PD4105

DESIGN FOR REPAIR

Emilia Ziolek - 21307067

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WEEK 1

BRIEF

PD4105 – Design for Repair

Tutor Details

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Bas Flipsen TUDelft

Project Background & Information

'If you try and take a cat apart to see how it works, the first thing you have on your hands is a non-working cat'. *Douglas Adams*

With dwindling resources, changing consumer habits and a growing appetite for repairing devices from citizens, we, as designers need to rethink how we design and develop products so they are ready for a truly circular economy.

Building on the product disassembled in Design for Sustainability, you are asked to examine and explore the system to identify hotspots for improvement that are efficient and worthwhile. You will then complete a full redesign an identified component(s) or part(s) of the product.

At the same time you will work on raising awareness and building capacity and confidence amongst citizens to conduct repair through visual blueprints and repair instructions, as well as visualisations for the product and the redesigned components.

This Project Teaches You To:

- *To expand knowledge and practical application of mechanical reasoning, manufacturing and materials, and design detailing.*
- *To develop critical thinking skills and complex problem-solving abilities.*
- *introduce tools, techniques and methods applicable to innovation and industrial demands.*
- *To develop and advance design skills in DFM, Visualisation, Graphic Representation.*

Deliverables

1. Process Book
2. DfM Files
3. Repair instructions
4. Visualisation

Duration
4 weeks

Weighting
100%

UNIVERSITY OF LIMERICK
OLLSCOIL LUIMNIGH

School of Design

Project Details

Project Stage	Stage Details	Deadline
Revisit and Revise 25%	Revisit the product you disassembled in DfS class, if you don't have a product then ask a classmate for their Bill of Materials Data. Use the data to create a Disassembly Map and an LCA. Analyse the data to identify hot spots where impact is high and the potential benefits apparent. Explore current legislation, future legislation, reports and articles on repair, to help justify your decisions. **DELIVERABLE: Revised LCA**	**Week 9**
Ideas & Prototyping 25%	Develop a range of ideas for the hot spots identified through your disassembly and LCA. Generate high quality sketches, schematics (both 2D and 3D) to explore the components themselves and how they will fit into the existing product. **Using underlays of the original product might help here* *** Explore different sketching styles until you find one that suits you* **DELIVERABLE: Range of sketches illustrating a broad variety of ideas**	**Week 10**
Refining and Detailing 25%	Choose the component(s) or part(s) that presents the most viable solution for repair. Refine and develop it thought a detailed Design for Manufacture process. At the same time plan the instructions for repair considering how to communicate without text and explore novel ways to visualise and communicate the revised product (think beyond computer generated renderings). **DELIVERABLE: Drafts of DFM documentation, instructions for repair and product visualisations.**	**Week 11**
Final Design 25%	Develop a fully detailed DfM suite for the redesigned component- the report should contain a set of completed working drawings (including 2D Orthographic Drawings, a full Bill of Materials, an exploded view/ cut away view and at least one 3D view of the component). Visual instructions/ blueprints for repair usable by citizens and a visualisation of the product and its redesigned component(s). **DELIVERABLE: DfM suite, Visual instructions for repair and a Visualisation of the redesigned product showing the repaired component in situ.**	**Week 12**

Project TIMELINE

07 08 — 10%

Analyzing the Product

Revisiting Product Information, Cons, Pros, Bill of Materials & Lifecycle Information.

09 12 — 20%

Collecting Data

Hotspot Mapping, Disassembly Diagram, Legislation, Articles & Visualization Research.

13 19 — 30%

Ideation

Develop Sketches, Schematics, Ideas and Explore Components for Repair.

20 26 — 60%

Refinement

Refine and Develop Components for Repair using DFM Principles.

27 29 — 80%

Instructions

Explore Novel Ways to Visualise Communication in the Instructions.

30 01 — 99%

Final Design

Gather report on DFM and visual instructions for final presentation.

Our Product

FERREX V12 ROTARY TOOL

“A cordless dremel with a charging time of about three hours, the Ferrex V12 is ideal for getting that professional finish touch on your DIY projects.”

This project aims to focus on the disassembly of the dremel and suggests solutions for making the item more repairable to the average customer. Here is a list of the initial pros and cons noted during the disassembly of the product:

PROS:

- Easy to dismantle if screwdriver is provided.
- Components are easily identified.

CONS:

- Cannot separate components without cutting/de-soldering wires,
- Smaller components are loose and held solely by the clasp of the shell pieces, making them fall out immediately during disassembly.
- The spindle couldn’t be taken out, very hard force is needed and the part is what breaks the most on a dremel.

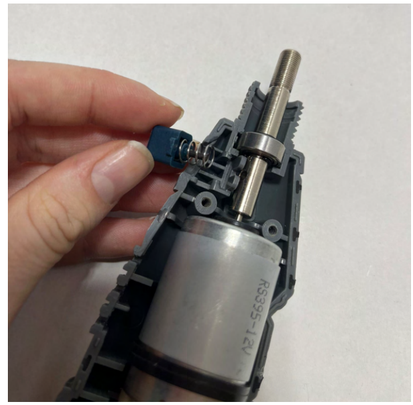
Our Product

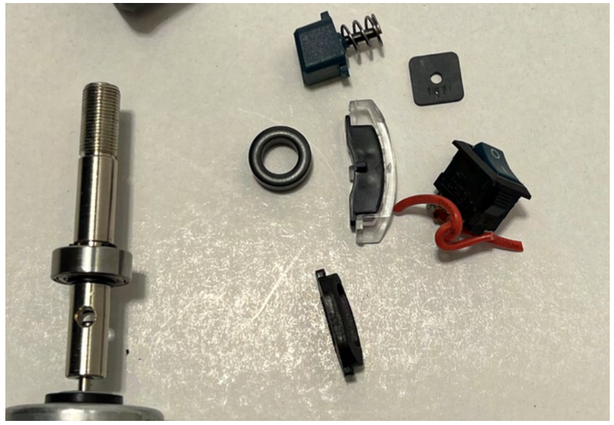
FERREX V12 ROTARY TOOL

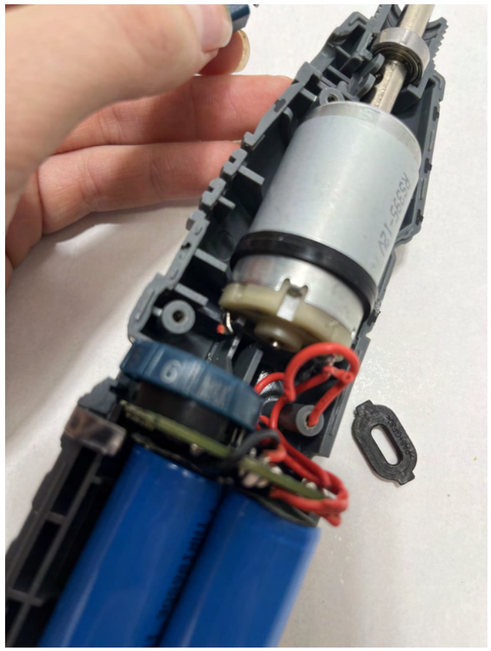
Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass (kg)
Shell 1	Polyamides (Nylons, PA)	Virgin (0%)	0.062	1	0.062
Shell 2	Polyamides (Nylons, PA)	Virgin (0%)	0.058	1	0.058
Rubber grips	Polychloroprene (Neoprene, CR)	Virgin (0%)	0.024	1	0.024
Spring	High carbon steel	Typical %	0.001	1	0.001
Charge port surround	Acrylonitrile butadiene styrene (ABS)	Virgin (0%)	0.001	1	0.001
Screw	High carbon steel	Typical %	0.0005	6	0.003
Tip screw	Acrylonitrile butadiene styrene (ABS)	Virgin (0%)	0.007	1	0.007
Lock button	Acrylonitrile butadiene styrene (ABS)	Virgin (0%)	0.001	1	0.001
Battery LED cover	Polymethyl methacrylate (Acrylic, PMMA)	Virgin (0%)	0.001	1	0.001
LED cover backing	Acrylonitrile butadiene styrene (ABS)	Virgin (0%)	0.001	1	0.001
Lock button plate	Low carbon steel	Typical %	0.001	1	0.001
On/Off switch	Acrylonitrile butadiene styrene (ABS)	Virgin (0%)	0.002	1	0.002
Circuit board	Printed circuit board assembly	Virgin (0%)	0.014	1	0.014
Dial	Acrylonitrile butadiene styrene (ABS)	Virgin (0%)	0.002	1	0.002
O ring (Large)	Polyurethane (ePUR)	Virgin (0%)	0.001	1	0.001
O ring (Small)	Polyurethane (ePUR)	Virgin (0%)	0.0005	1	0.0005
Battery pack	Li-Ion AA cell battery	Virgin (0%)	0.13	1	0.13
Motor assembly	Small (hand held) electronic devices	Virgin (0%)	0.091	1	0.091
Total				23	0.4

MY THOUGHTS ON THE DISASSEMBLY/REASSEMBLY OF THE PRODUCT:

- what goes where - I don't know where the parts went after I had to put them back in.
- what orientation?
- will it still work?
- am I doing it right?
- I had to use an IFixIt Kit to disassemble the device.







Our Product

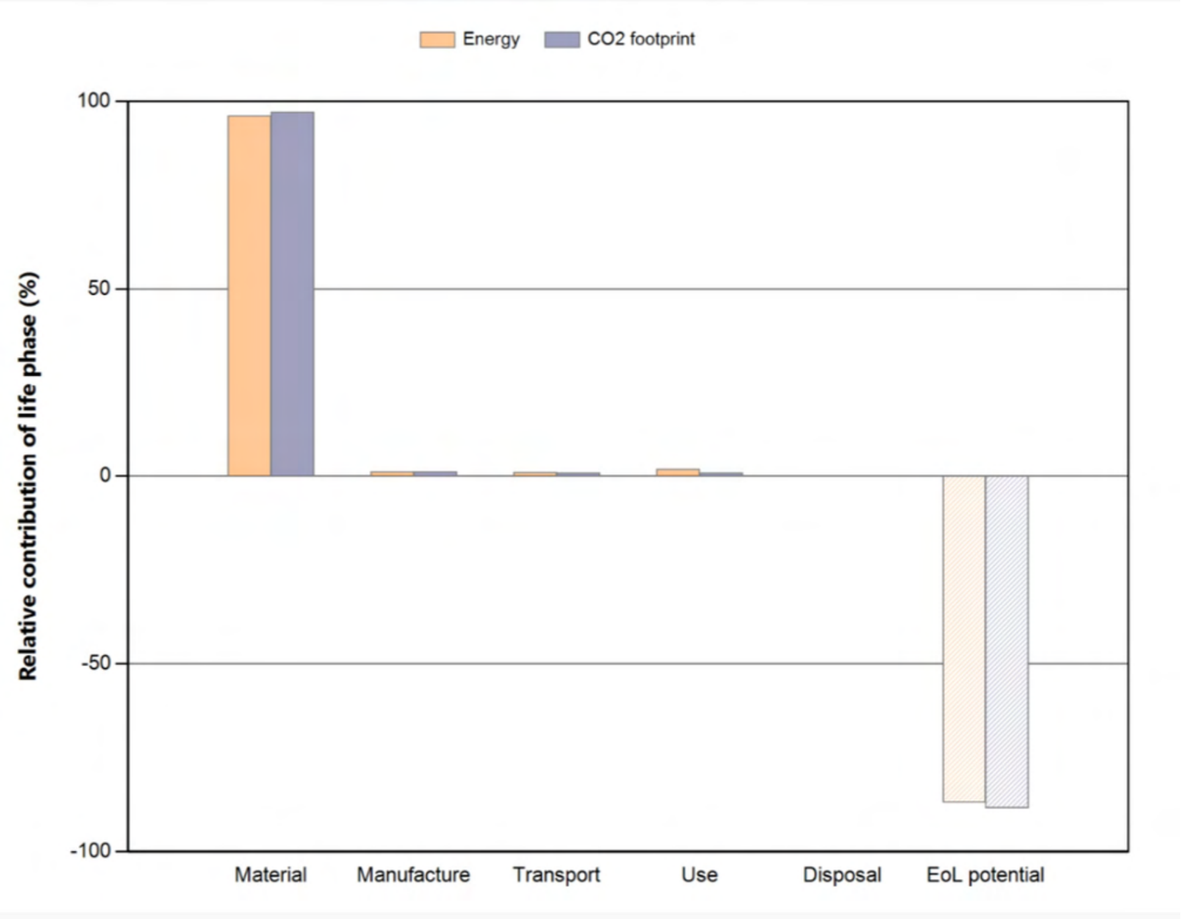
LIFE CYCLE REVISIT

Product Life: 3 years (Without repair)

KEY POINTS:

- Material Procurement phase was 96% of the entire life cycle.
- EoL potential is very high if not product is not to be reused and recycled.
- The energy put into the procurement of the product currently does not remain at the same value for as long as it should.
- There is no indication or intent for the product to be repairable by its design, the product is not considered sustainable.
- The product is manufactured in third-world countries where inventory and labor are cheap and the product does not adhere to any EU legislation or sustainability standards in its manufacture and design.

The goal of this project is to prolong the product's use by facilitating straightforward repairability, ultimately ensuring its continued value for an extended period during its use phase.



Phase	Energy (MJ)	Energy (%)	CO2 footprint (kg)	CO2 footprint (%)
Material	303	96.1	22.4	97.1
Manufacture	3.56	1.1	0.269	1.2
Transport	2.91	0.9	0.201	0.9
Use	5.66	1.8	0.196	0.8
Disposal	0.118	0.0	0.00827	0.0
Total (for first life)	**315**	**100**	**23.1**	**100**
End of life potential	-274		-20.4	

HOTSPOT MAPPING DATASHEET

Hotspot Mapping Datasheet for product disassembly sourced from TU Delft

HotSpot Mapping Datasheet

General project information

Brand name	Ferrex
Product category	Hand Tool
Authors	Emilia Ziolek
Date	Nov-23
Location	University of Limerick

Overall HotSpot Results

Total:		**Average:**		
- time to disassemble	169 sec	- time per step	11.3 sec/step	
- number of tasks	24	- force	2	[1=low .. 5=high .. 10=extreme]
- number of steps	15	- accessibility	3	[1=clear .. 5=moderate .. 10=difficult]
- number of tools	4	- positioning	3	[1=easy .. 5=moderate .. 10=difficult]

General			Activity					Accessibility			Functional		Material		HotSpot Indicators					
Step number	Name	Subasssembly?	Part of ...	Type of activity	Required tool	Tool size	Task frequency	Total time to disconnect (sec)	Force	Accessibility	Positioning	Failure Likelihood	Functinoal relevance	Material group	Weigth (g)	Time	Activity	Priority part	Environmental	Economic	Notes
1	Screws x6	no	main assembly	Unscrew	Screwdriver	J1	6	45	level 0 -	level 1 -	level 1 -	level 0 -	level 2 -	Steel	3						repetetive, hard to reach.
2	Screw Tip	no	main assembly	Unscrew	Hands	N/A	1	7	level 0 -	level 0 -	level 0 -	level 0 -	level 2 -	Thermoset	7						
3	Shell 1	no	main assembly	Remove	Hands	N/A	1	3	level 0 -	level 0 -	level 0 -	level 0 -	level 2 -	Thermoset	58						
4	Charge port surround	no	main assembly	Remove	Hands	N/A	1	1	level 0 -	level 0 -	level 0 -	level 0 -	level 0 -	Thermoset	1						
5	LED Display	no	main assembly	Remove	Hands	N/A	1	1	level 0 -	level 0 -	level 0 -	level 0 -	level 0 -	Thermoplastic	1						
6	Lock Button	no	main assembly	Remove	Hands	N/A	1	1	level 0 -	level 0 -	level 0 -	level 0 -	level 0 -	Thermoplastic	1						
7	Lock Button Plate	no	main assembly	Remove	Hands	N/A	1	1	level 0 -	level 0 -	level 0 -	level 0 -	level 0 -	Thermoplastic	1						very small and unclear of where to put
8	Motor Assembly	yes	main assembly	Remove	Hands	N/A	1	5	level 0 -	level 0 -	level 0 -	No to low precision									
9	Battery Pack	no	Motor Assembly	De-solder	Soldering iron	N/A	2	5	level 0 -	level 1 -	level 0 -	level 2 -	level 2 -	Battery	13						cannot be put back together
10	Circuit Board	no	Motor Assembly	De-solder	Soldering iron	N/A	2	8	level 0 -	level 1 -	level 1 -	level 1 -	level 2 -	Other Electronics	14						
11	Dial	no	Motor Assembly	De-solder	Heat	N/A	1	12	level 0 -	level 1 -	level 1 -	level 1 -	level 2 -	Thermoplastic	2						
12	Motor	no	Motor Assembly	De-solder	Soldering iron	N/A	3	10	level 0 -	level 1 -	level 1 -	level 2 -	level 2 -	Mixed materials mainly	91						
13	Spindle	no	Motor Assembly	Remove	Lever / Prybar	N/A	1	60	level 2 -	level 1 -	level 2 -	level 1 -	level 2 -	Steel	8						
14	On/Off Switch	no	main assembly	De-solder	Soldering iron	N/A	1	7	level 0 -	level 0 -	level 0 -	level 0 -	level 0 -	Thermoplastic	2						
15	Shell 2	no	main assembly	Remove	Hands	N/A	1	3	level 0 -	level 0 -	level 0 -	level 0 -	level 0 -	Thermoplastic	2						

Analysis

HOTSPOT MAPPING

Overall HotSpot Results

Total:		**Average:**		
- time to disassemble	169 sec	- time per step	11.3 sec/step	
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- number of tools	4	- positioning	3	[1=easy .. 5=moderate .. 10=difficult]

RED FLAGS:

Time

Screws: Take too long to unscrew all six

Spindle: Press-fitted which takes a lot of force and effort to remove.

Activity

Spindle: A lot of force and the proper tool is required to disconnect from the main body.

Economic

Circuit Board: Lots of standard features and reusability opportunities.

Motor: Lots of standard features and reusability opportunities.

Priority Part

Battery: Dremel needs the battery for power.

Motor: Dremel requires a motor for function and use.

Environmental

Shell 1: Made from a lot of thermoplastic that is injection-molded.

Motor: Made from a lot of precious materials.

SURFACING?

Ideas for decreasing the number of steps to reach a critical part could involve:

- Removing the need for so many screws? finding another way of holding the model together?
- Allowing the wires to be connected rather than having to be de-soldered every time.

CLUMPING?

Ideas to group parts together to reach the critical part:

- The Dremel already has the subassembly that helps the critical part to be located.

TRIMMING?

Ideas for bringing down the number of activities and the time needed to reach the critical part:

- Eliminate uncommon tools needed to disconnect parts and replace them with reversible fasteners.

DISASSEMBLY DIAGRAM

The initial process with screws is quite time-consuming.

The screws require a tool that not everyone has access to.

A lot to keep track of with the small parts.

These parts are easily collected but hard to reassemble.

To understand the viewer has to keep switching back to the legend which can become annoying.

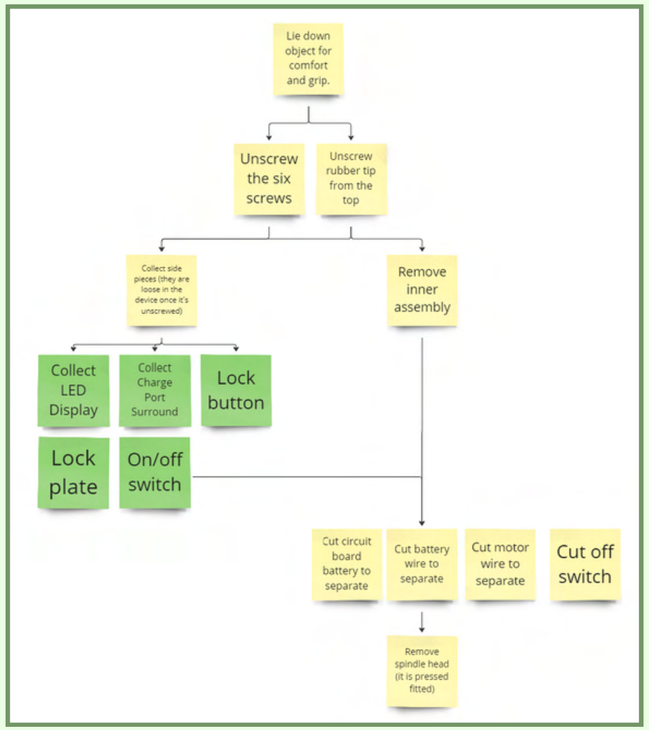
All priority parts are located at the end of the three.

