
- (Eyjólfur Emil Jóhannsson) What helps decide DFC guidelines? - Depends on company and its priorities, what matters to you

Aisha, Inga, Gunnlaug, and I also met up with Foley after class to discuss the paper and he had this to say:

- Add axiomatic design - how did you make it modular and robust (add this in abstract)
 - Talk about false negatives and positives - ratios of those to the whole result from the data, see if that is ok (for sensitivity and selectivity)
-

4.2 11.03.21

- Deleted 2 assignments - Yay!
- Overview of oral exam
 - Q1: show us how you are a hard worker
 - Q2: show us how you are awesome
- Robust design - axiom 2
- Optimize linear process - easier, more predictable
- As an engineer you need to figure out what tests you can get away with not doing
 - I found this image pretty funny from the slideshow Foley showed about assessing robustness (an important factor in product development).

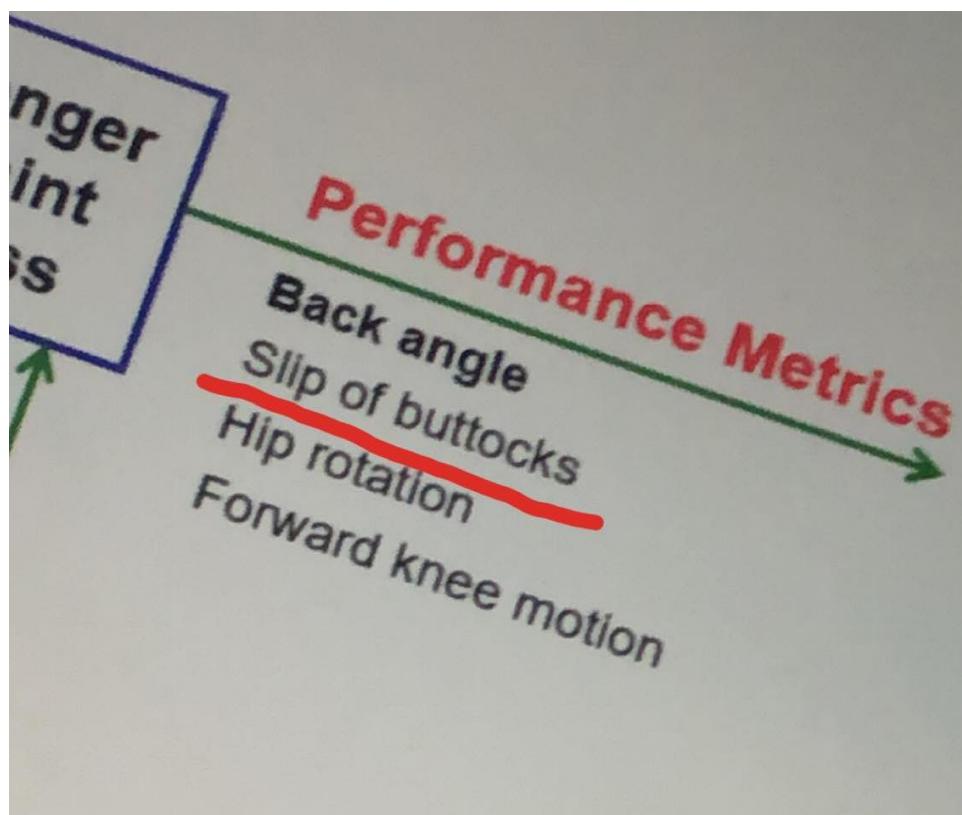


Figure 27: Slip of Buttocks when assessing the robustness of seat belts

4.3 Assignment 8: Freyja Chocolate

1. Define the purpose of your prototype

See table 3

2. Establish the level of approximation of the prototype

See table 3

3. Outline an Experimental Plan

See table 3

4. Create a schedule for Procurement, Construction, and Testing

Name of Prototype	Akravis Accuracy Test
Purpose(s)	<ul style="list-style-type: none">• Select the correct tolerance parameter for the chocolate error detection• Have the system detect no more than the minimum amount of allowable false positives and negatives
Level of Approximation	<ul style="list-style-type: none">• Correct parameter settings depending on the environment
Experimental Plan	<ul style="list-style-type: none">• Identify the outline of the mold for the chocolate containers• Detect the amount of black pixels from live video feed• Conduct accuracy tests on various defective chocolates
Schedule	<ul style="list-style-type: none">• 25.03.21 Identify the outline of the mold• 31.03.21 Determine the parameter of the tolerance• 03.04.21 Create the interface to turn the system on and off• 10.04.21 Determine and fix bugs in system• 14.04.21 Finish hardware setup of the system

Table 3: Example 1-4

5. Create a minimal prototype in class to present next week

Our experimental prototype shows how the program is supposed to work, when the system spots a defective chocolate the system should send a signal, otherwise the system shows that everything is okay. We decided to demonstrate the conveyor belt with some paper bags and replicate what the camera sees. While the amount of black spots is within range the system shows a green frame around the chocolate. But when the system detects too many black spots the frame turns red and we get a warning signal.

6. Formulate an Objective Function for your experiment

For our design the objective is to minimize the number of defective chocolate. This revolves around the balance of false negatives and positives. The team's objective will be to pick the system setting parameters that will result in the smallest values of false positives and false negatives. Therefore the team will be using the minimizing type of an objective function that is described in the following manner in chapter 15 the book ⁶:

$$\eta = \frac{1}{\sigma^2}$$

Where the η will represent the amount of defective chocolates and σ represents the sensitivity/tolerance variable that determines if there are enough black pixels to be defined as a defective chocolate.

7. Choose an "Experimental Design" p323 that you will be performing later with a full prototype

For our prototype the team decided to pick the 1/8 fractional factorial design. This is the most appropriate solution for the following project as it the most inexpensive way to test. Testing will mostly depend on the output of the design. Testing will be conducted until the number of false positives and false negatives are minimized. Only the necessary amount of defective chocolate molds will be produced until the balance between false positives and false negatives is achieved.

⁶Product Design, by K.T. Ulrich, S.D. Eppinger and M.C. Yang

4.4 Assignment 8: CHILL-ICE

Define the purpose of your prototype

Confirm that the router can reliably distribute WiFi inside the habitat cave.

Confirm that the VoIP service has a steady connection inside and outside the habitat cave.

Establish the level of approximation of the prototype

Correct antenna and router combination.

Correct VoIP service.

Correct WiFi frequency.

Outline an Experimental Plan

Conduct VoIP communication testing on site.

Conduct testing of different VoIP Services (Discord, Teams, Linphone, etc.).

Conduct testing of different WiFi frequencies (2.4 GHz vs 4 GHz).

Create a schedule for Procurement, Construction, and Testing

Procurement will occur once talks with Síminn have finished regarding a sponsorship or new information from Space Iceland regarding money.

Construction will happen as soon as procurement is finished. (Approx. Procurement + 1 week.)

Testing will occur once construction is finished. (Approx. Construction + 1 week.)

Create a minimal prototype in class to present next week

The minimal prototype is Aron and Bjarki using headsets to communicate with VoIP on discord.

Formulate an Objective Function for your experiment

A Maximizing function is used, since we want a strong WiFi signal inside of the habitat to ensure the communication is reliable and doesn't lose connection during missions. The objective function will be in the form of $\eta = \mu$. μ is the mean of the experimental observations and η is the objective function.

Choose an "Experimental Design" p323 that you will be performing later with a full prototype

Since there are only a handful of factors that need to be tested and all of them are cheap to test, the Full factorial matrix was chosen. Using the Full factorial matrix, different types of VoIP will be tested on the two different router settings (2.4GHz and 4GHz) to see which VoIP has the best quality and stability.