The final parts have to be de-soldered which is very time consuming.

Tools:	Components List:	Connectors:	Factors:
HS Hands	1. Shell 1	**FF** Friction Fit	**EN** Environmental
SD Screwdriver	2. Shell 2	**SS** Screws	**EC** Economic (Valuable)
SI Soldering Iron	3. Charge Port Surround	**SR** Solder	**PP** Priority Part
HR Hammer	4. Screw	**PF** Position Fit	**TL** Time Length
	5. Tip Screw		
	6. Lock Button		
	7. Lock Button Plate		
	8. LED Display		
	9. Motor Assembly		
	9A. Battery Pack		
	9B. Circuit Board		
	9C. Dial		
	9D. Motor		
	9E. Spindle		
	10. On/Off Switch.		

Things that help to shorten the time for disassembly and reassembly;

- Labeled parts?
- No loose parts?
- Color coding?



This is the initial disassembly tree that I created following a similar example by TUDelft. It involves the reader reading and familiarizing themselves with the legend to follow the visual process. The original disassembly was mapped in sticky notes in the above corner.

Decision LEGISLATION

REPAIRABILITY

Keeping in mind the people who want their things repaired...

- The Right to Repair - Europe coalition represents over 100 organizations from 21 European countries. Fight to remove barriers that stop people from repairing their products.

Following in the steps of France...

- The French Repairability Index - France is the first country in Europe to have implemented a repairability index on 5 categories of electronic devices. The index assesses documentation, disassembly, availability of spare parts, price of spare parts, and product-specific aspects that I hope to follow through with my new design iterations.

Using Sharepair...

- Sharepair offers guidance on product repair by identifying the problem, describing it, and taking action! They also offer DIY repair guides from the community which I intend to look into more. The website also offers a guide on 3D printing for Repair.

CURRENT EU LEGISLATION

- Regulation on electric motors and variable speed drivers (EU) 2019/1781 - Laying down ecodesign requirements for electric motors.
- EU Ecodesign Directive - manufacturers of SOME household appliances are obliged to make spare parts available, and the user has the right to request parts for approximately 10 years (like for a dishwasher.) Does not apply to our appliance.
- EU Right to Repair Proposal

--- European Quality Standards for Repair Services - to help identify reputable repair service providers.
--- Obligation to Inform Consumers - Producers will be required to inform consumers about goods they are required to repair.
--- Amendment to Sale of Goods Directive - Mandating sellers to offer free repairs whenever the cost equals or is less than replacement.
The proposal is currently being debated and under consideration within the European Parliament and the Council.

Decision ARTICLES

I did some further reading into articles and reports that relate to product repairability.

A POORLY EDUCATED GUESS OF CONSUMERS' LIFETIME ESTIMATIONS, ATTITUDES TOWARDS REPAIRABILITY, AND A PRODUCT LIFETIME LABEL

Renske van den Berge(a), Lise Magnier(a), Ruth Mugge(a)
a) Faculty of Industrial Design Engineering, Delft University of Technology, The Netherlands

The report details how consumer's expectations about product lifetimes actually have an influence on the actual lifetime of the product. Therefore, promoting repairability could potentially encourage consumers to extend these lifetimes.

The report revealed that consumers;

- Feel unable to make a well-informed estimation of the product's lifetime.
- Have negative associations with repairability
- Have concerns about how use intensity can be taken into account.

BUSINESS INNOVATION FOR PRODUCT REPAIRABILITY: IMPLICATIONS FOR FUTURE POLICIES

Tung Dao(a), Tim Cooper(a), Matthew Watkins(a)
a) Nottingham Trent University, Nottingham, UK

The paper summarises the recent legislation concerning repair and identifies potential implications for future policies in reference to the Right to Repair.

The report revealed that:

- There are value creation opportunities for businesses in product repairability - the ease of commercial repair processes and benefits to the brand with loyal customer satisfaction.
- The introduction of financial incentives was considered, acting as a catalyst for sustainable business models.
- The need for strong and consistent communication.

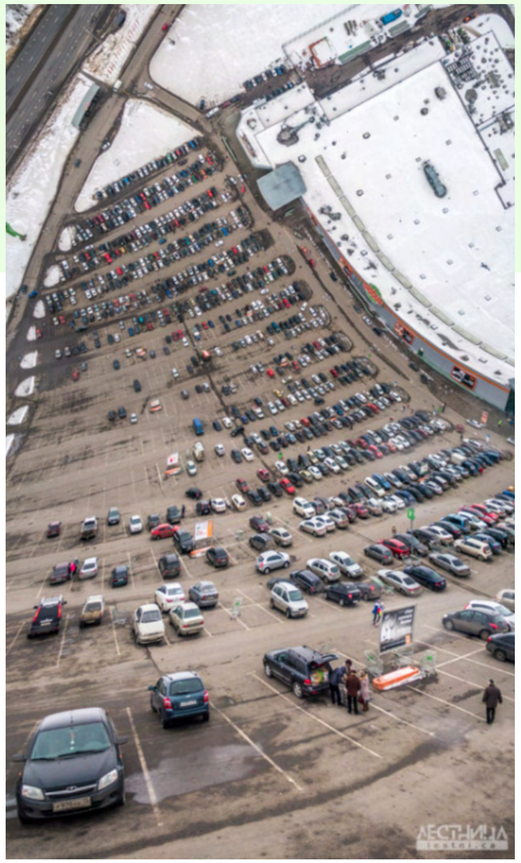
BUSINESS OUTCOMES OF PRODUCT REPAIRABILITY: A SURVEY-BASED STUDY OF CONSUMER REPAIR EXPERIENCES

Mostafa Sabbaghi a, Behzad Es.maeilian c, Willie Cade d, Kyle Wiens e, Sara Behdad a, USA

This paper highlights the impact of repairability on consumers' future purchases and recommendation decisions.

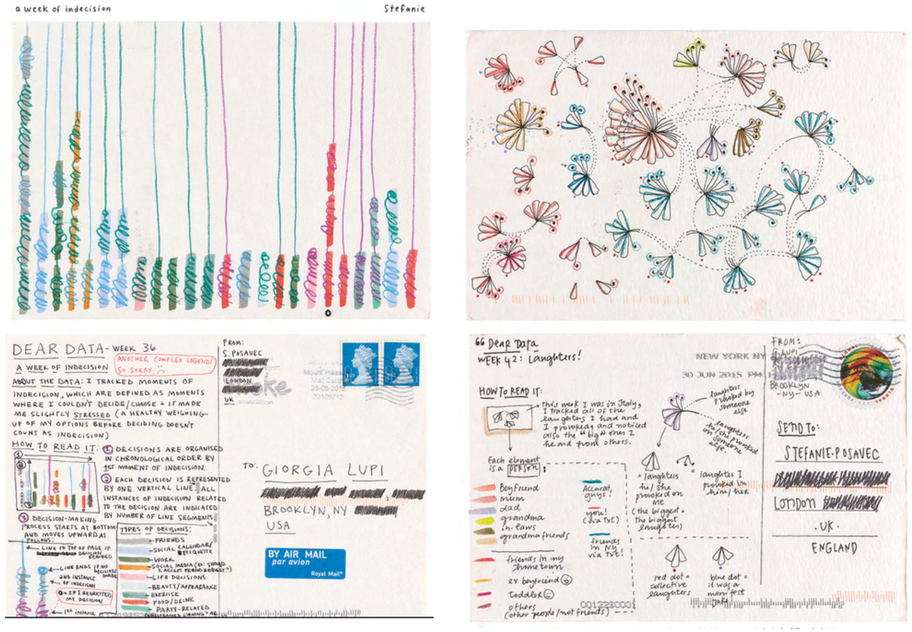
The team found that sharing repair manuals, the usefulness of repair information, the repair capability of consumers (clear about the repair process), higher desirability to repair a product, and finally consideration of reparability and repair cost at purchase time will **have a positive impact on future repurchase** and **purchase recommendation** of a repairable product.

Decision
VISULISATION RESEARCH



DEAR DATA

Dear Data is a free-to-access website that presents the work of two designers who explain very heavy data in a visual matter. Here is some of my favourite work from them;



I really like the idea of something as basic as scribbles representing a data-set, and if explained correctly could give it so much meaning. I want to plan my tree diagram around this sort of method.

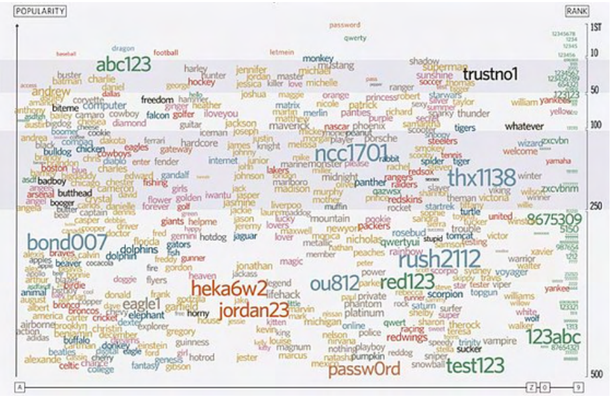
PHOTO-VIZ

Photo-Viz is a book made by Nicholas Felton that have an overlap between photography and data visulisation.

I really enjoy the picture on the left that displays an 'inversed planet' car park. There is just something about it that catches my attention and makes me want to explore it more to see how it works. I want my instructions to also follow a similar format.

KNOWLEDGE IS BEAUTIFUL (BOOK)

I rented out 'Knowledge is Beautiful' by David McCandless in the library to look a more infographics displayed in a visual fashion. Hopefully, this book can inspire me to showcase my data and findings in a better and more unique way.



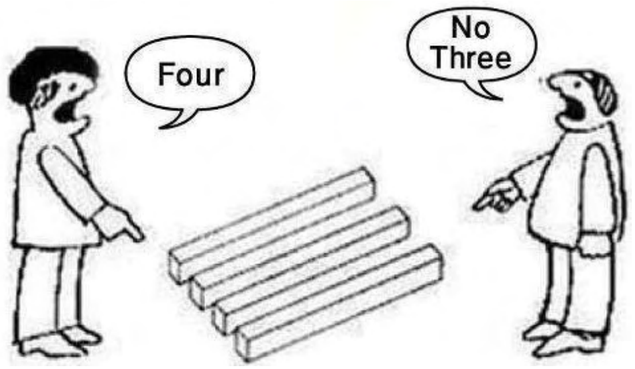
Decision VISUALISATION RESEARCH

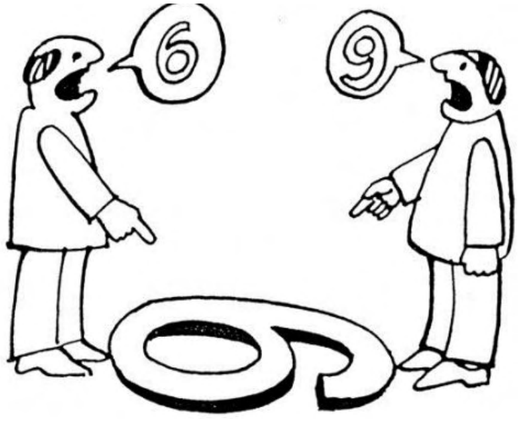
HOW DO PEOPLE INTERPRET INFORMATION?

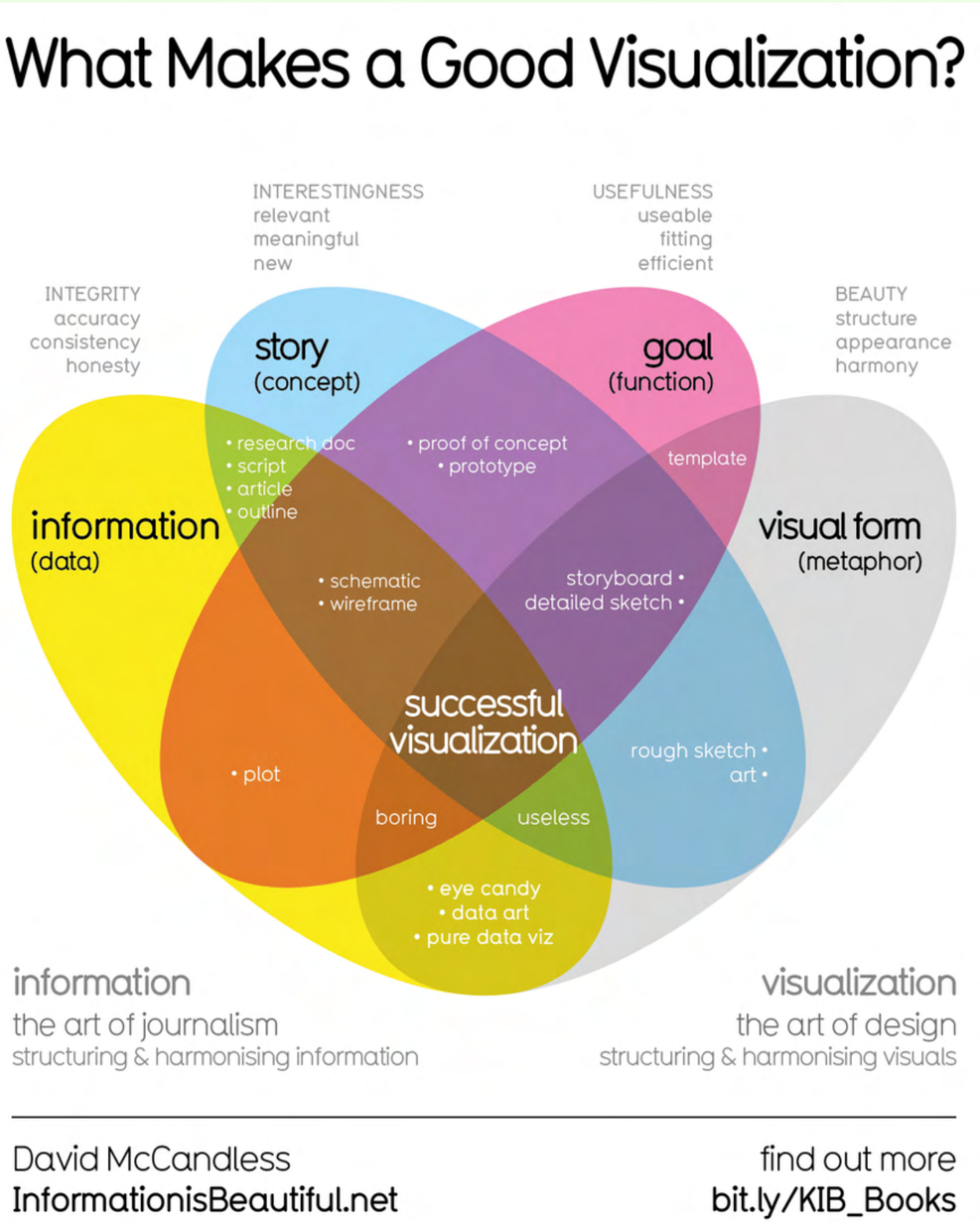
In my opinion, the current barrier to repairability is a lack of enthusiasm due to prejudice and not enough information given to the user to succeed in the task.

Everyone interprets something differently - unless they default to another's interpretation based on fear of being different, laziness, to fit in, etc.

For this assignment, it is important to note that people choose to select different aspects of a message to focus their attention on what interests them, what is familiar to them, or what they consider important. The aim is to visually depict the data (how to repair the product) In a way that everyone can interpret and find their own importance in.







Decision

DESIGN GUIDE

Target Demographic: Professionals in construction and trades, manufacturing workers BUT ALSO normal homeowners, DIY enthusiasts and students (In Education Facilities)

Must Haves:

MODULAR DESIGN

Users should be able to identify components and replace them easily.

REPAIRABILITY INDEX

The index assesses documentation, disassembly, availability of spare parts, price of spare parts, and product-specific aspects

USER FRIENDLY TOOLS AND FASTENERS

Accommodate users who don't have access to tools and use better fastners.

USER FEEDBACK

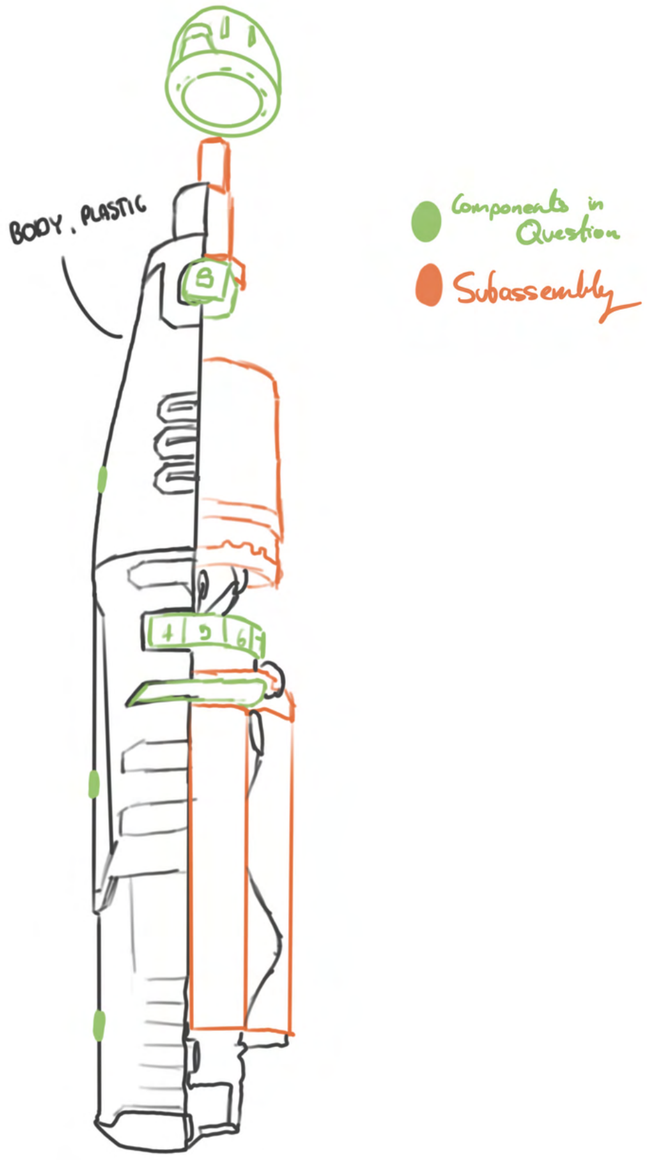
Incorporate user-friendly feedback and potential indicators of the product needing repair.

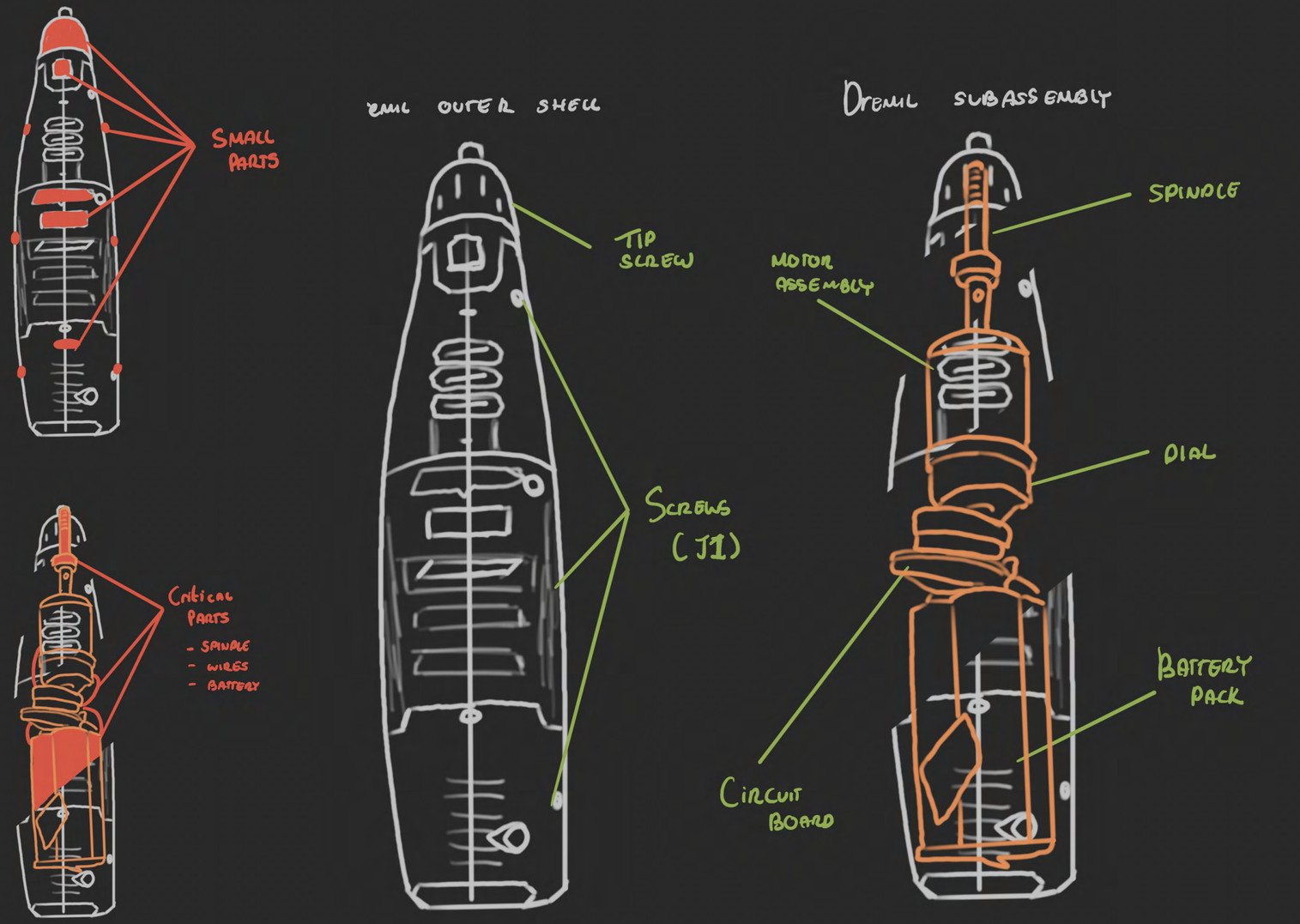
Nice to Haves:

- COLOUR CODING
- STANDARD COMPONENTS
- BETTER MATERIALS
- A WAY OF NOT LOSING SMALLER COMPONENTS
- ONLINE COMMUNITY

WEEK 2

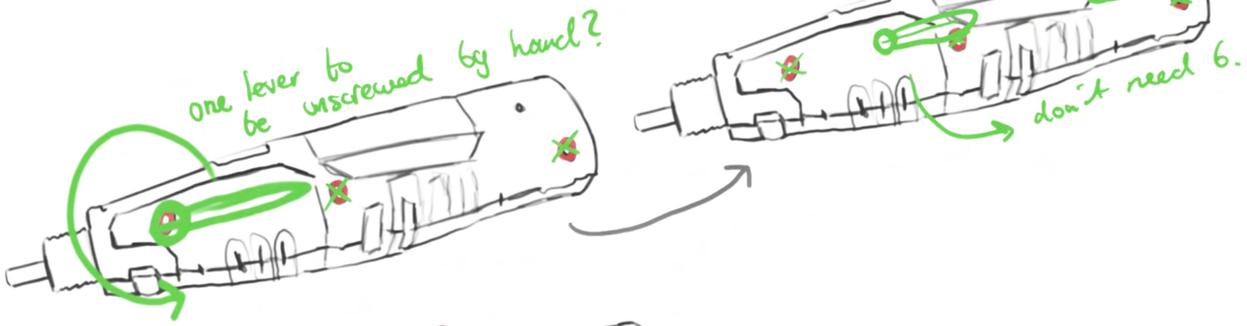
Ideation
EXPLORATION





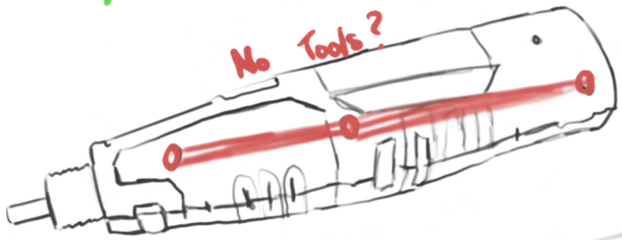
Exploring the functions of the dremil through sketches on black paper to highlight detail.

Ideation
EXPLORATION



HOTSPOT

Screws: Take too long to unscrew all six



What else could we use?

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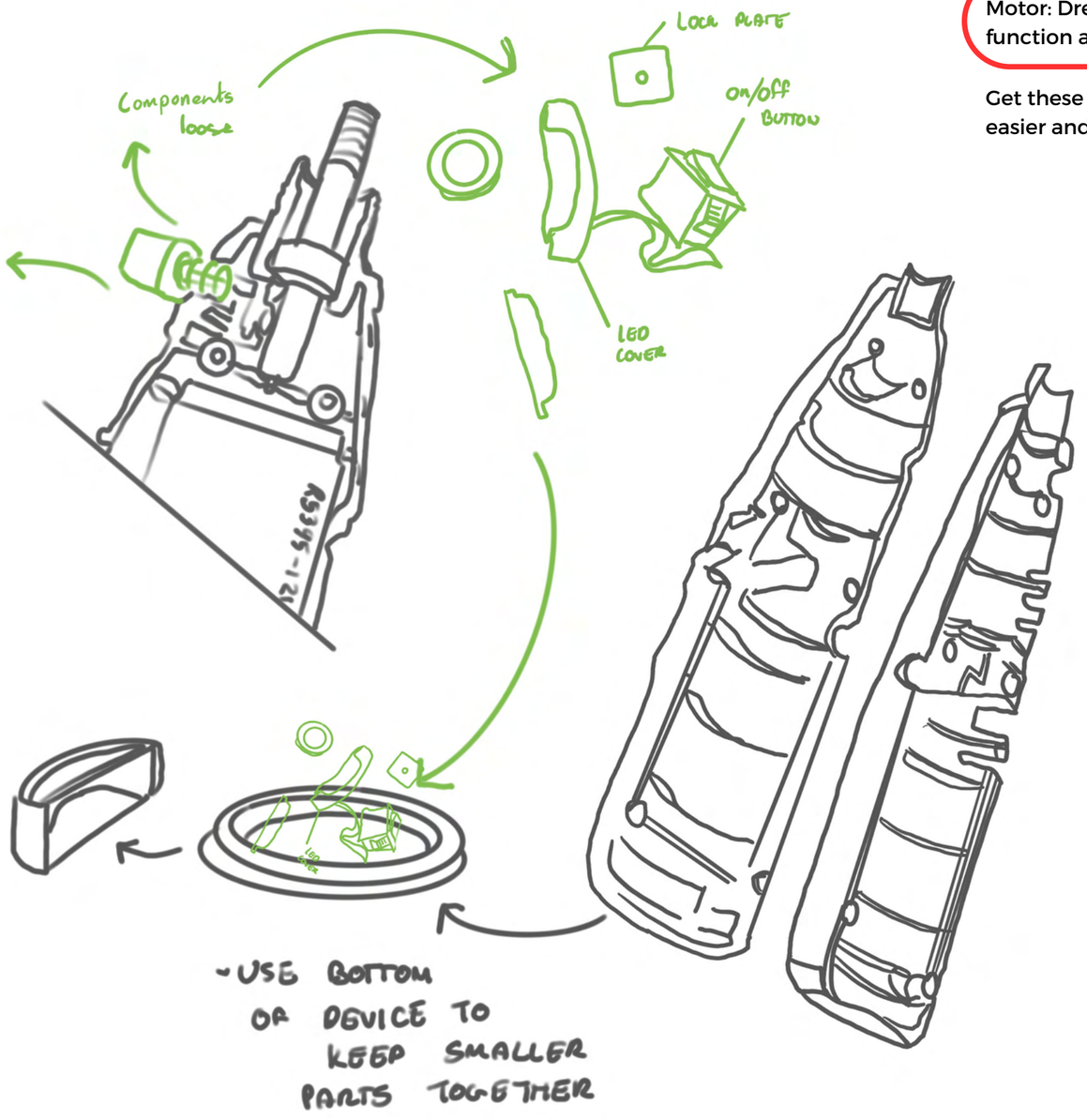
Ideation
EXPLORATION

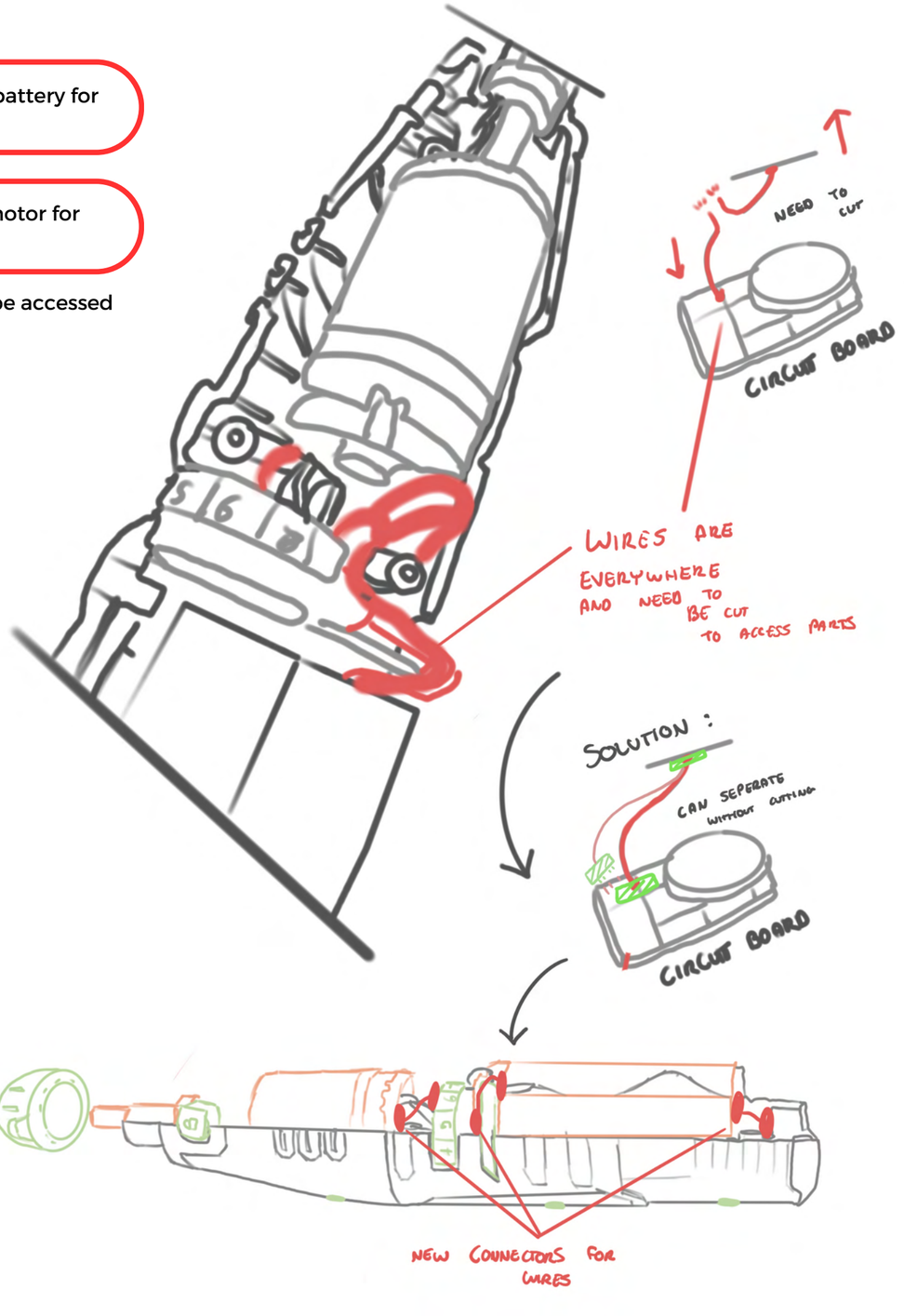
HOTSPOT

Battery: Dremel needs the battery for power.

Motor: Dremel requires a motor for function and use.

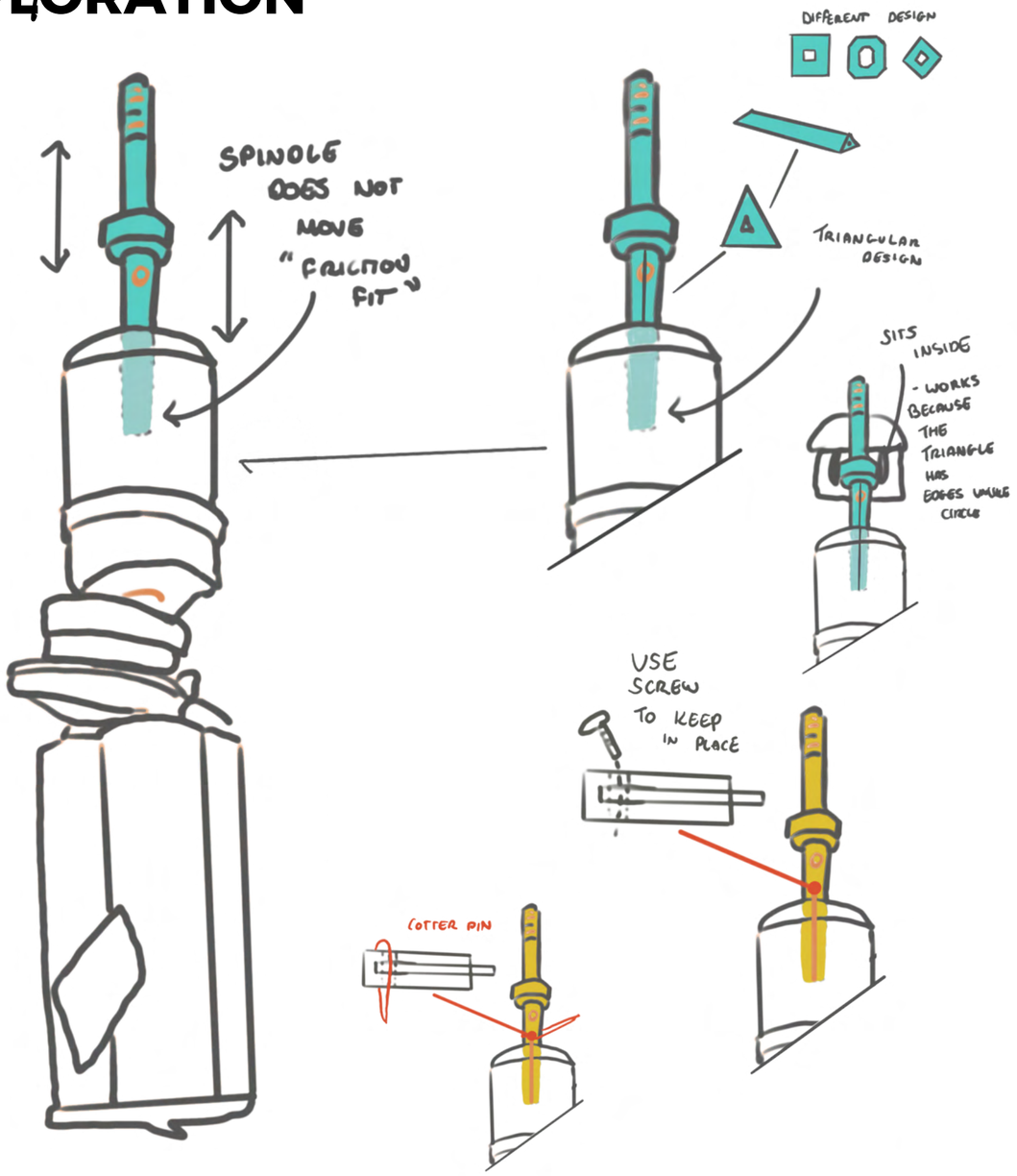
Get these components to be accessed easier and quicker.