Here is an image of where we will be:

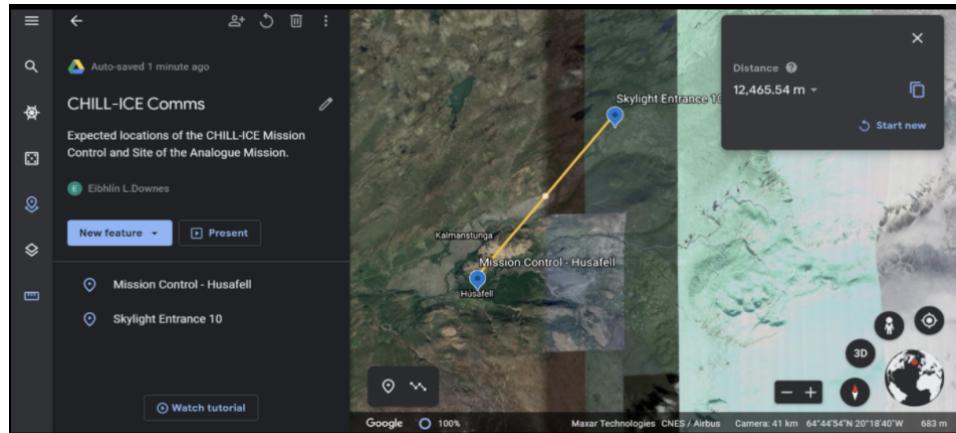


Figure 28: A map of the area we will be testing in courtesy of the CHILL-ICE core team

5 Week 10

5.1 16.03.21

Inga, Gunnlaug, and I met up at Samey to continue working and to record for our minimal prototype. Here the team is up at Samey



Figure 29: Picture of Inga and I working on setting up for the minimal prototype at Samey taken by Gunnlaug

Here you can see the setup for the minimal prototype to show what we had in mind. We would not have a huge tripod in the final product but rather mount it up over the conveyor belt for a better angle but the tripod works for now.

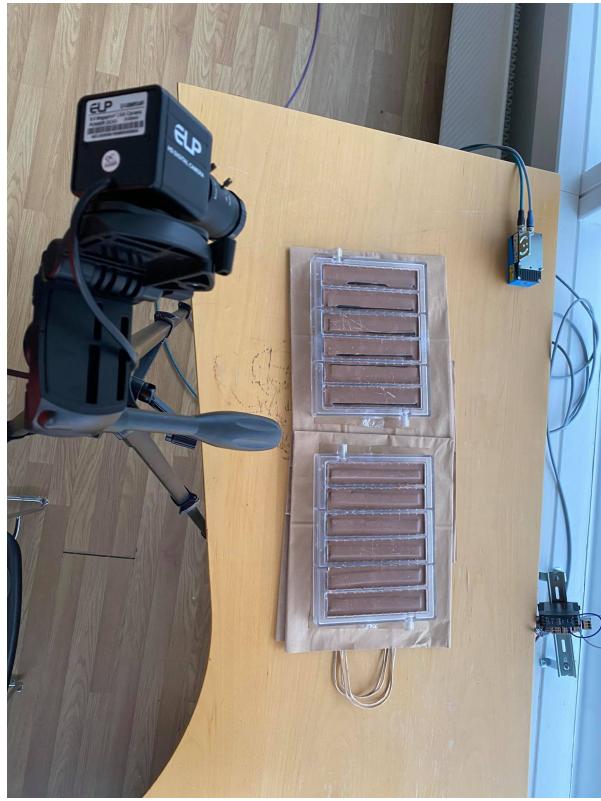
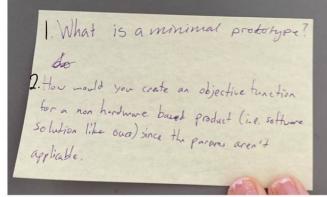


Figure 30: Setup of the minimal prototype so we can show what we had in mind

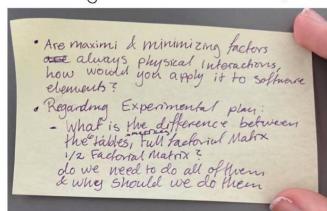
Here are Inga's notes in my scratch book (a book I use when while we were discussing the questions for this class period which Inga, Gunnlaug, and I discussed since Aisha was stuck elsewhere.