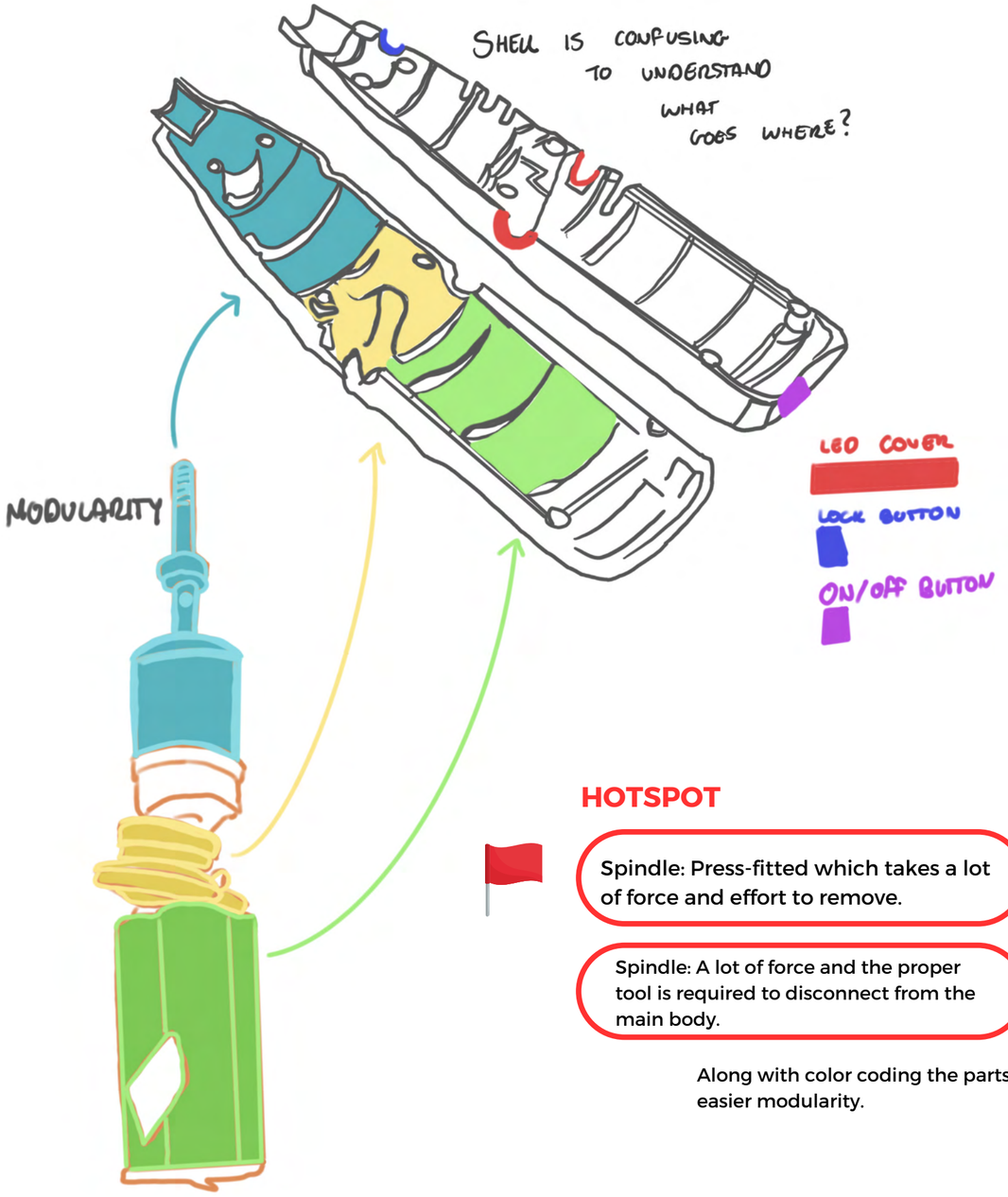




Ideation

EXPLORATION





HOTSPOT

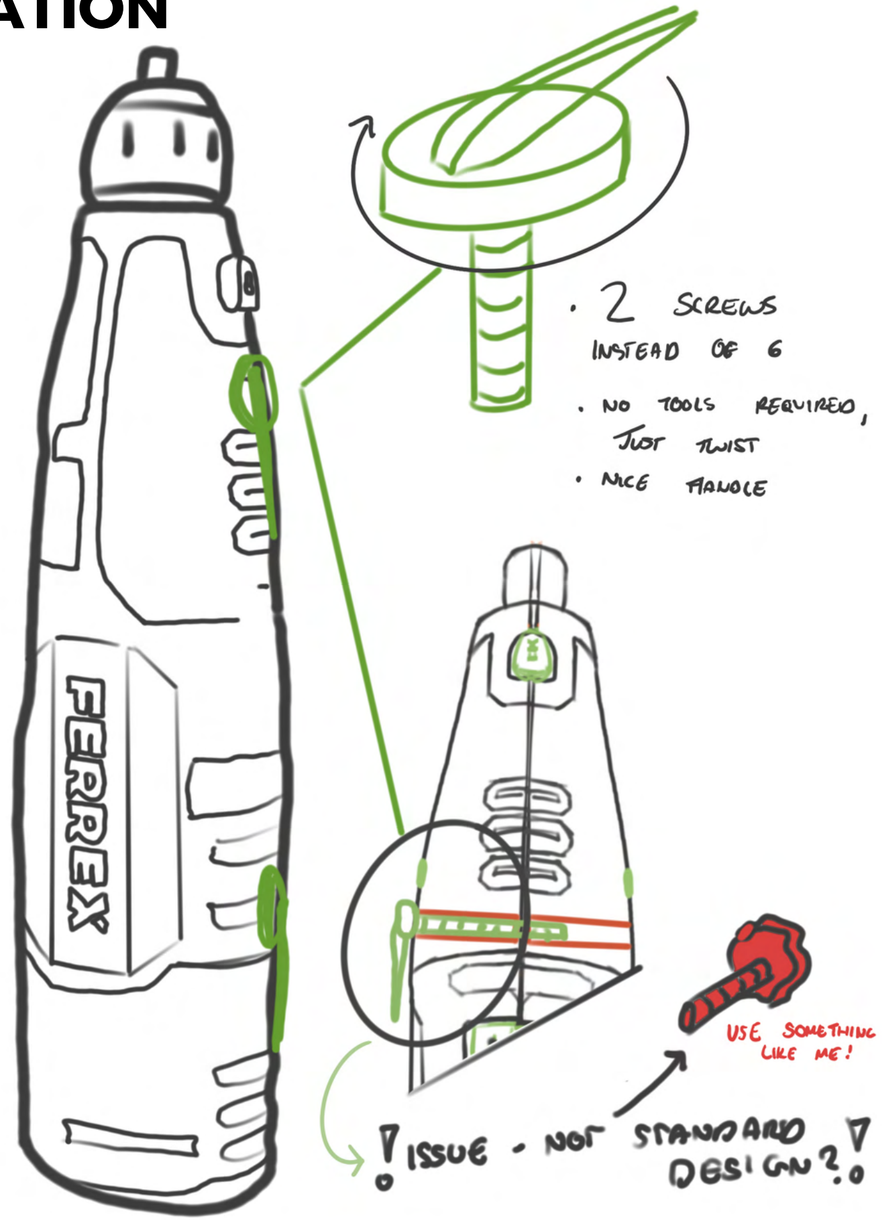
Spindle: Press-fitted which takes a lot of force and effort to remove.

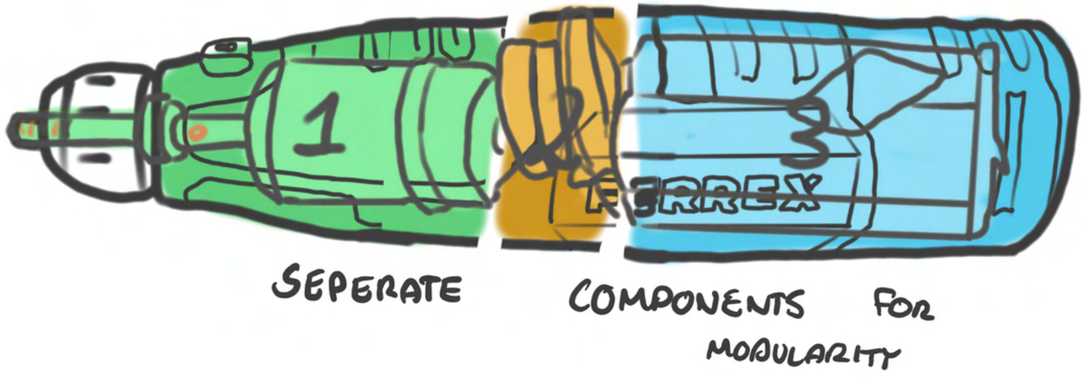
Spindle: A lot of force and the proper tool is required to disconnect from the main body.

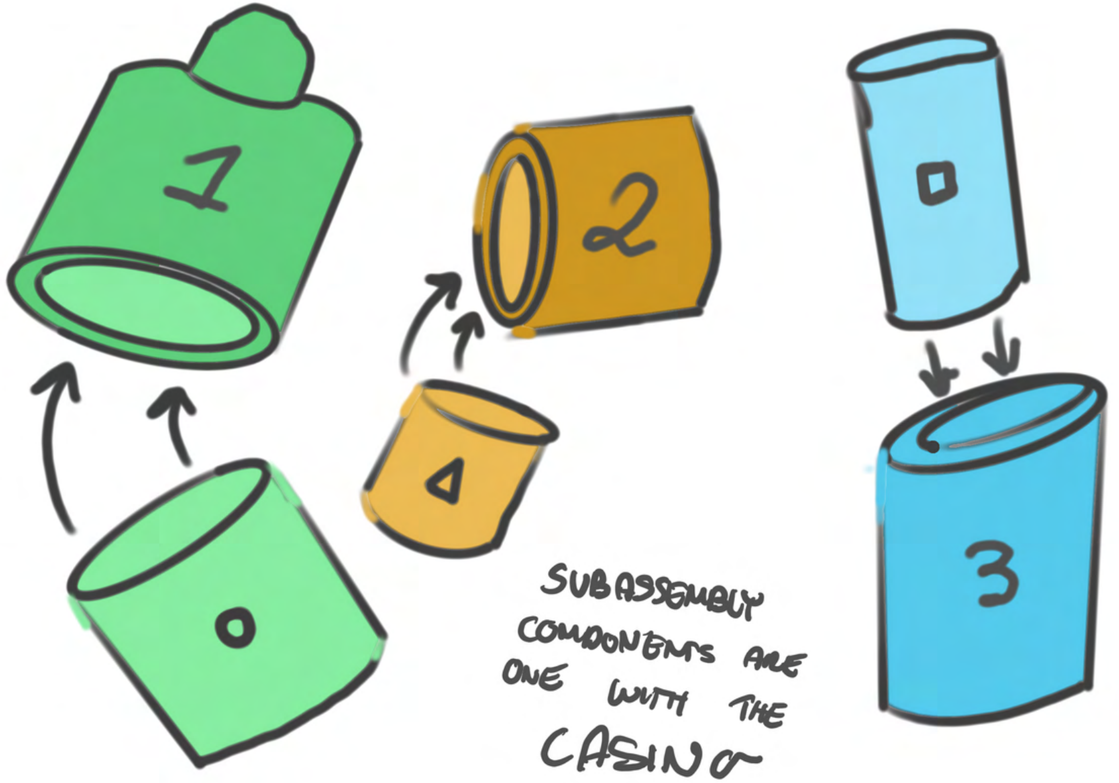
Along with color coding the parts for easier modularity.

Ideation
EXPLORATION

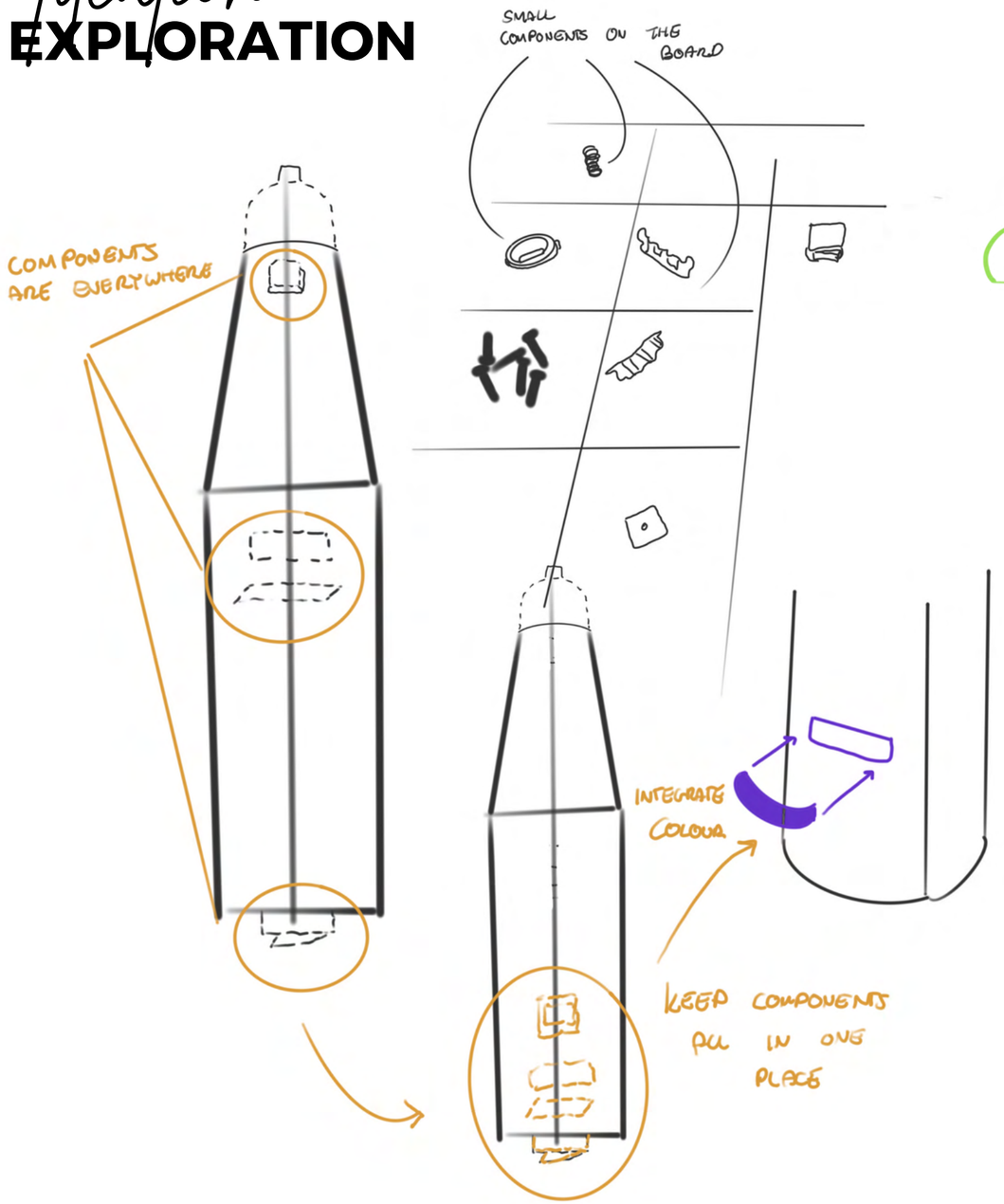
Exploring some other extended components before I choose a direction.

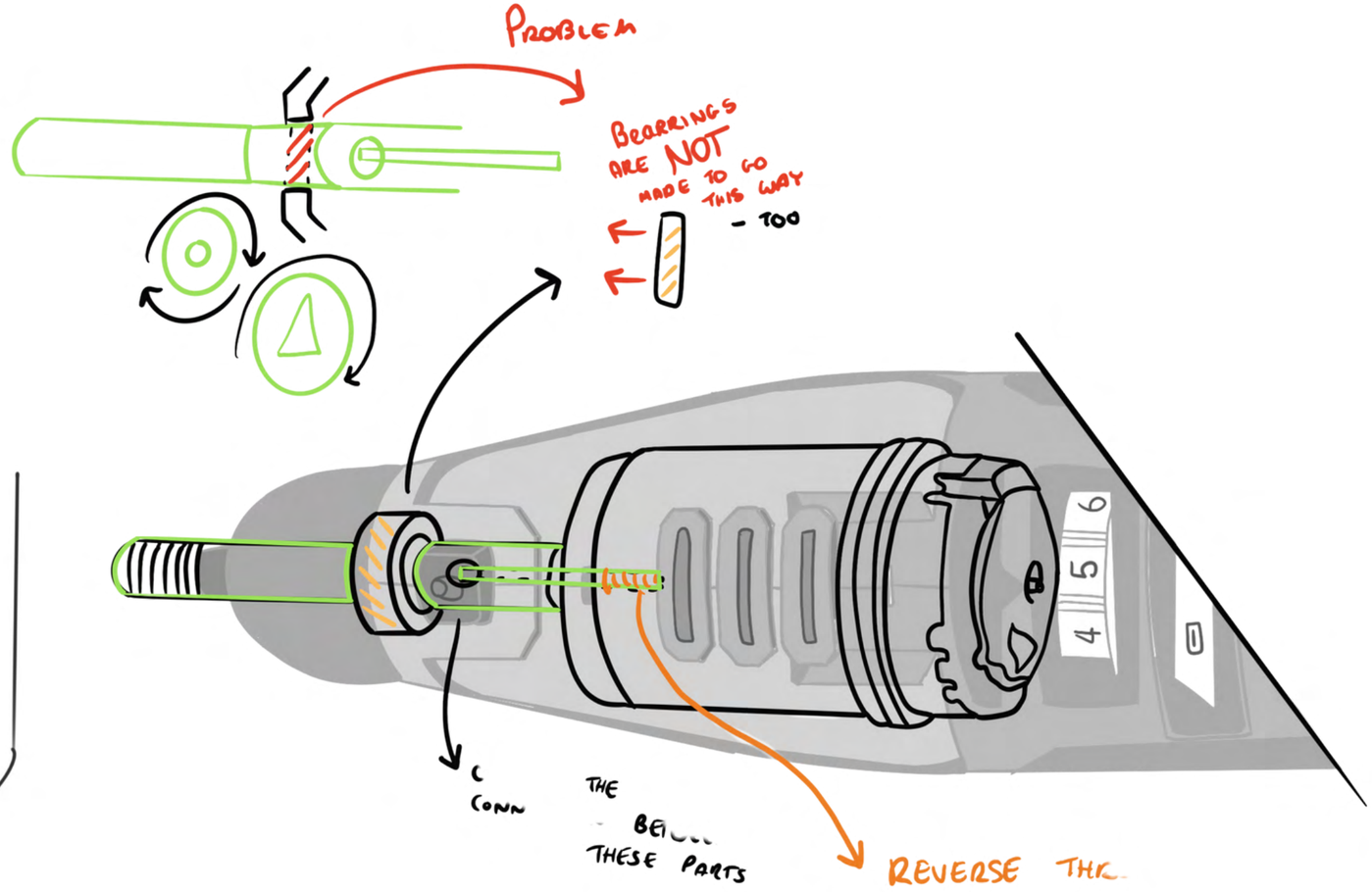






Ideation
EXPLORATION





Reidentifying some of the problems I've mentioned and coming up with other solutions.

Ideation
DIRECTION

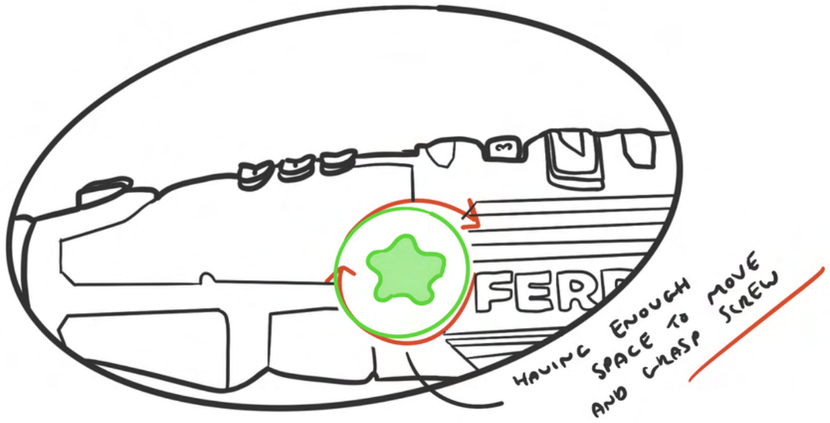
For this project, I have chosen the direction of making the screw access easier/completely different. This is the first initial direction I will go with in trying to make the screws;

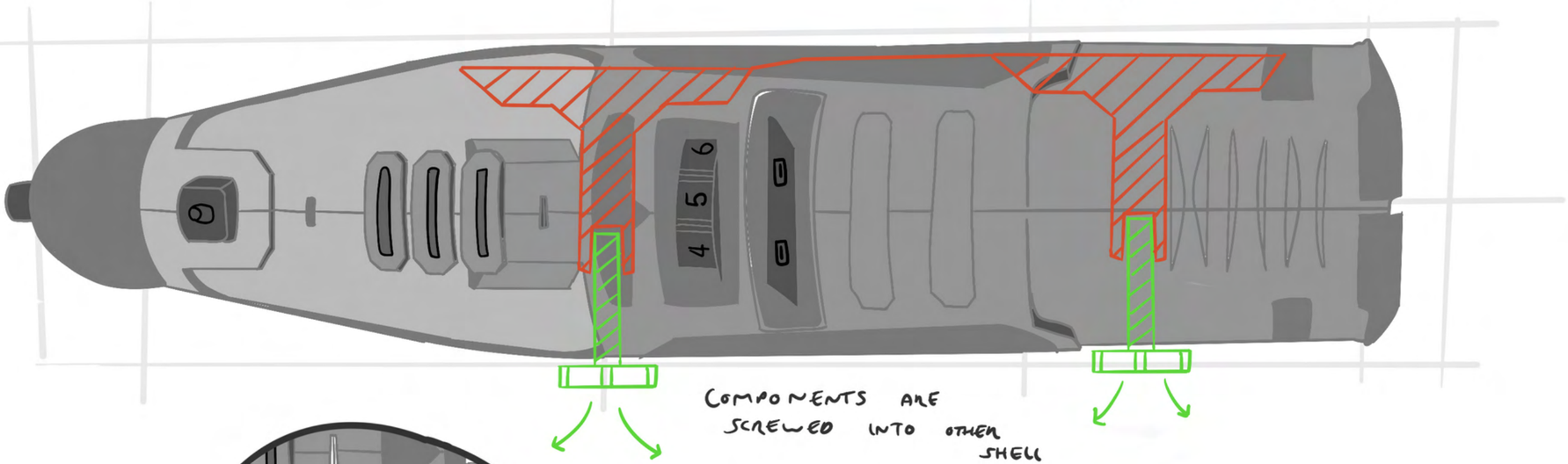
- Not need a specific tool.

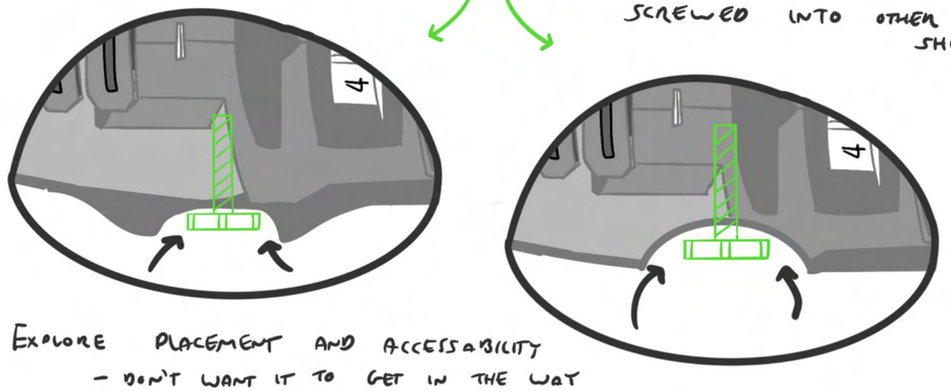
HOTSPOT

Screws: Take too long to unscrew all six

SURFACING - to be used as the method.







Clay PROTOTYPING

I wanted to get into prototyping with the screws as I wasn't sure what actually worked without making a model.

- I first made a mold that similarly follows the shape of the dremel from aluminum wire and clay.

Clay PROTOTYPING

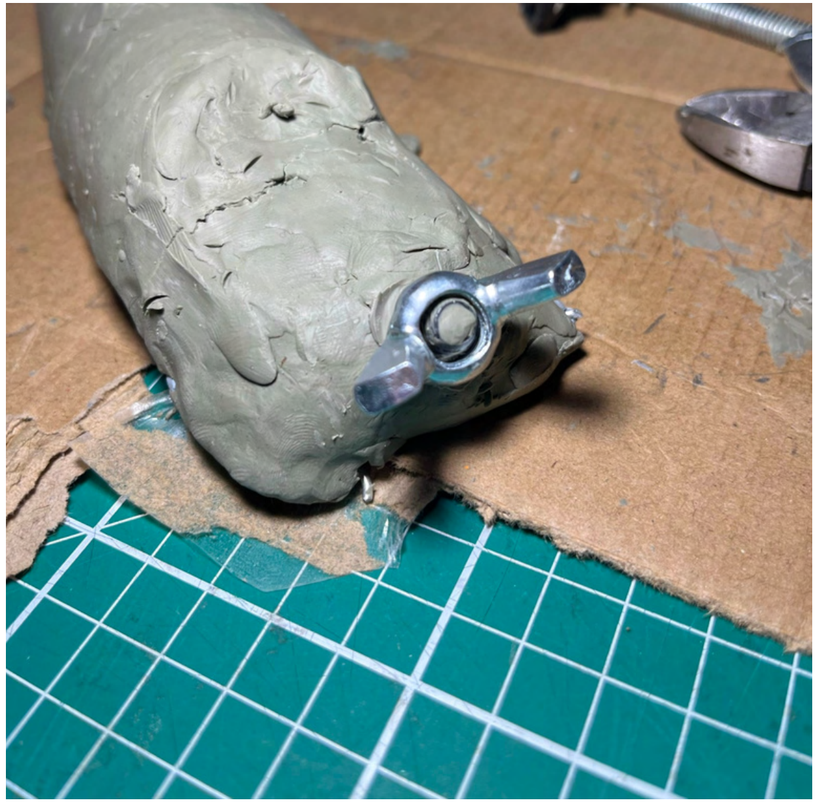
I bought some wing nuts in the local B&Q to investigate where on the dremil they would go and where they would fit in and not get in the way of the task. I bought M10 screws to work with the biggest size possible so that when the problem is solved it will be much less if I use a smaller screw.

Clay PROTOTYPING

Since putting the screws on the flat surface was unfeasible as it kept getting in the way, I thought about changing the form of the dremel so that it dips at the end. This idea however still didn't work as you can see from the pictures my hand was still getting stabbed by the screw.

Clay PROTOTYPING

As a last measure, I tried putting the screw at the end of the dremel, as I realized that not a lot of support is actually required in the middle part of the dremel and it is only at the end that it is loose. I however decided to look into the original screw type I wanted to use.



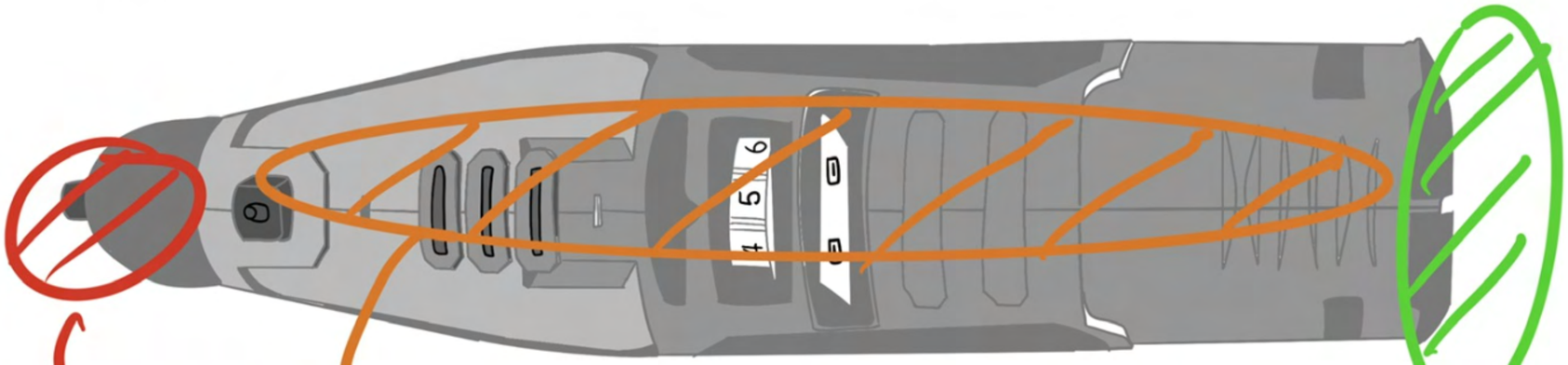
Clay PROTOTYPING

I couldn’t receive the star screws in time online, so I 3D printed them and attached them to H8 bolts. I used a big size as previously stated to ensure the problem would be minimized. Thes worked much better but there was still something I didn’t like.

WEEK 3

Ideation
FINALISING

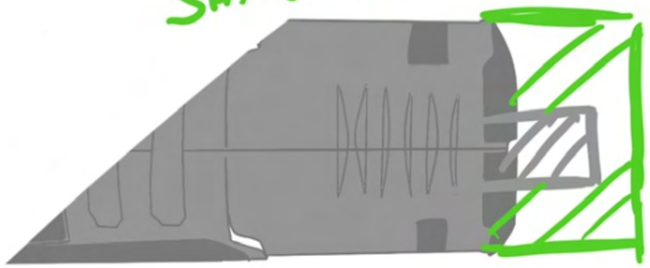
WHAT ELSE WILL WORK?

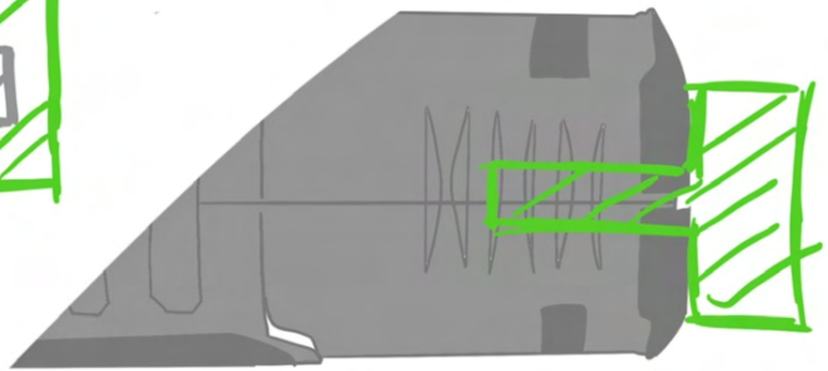


ACTION!!
ACTION!!

THE TOP IS TOO BUSY
(WILL GET IN THE WAY)

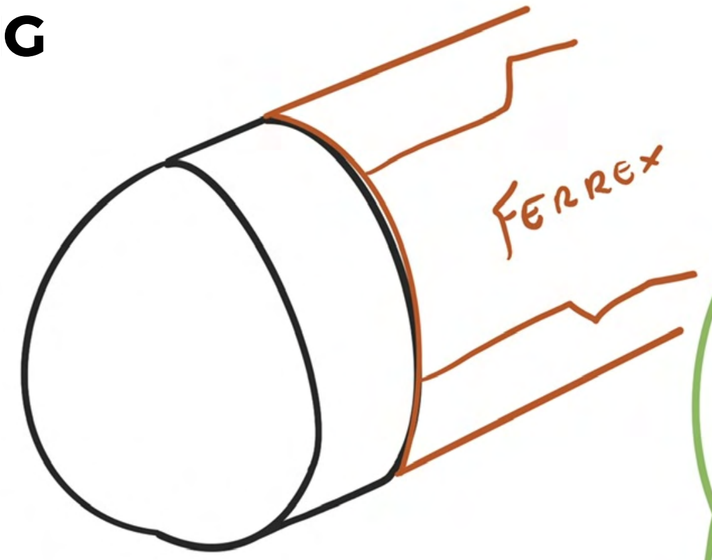
SAME AS TOP?

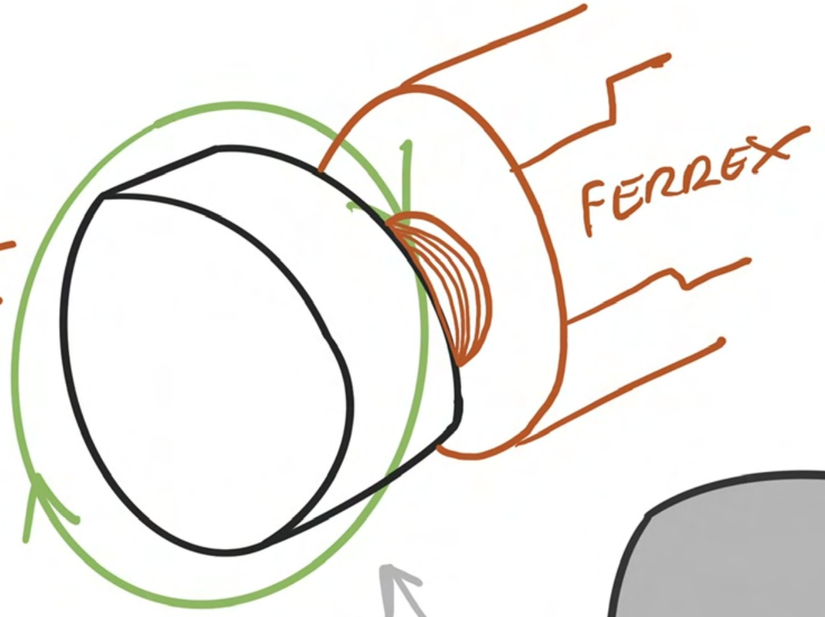




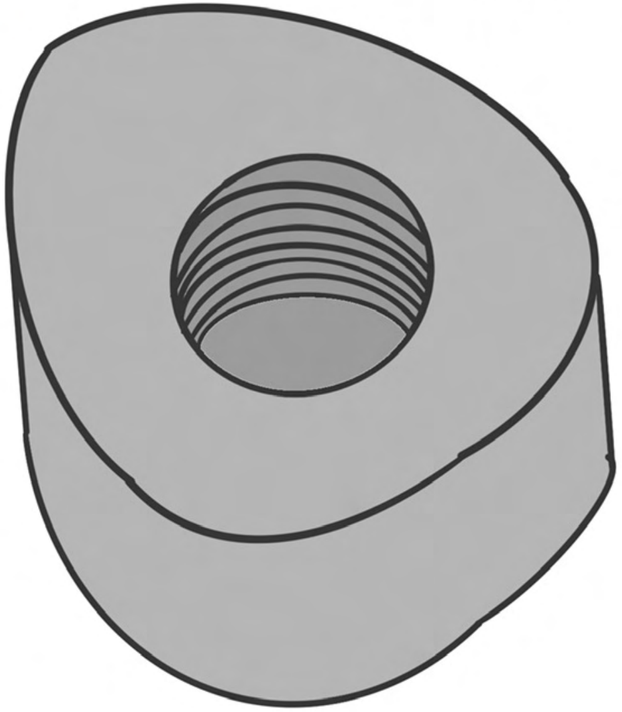
NOT IN THE WAY ✓

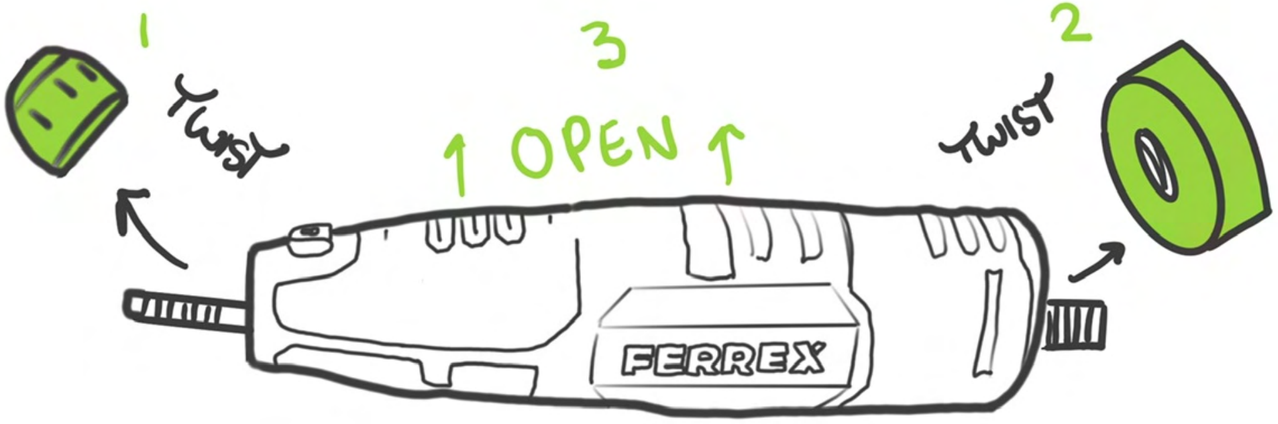
Ideation
FINALISING



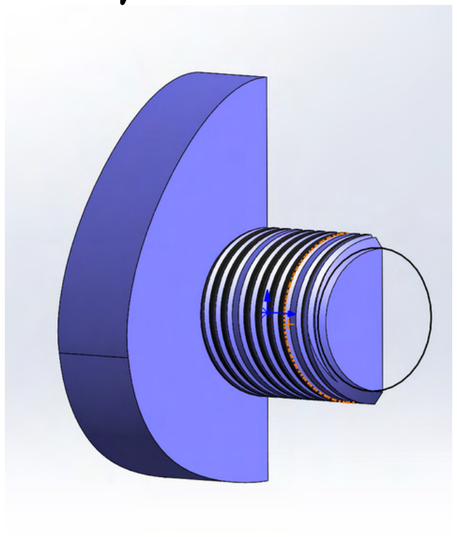


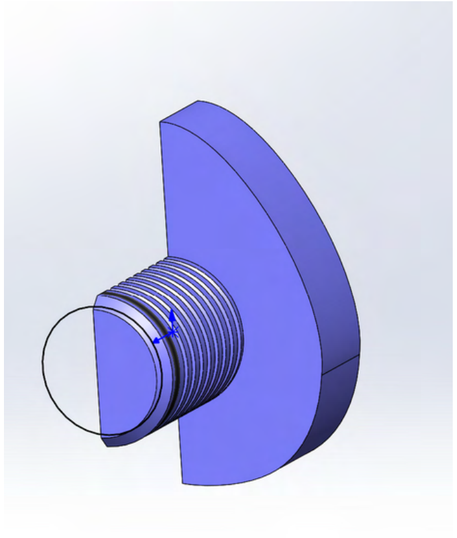
SAME CONCEPT AS SCREW TIP BUT ON THE BOTTOM





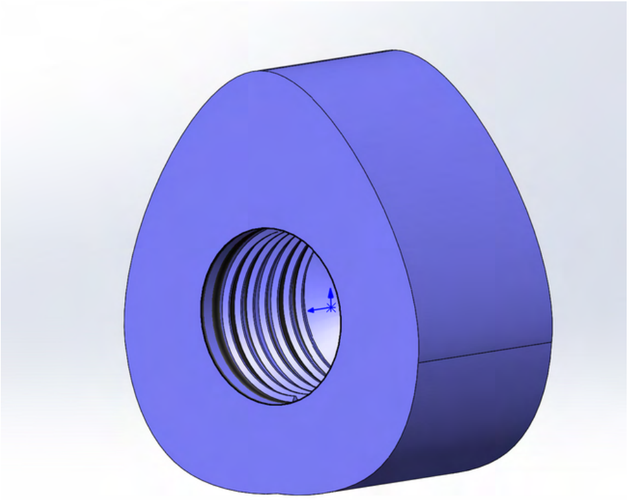
DFM
SOLIDWORKS

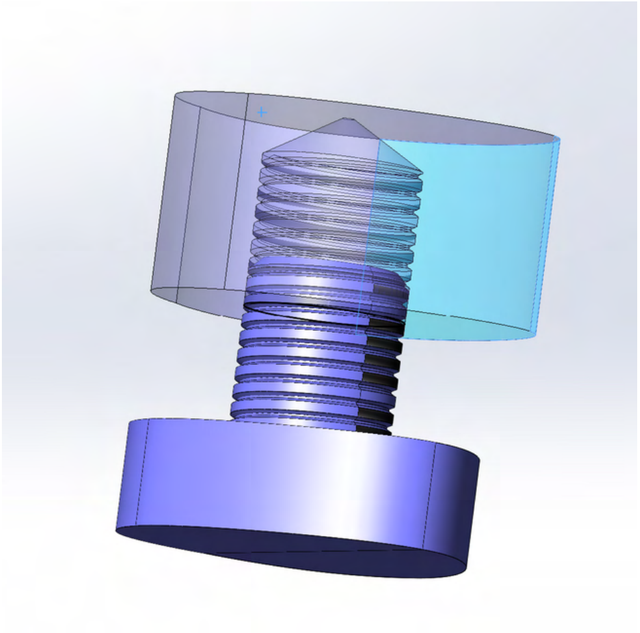




I had to model the front (now back) part of the dremel so that I can model the attachment.

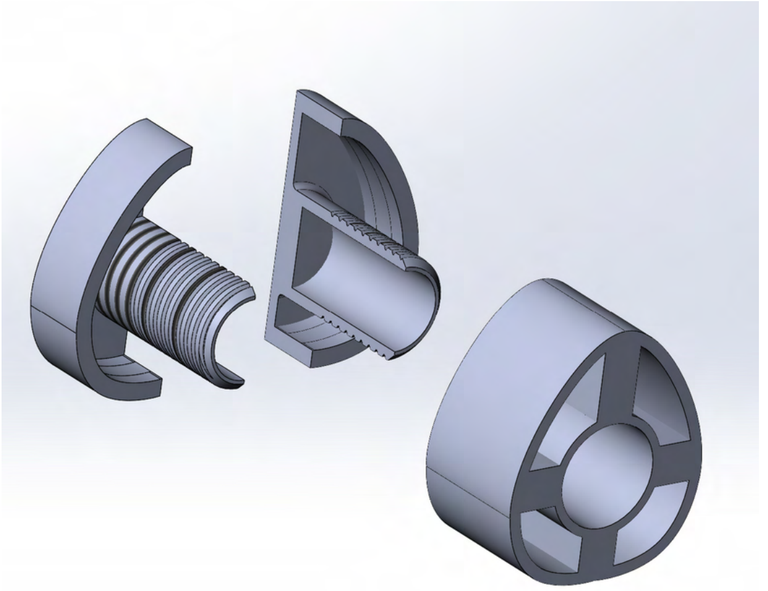
The new dremel screw bit for the bottom.