We asked (breakout room med 6- og 7)



This is fun

Writing becomes super bad



•

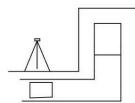
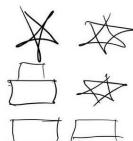


Figure 31: Notes from Inga in my scratch book

Questions:

- (Egill Guðbergsson) Looks vs. Works in prototype? - depends on the product and the experiments
- (Lilja Ýr Guðmundsdóttir and Gunnlaug Margrét Ólafsdóttir) What is a minimal prototype? - Full prototype = comprehensive prototype
- (Lilja Ýr Guðmundsdóttir and Gunnlaug Margrét Ólafsdóttir) How would you create an objective function for a non hardware based product since parameters aren't exactly applicable? - Test driven development, create tests - OF (minimize defective chocolate), sensitivity + selectivity by changing variables, optimal experimentation
- (Leifur Halldór Arason) Factors and levels - what are the levels? Metrics (project specific), discuss what you can adjust, find levels from competitors and previous products, defines whether it matters or not
- (Sigurður Ágúst Jakobsson) What is the best way to choose expense plan? - decided based on cost and resources available
- (Aron Ingi Sverrisson) Adaptive version of one factor at a time? - written about in paper (mentioned page 330 in book), Foley doesn't know how to do it

Design

number design params

itemize list but still number them

p. 7 → DP list

revise design section so we are only focusing on NJ or CN

Due to this limitation the SICK camera will not (be used at all)
↳ doesn't meet FR-# in decision process

DP-O → mention using NJ

↳ our DP is not a DP, too much like a FR

make NJ sys that detects black pixels → new DPO

↳ make as wide as possible wrt regards to chosen method

↳ detect defective choc without oversight

p. 4 design sys that does not need monitoring → FR-O

↳ chocolate and defects not mentioned in FR-O

no need for monitoring = constraint

Ax. digr - design decomposition

↳ also illegible picture

p. 7 restate DPs

p. 9 not a modular dependency diagram → technically is though

Architectural diagram / System diagram

Architect. schematic

Figure 9 → fix contrast, looks unprof.

Fig 6 → landscape
and rectangles

Fig 10 → text unreadable

Make all figure text big as caption text

Figure 9 and 10 unnecessary

Figure 32: Design notes

5.2 18.03.21

Missed class, decided to just work on the prototype instead. I used this to imitate the green square that would track the "good" chocolate