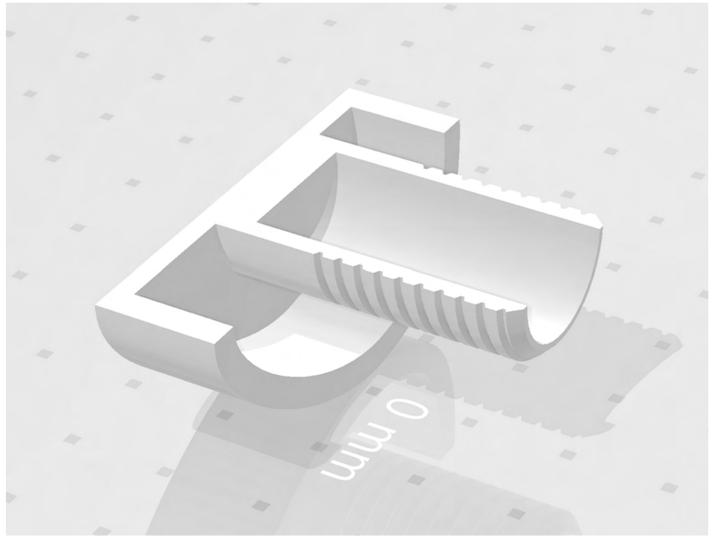
I then made an assembly of the parts to see how they fit into each other.

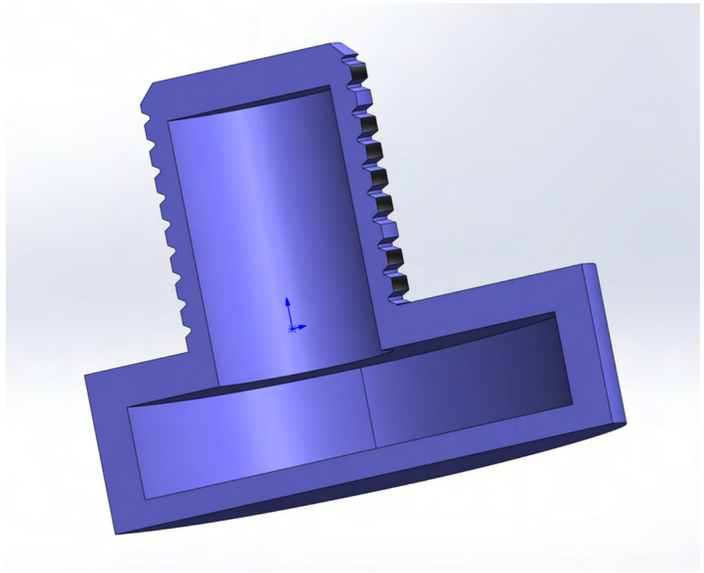
Made an exploded view of the parts.



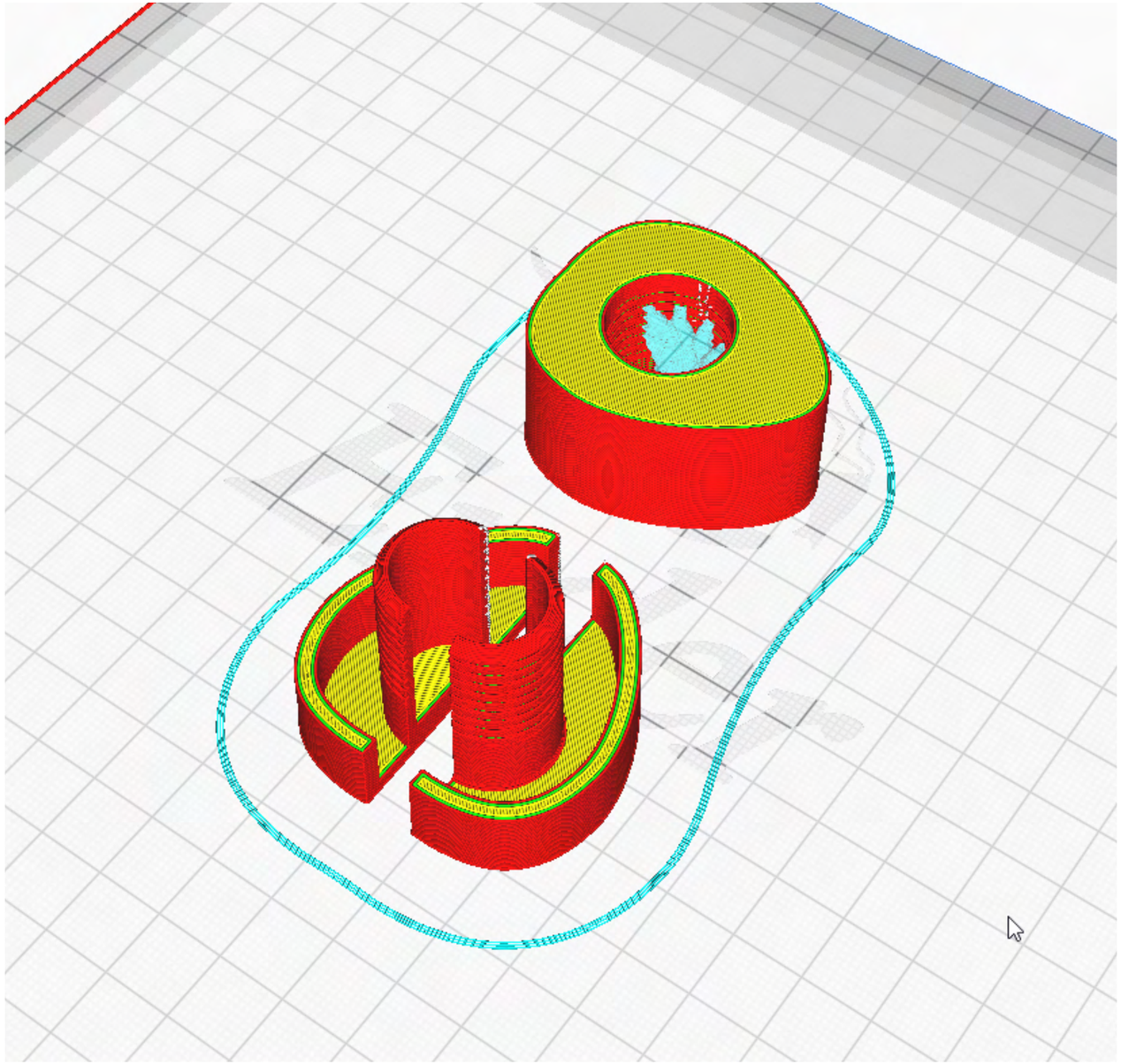
DFM
3D PRINTING

I wanted to 3D print my design so that I could see how it interacts with the real-world environment.





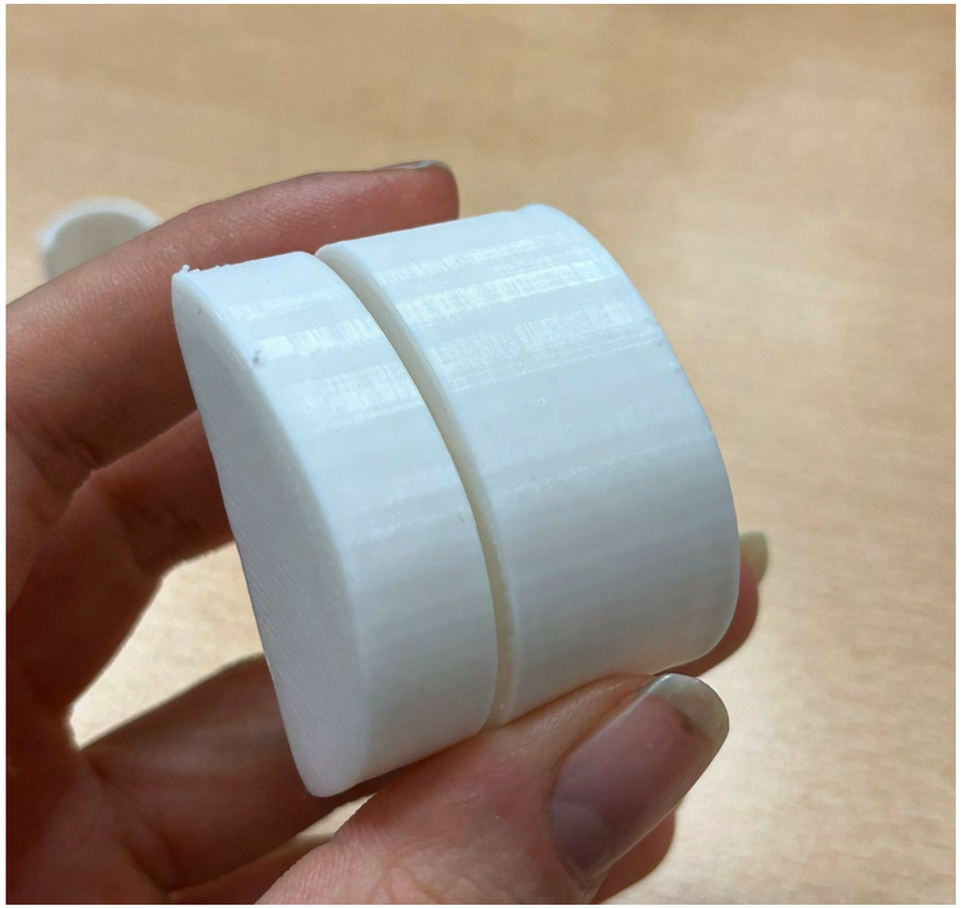
I had to adjust the model for 3D Printing to reduce the amount of infill, thicken soe of the walls etc.

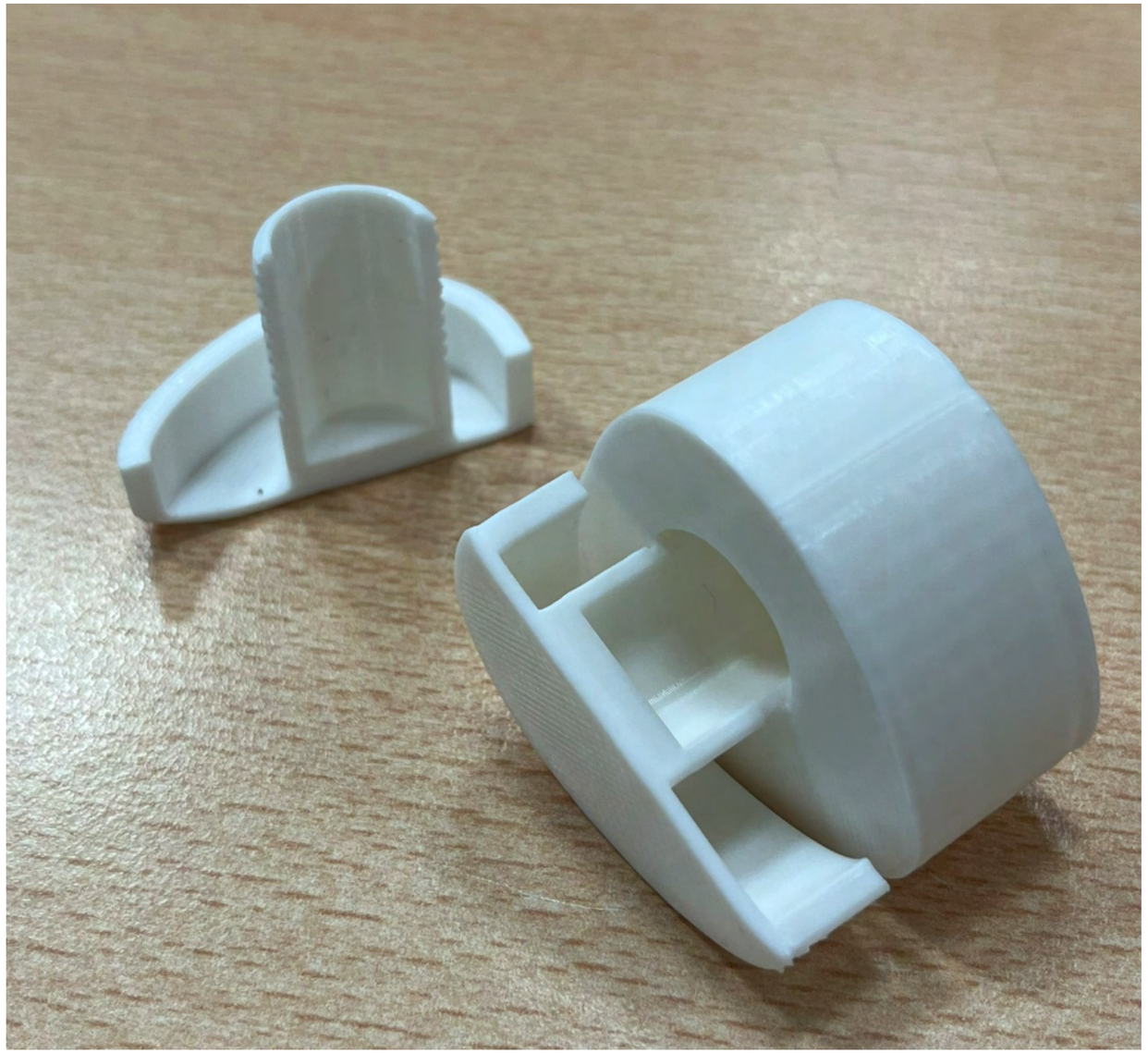


DFM

3D PRINTING

This was the end result of 3D Printing. It worked quite well, only problem was I didnt leave enough clearance for both parts to go into the hole at the same time. Nevertheless I just wanted an idea of the concept.

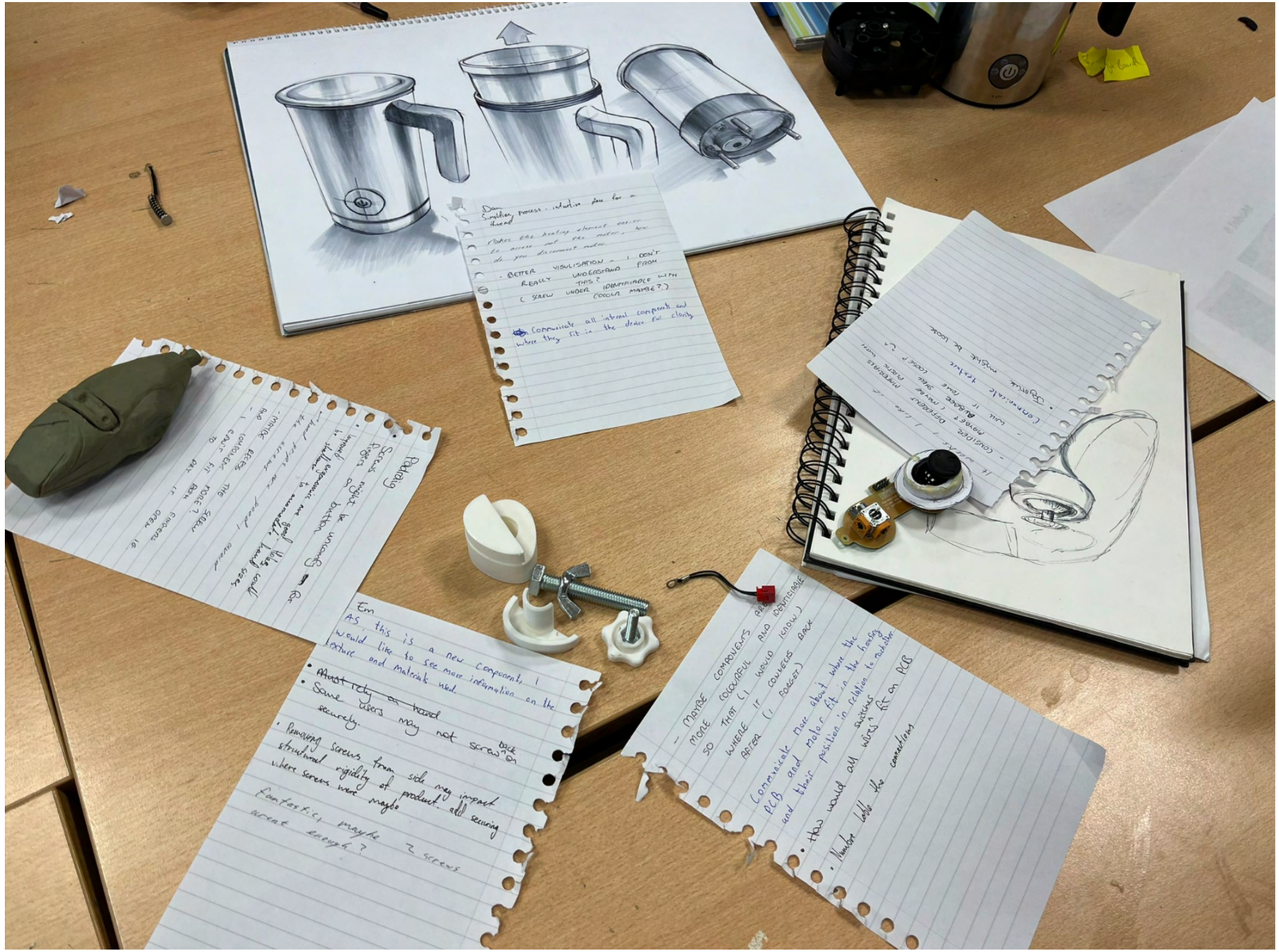




Visulisation
GROUPWORK

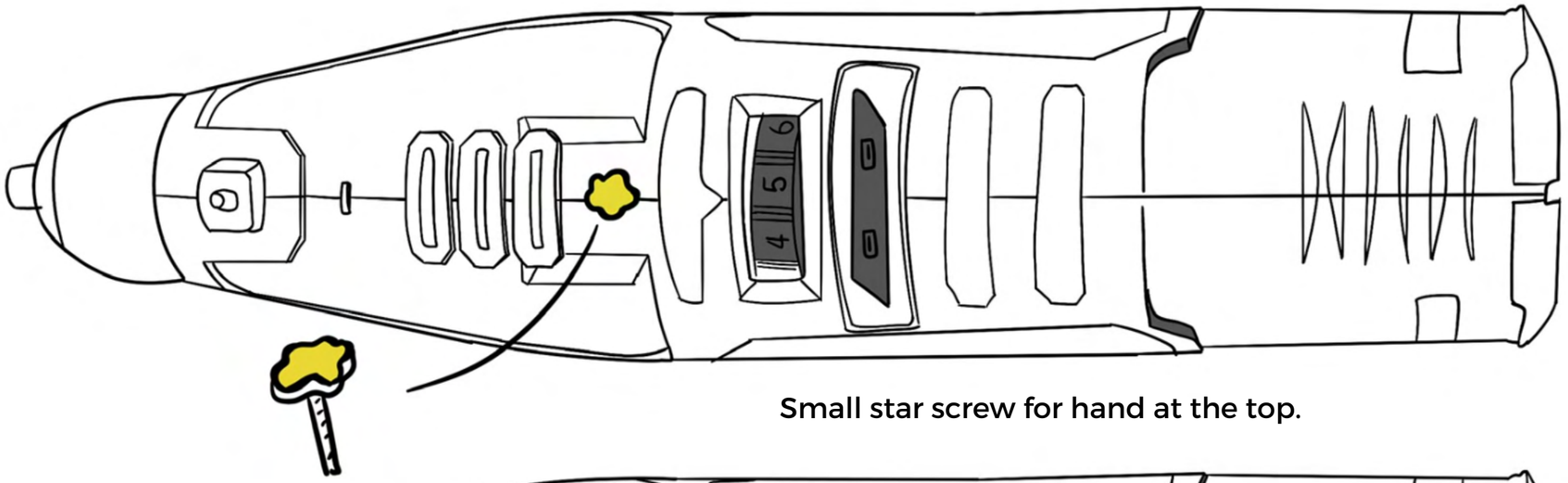
We did group work at our table and passed our projects around to each other to look at and critique in five-minute intervals, we then further explained the ideas to each other and continued.