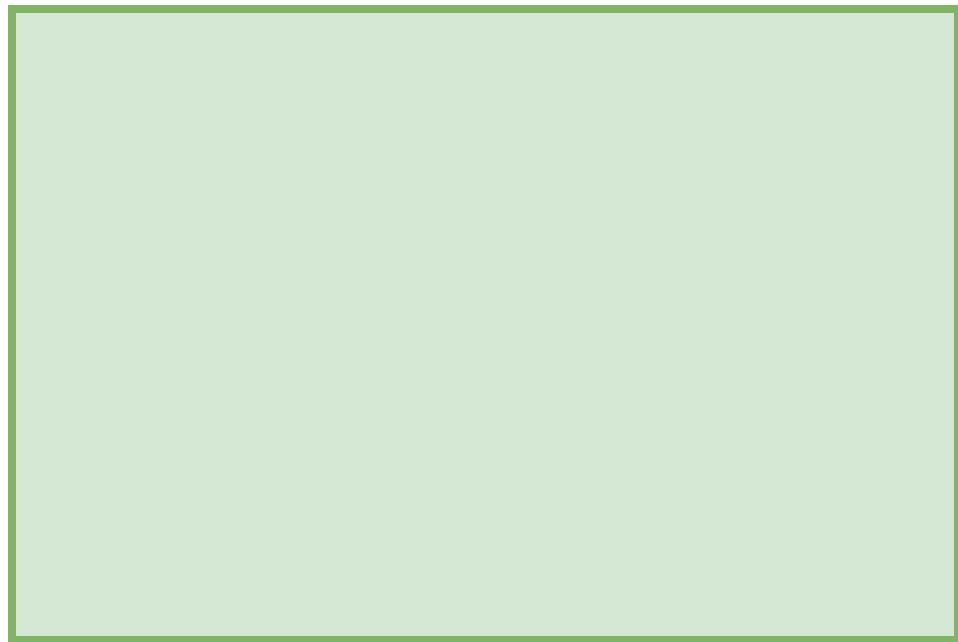


Figure 33: Design notes

6 Week 11

6.1 22.03.21

I had a meeting with CHILL-ICE. They were all nice and my internet was crap. Met with Charlotte Roos Pouwels, Marc Heemskerk, Sabrina, Robert Heemskerk, Annelot, and Kevin McGrath.

Foley sends bill of materials for chill ice

They want test results

Like hands free bluetooth → heavy suits
fat suits

TEST

They want to be able to listen in

+ Iceland

Check out for power supply inside RU

↳ Kevin, check with Foley

Student grant (Rannis) Space Iceland

Funding for food and cars

no dry freeze

Húsafell gisting → cabins from Susanne
might be reddad

Figure 34: CHILL-ICE Notes to keep in mind

6.2 23.03.21

Foley went over patents and things to have in mind.

Lecture 23/03/21

Patent → lawyers

Secret → like with coca cola

↳ one div only knows one
another div knows the other one

Trade secrets for mech project

NDA in Germany → one thing wrong makes entire thing invalid

Always get a lawyer that knows national and international laws

You can patent plants, what?

Figure 35: Patent reminders to keep in mind

6.3 25.03.21

Oral exam with Foley over zoom to assess the status of the project, didn't show enough about what I did. Forgot to mention:

- Main contact with the CHILL-ICE core group
 - Working with fidgeting with the AI and getting the camera to work with Gunnlaug
 - Did the presentations for both groups
 - Went over the English for both final essays.
-

7 Week 12

7.1 30.03.21

Foley forgot class and I showed our team's [minimal prototype](#) which I created in iMovie for the chocolate project. Then we worked on the final essay.

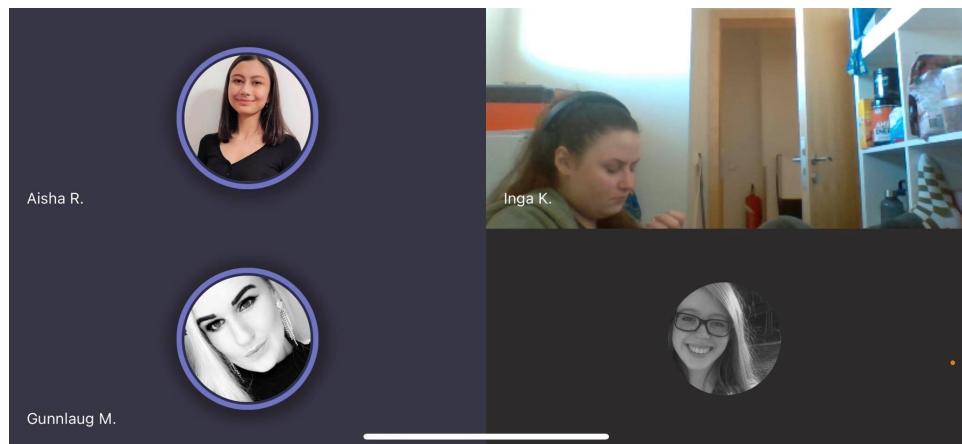


Figure 36: Meeting on teams