There were a few things I learned and wanted to develop in my project that my peers mentioned that I sketched and adjusted in the next slide.

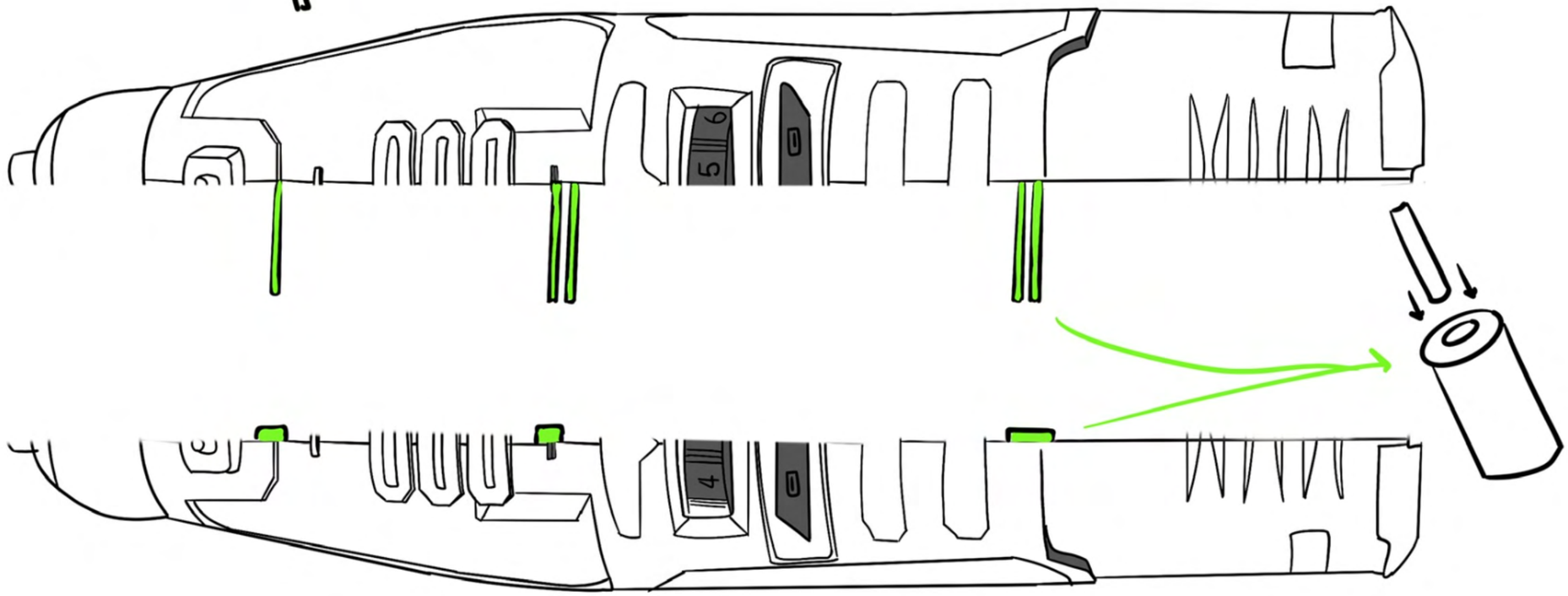


Visulisation
GROUPWORK

As suggested by my peers, the first idea was to still include a small screw on the top of the dremel for test impact issues and durability, the second idea was to not forget about the screw placements but keep them and instead have a pin going into the hole so that the dremel remains stable.



Small star screw for hand at the top.



Pins going into the dremel body on one side for stability,

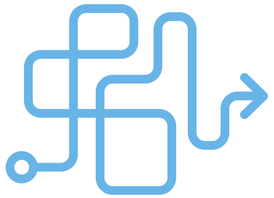
Visulisation
ETHNOGRAPHY

1. Who could your ideation sketches and models come into contact with in the design process? What different mediums, materials, and compositions might they use, and how could this transform your design works? How does this change the experience of your ideation sketches and models for the audience?
2. Who would your repair instructions come into contact with (what demographic are you aiming this towards, what is their visual culture)? How might they interact with your repair instructions in ways that could transform your design works (accessibility needs, fold outs etc)? How might this change the experience of your ideation sketches and models for the audience?
3. Who would your DfM drawings come into contact with (what demographic are you aiming this towards, what is their visual culture)? How might they interact with your DfM drawings in ways that could transform your design works (materiality, manufacture processes etc.)? How might this change the experience of your ideation sketches and models for the audience?

My ideation comes into contact with:

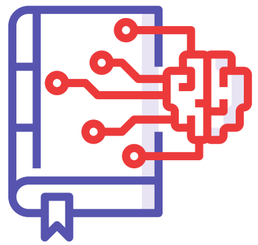
- Stakeholders in the design process.
- Engineers.
- Users.
- Lecturers.

My visualizations will come in different formats to suit these categories to communicate my idea like:



Working Drawings/ Detailed Drawings on part manufacture for Stakeholders and Engineers.

Visual and cohesive instructions for Users, potentially making it engaging.



Combine the two for a visually engaging but detailed process book for Lecturers.

I want to include the detailed working drawings from DFM suite solidworks, having precise measurements that detail how to make it.

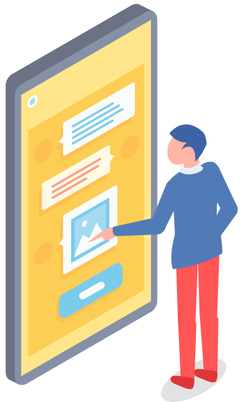
My repair instructions will be tailored towards these two groups in a positive and interesting way;

- Possibly use origami or pop-up style instructions, maybe puppet style instructions with the cardboard packing it comes with?

Visulisation ETHNOGRAPHY

USERS

Common users and the target demographic will most likely only be able to understand common symbols and expressions.



It is important to note how the average user interacts with a digital interface for instructions/idea purposes. Some consumers may be more techy, while others prefer the ol' paper. It is ideal to provide both of these solutions and have them easily accessible to the users.

Users with certain 'disabilities' like color - blindness, actual blindness, who need to use assistive devices should also be considered but not prioritized as this is a DIY rotary tool device that most users with these conditions would not need to use.

STAKEHOLDERS/ENGINEERS

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

The more technically advanced users will be able to understand a lot more symbols than the average users, especially complicated data. They might even make more sense of it than simplified data as it is what they deal with on a daily basis.

Along with the introduction to DPP (Digital Product Passport), the people who have a part in the design process will have access to part history and recycling information as common practice.

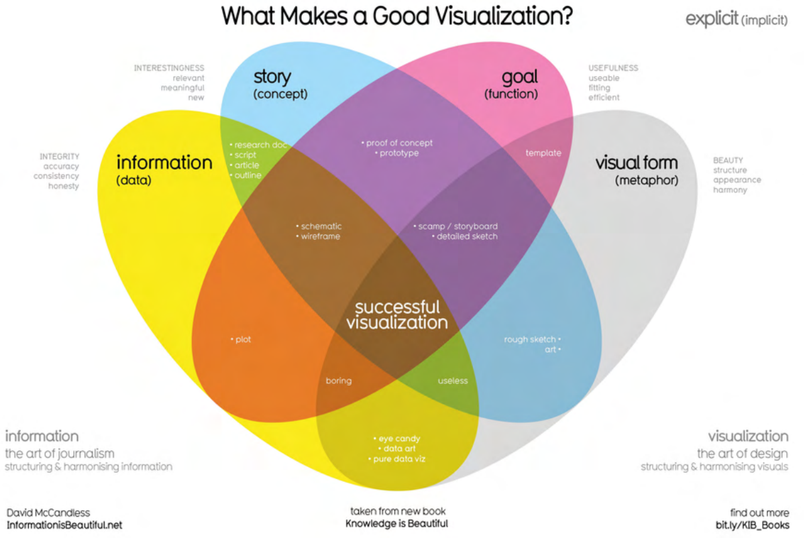
This group will also critique and want the work and information to be of high standards.

Let's not forget that this diagram shown in Week 1 still applies to all these groups!

LECTURERS

Lecturers grasp the basics of both worlds, yet it is best to simplify the understanding for everyone.

Lecturers also understand both physical and digital modes of ideation, and there is no preferred medium.

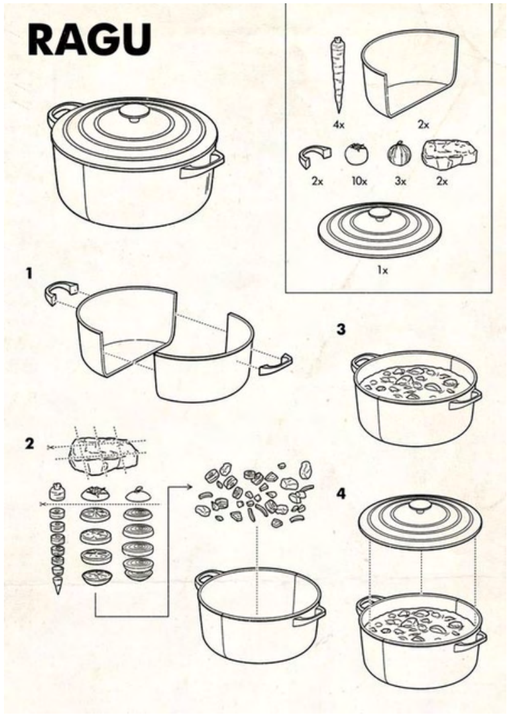


WEEK 4

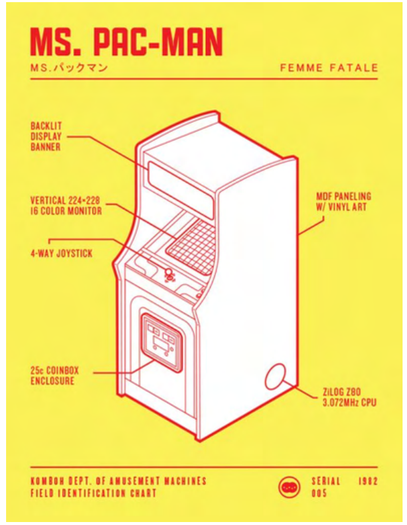
Instruction
IDEATION

COLOURS

SIMPLE



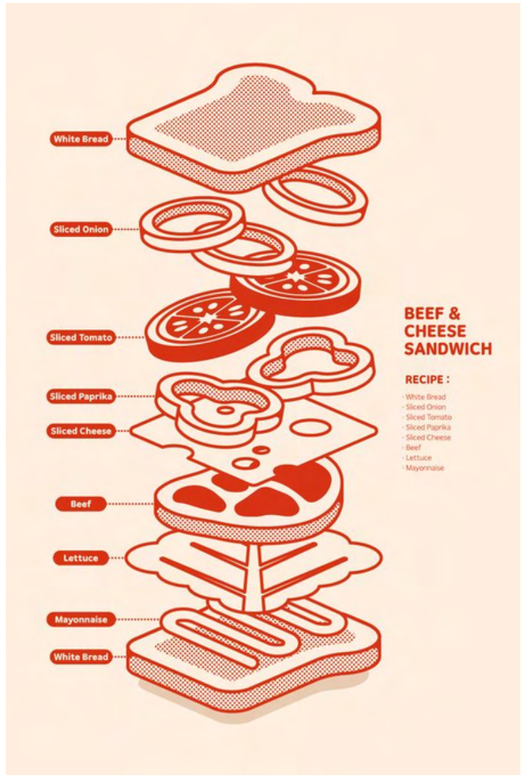
CLEAR TEXT/LAYOUT



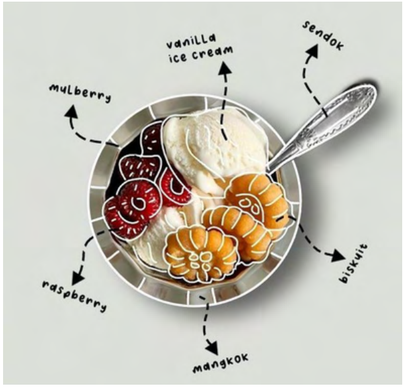
FUNNY/ENGAGING

INTERESTING DIRECTIVE

BREAKDOWN



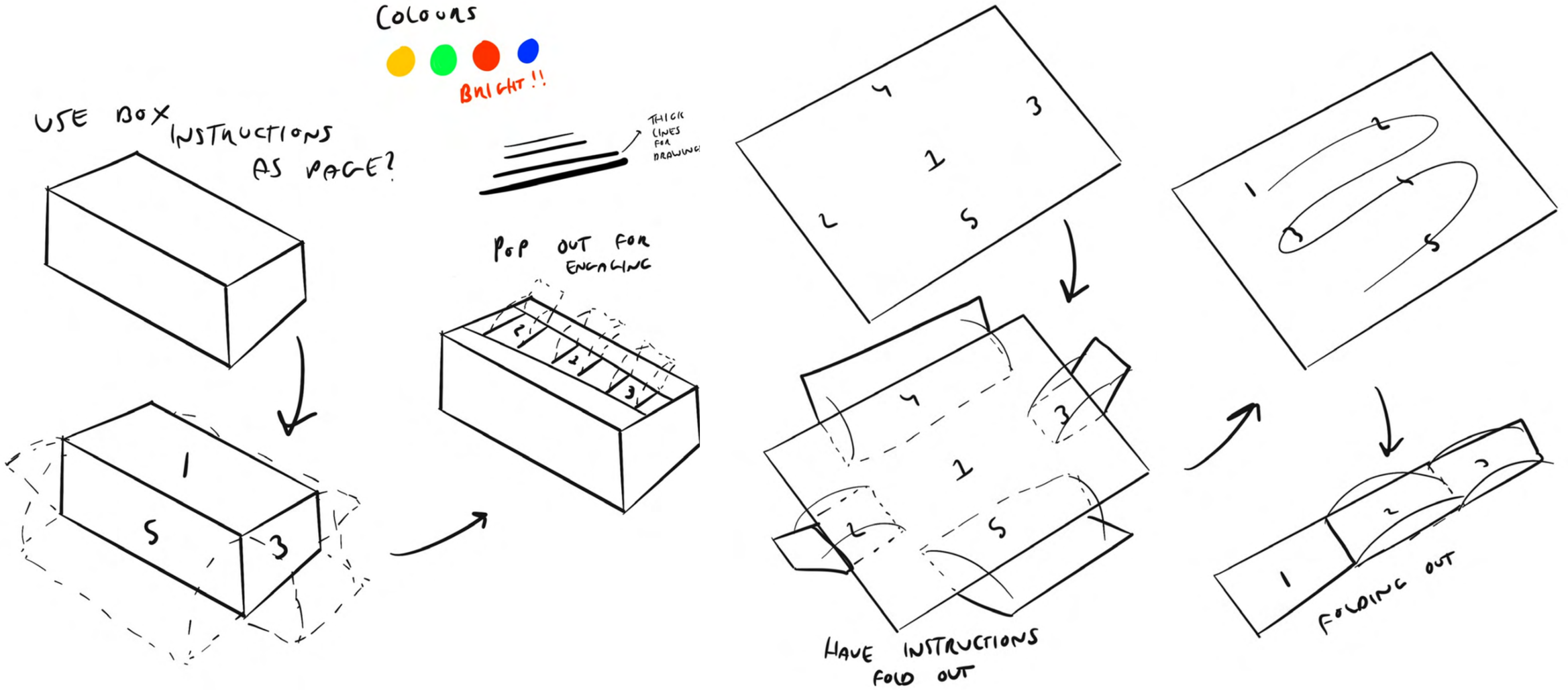
HIGHLIGHTING



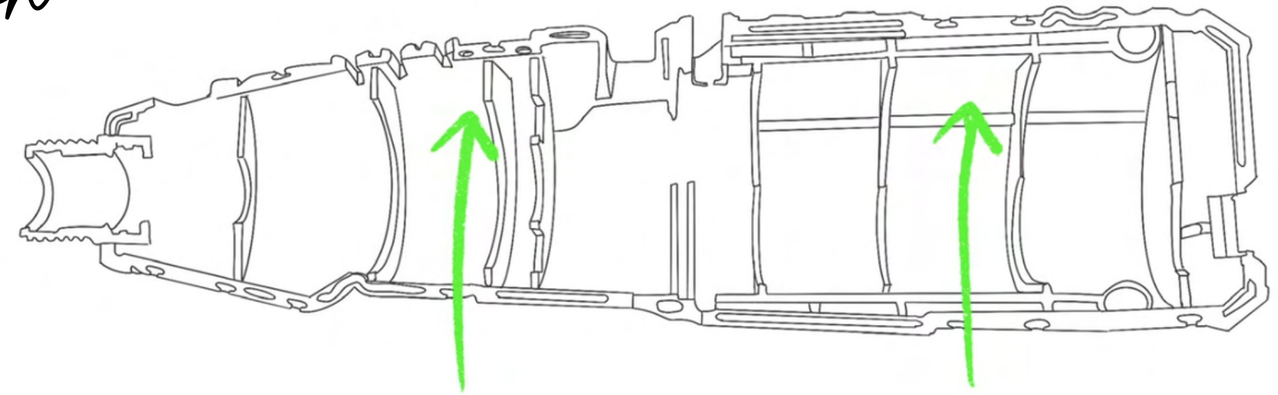
LITTLE THINGS TO NOTE!

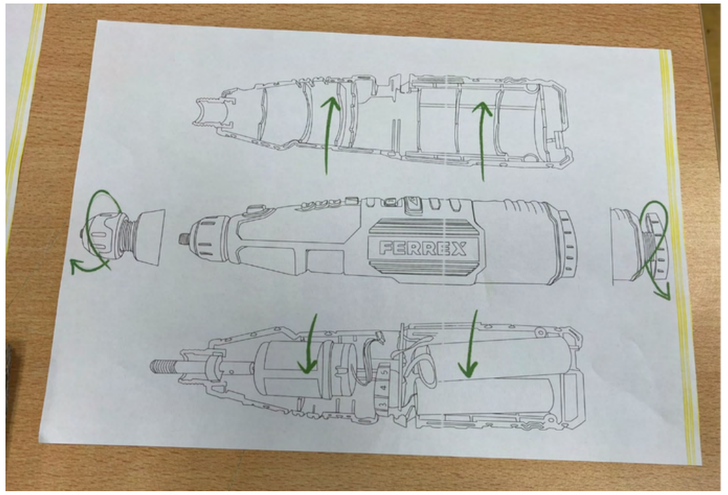
Instruction IDEATION

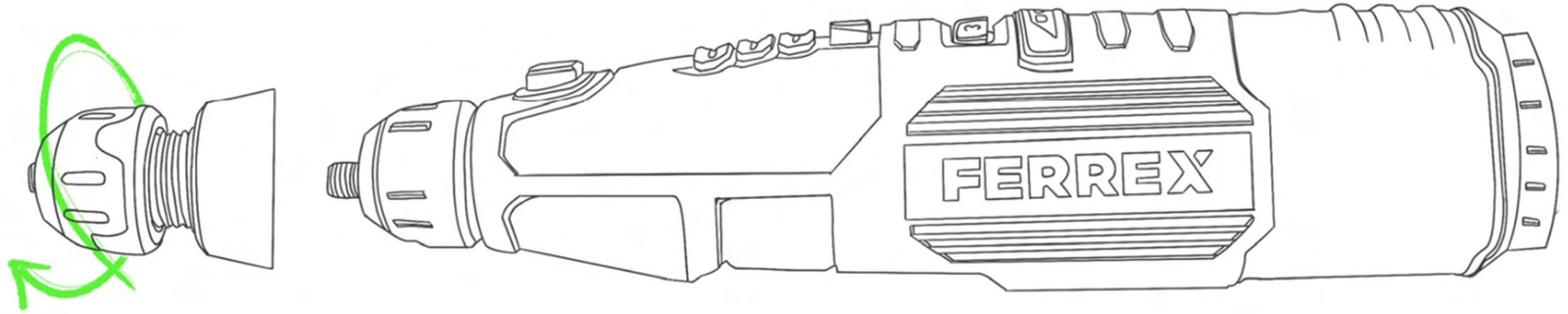
Using the mediums of paper and possibly cardboard to start with physical disassembly instructions that the customer receives when they buy the product.

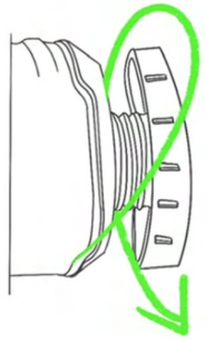


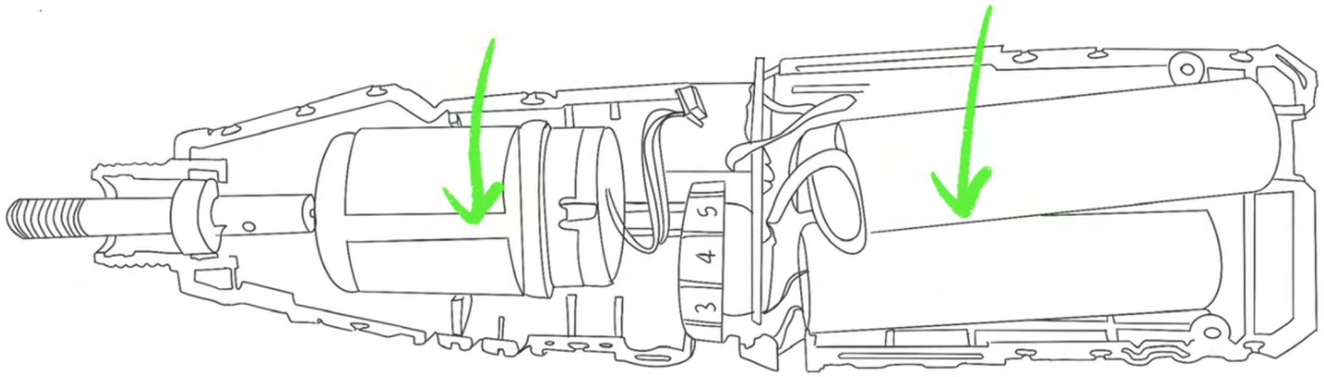
Instruction
IDEATION









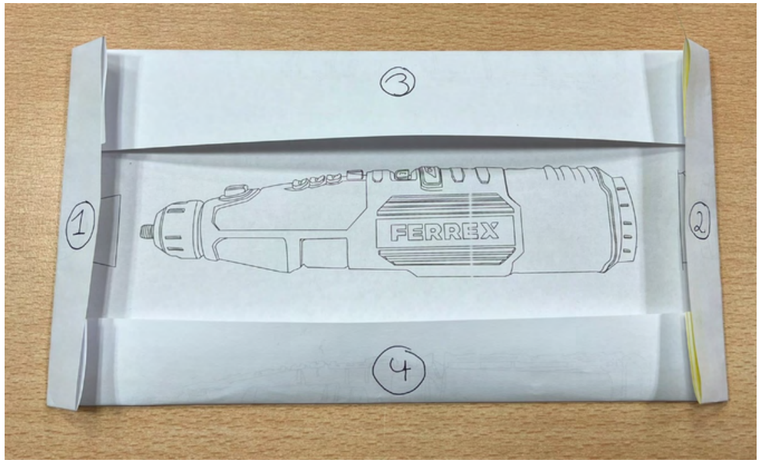


Using detailed outlines for instructions and separating into four simple steps, not considering the middle screw as part of it yet.

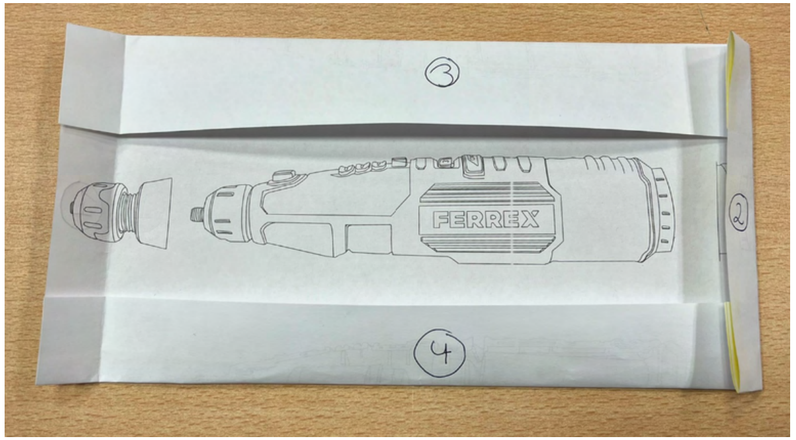
Instruction IDEATION

Following the first ideation of instructions each step is hidden until it is needed to not intimidate the user.

1



2



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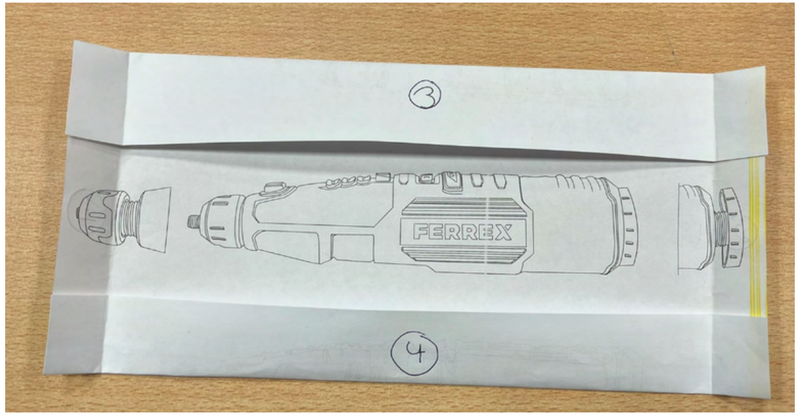

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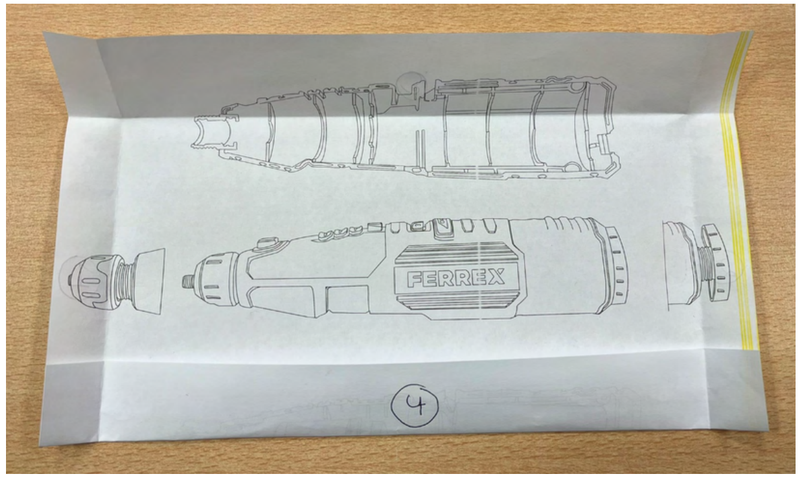
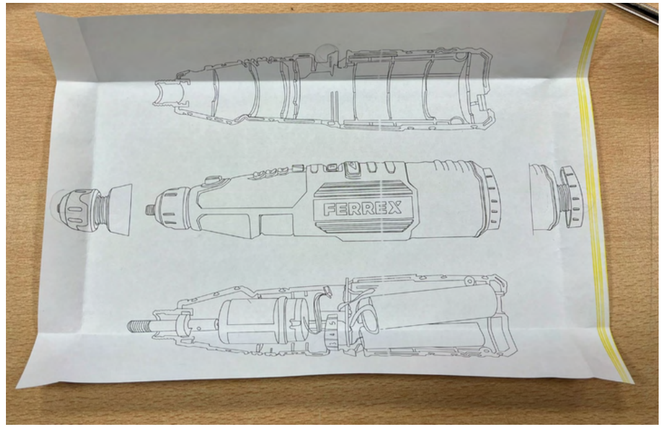


- Nice idea with hiding elements
- The concept itself is a bit boring

5

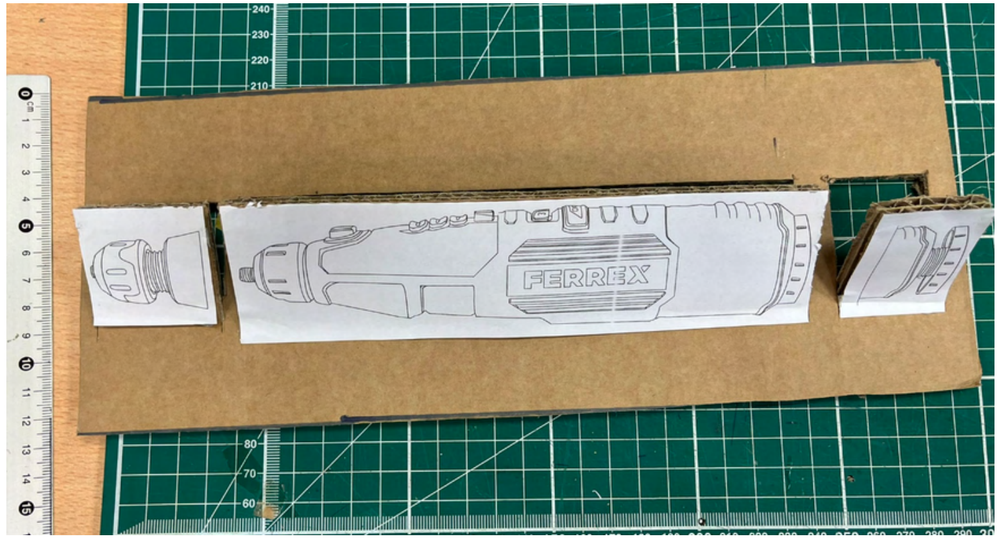


Instruction
IDEATION

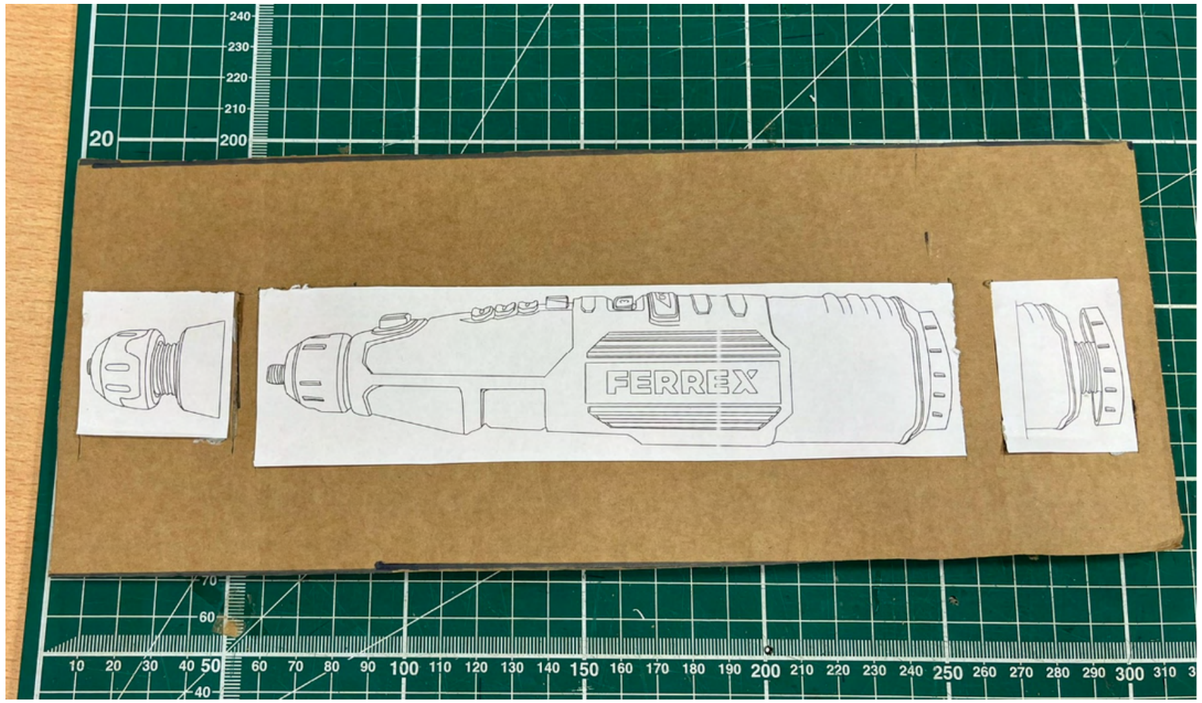
The next idea was to create pop-up instructions. As part of the redesigned cardboard packaging of the dremil, the side or top of the box can have these instructions that pop out one by one to give direction to a user.

- Using the box as part of the instructions I really like
- The concept doesn't really work as parts aren't really hidden.

2



1

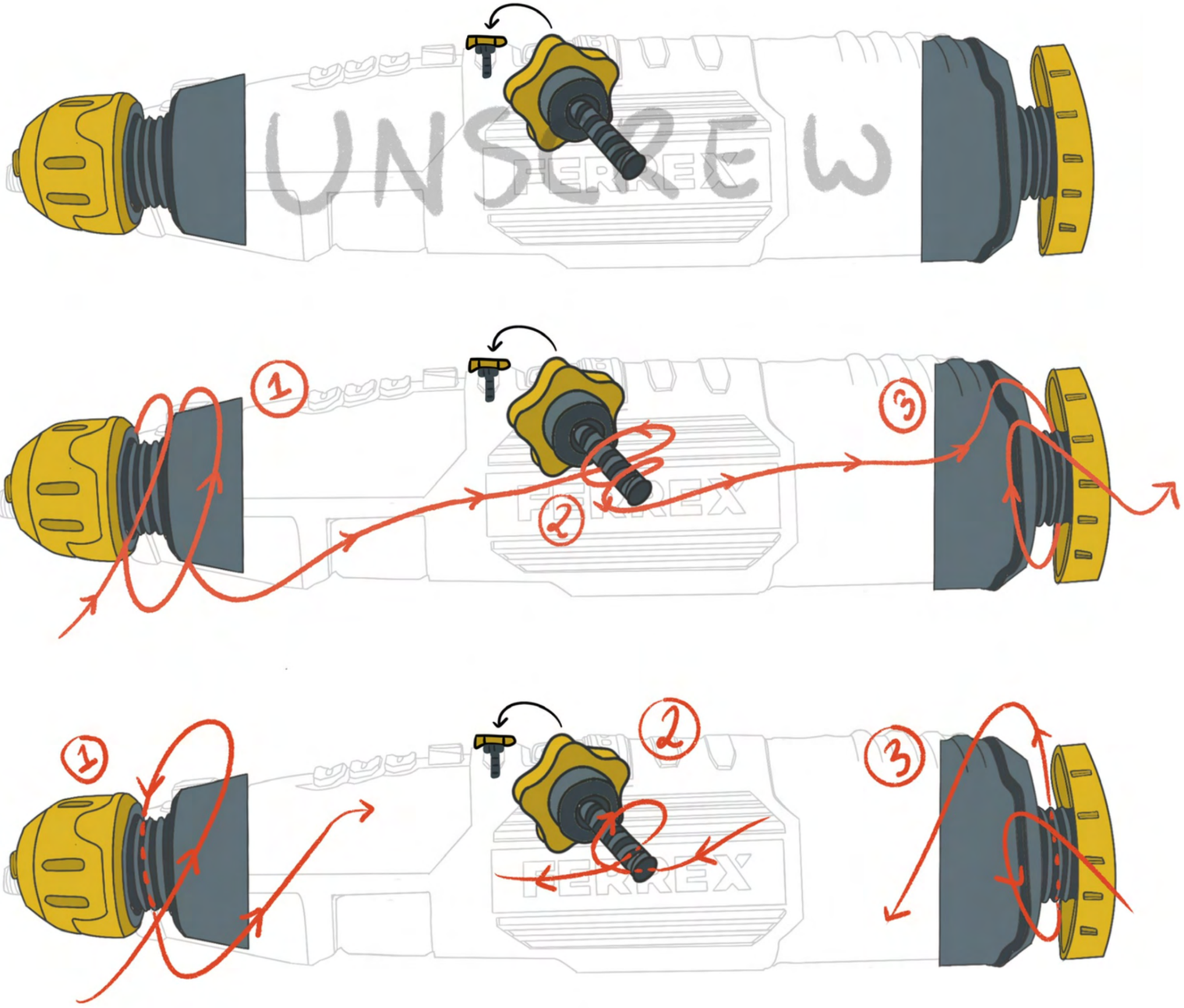


3

Instruction
IDEATION

I wanted to shrink the instructions a bit and re-design them before moving on to the next physical idea. I knew that there only really are 3 steps, and they are all to unscrew the device.

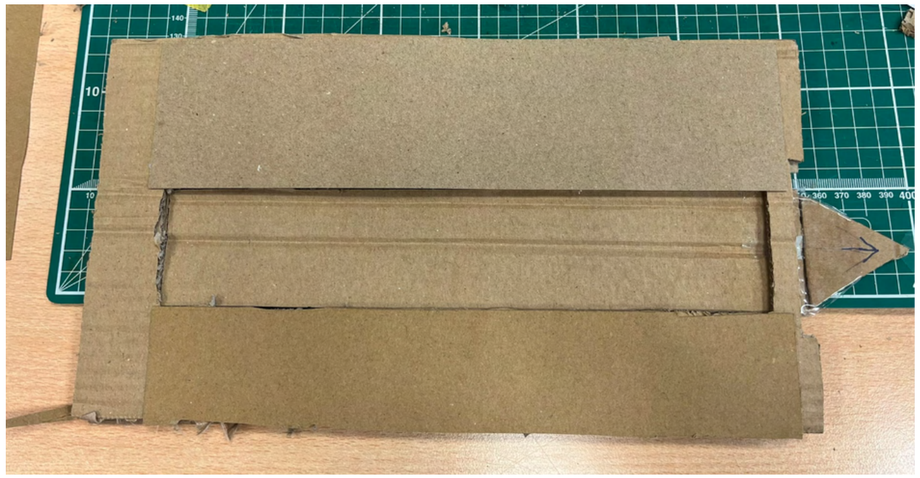
I experimented a bit and settled on the last design.



Instruction FINAL

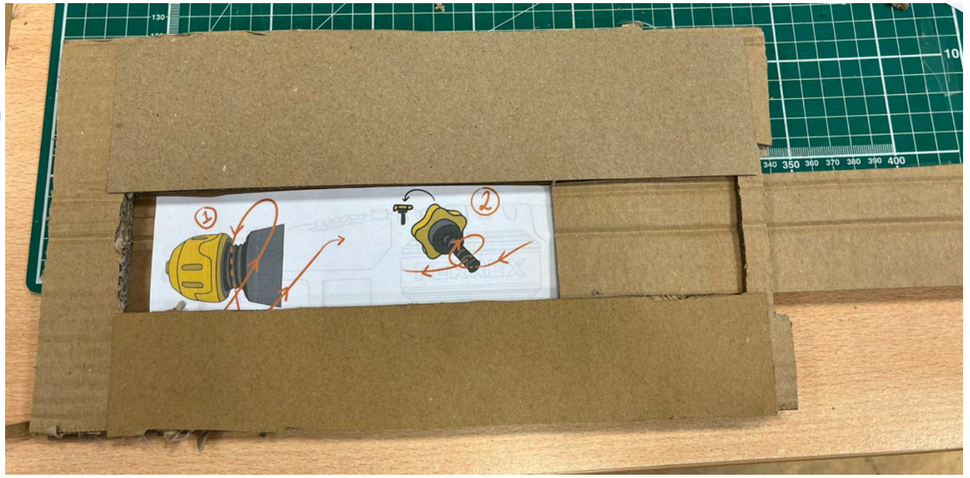
I did my final cardboard instructions design, I really enjoyed making this one. The solutions slide gradually to the right as the person progresses through them. I think it would be a good idea to incorporate this into the actual packaging of the product.

1



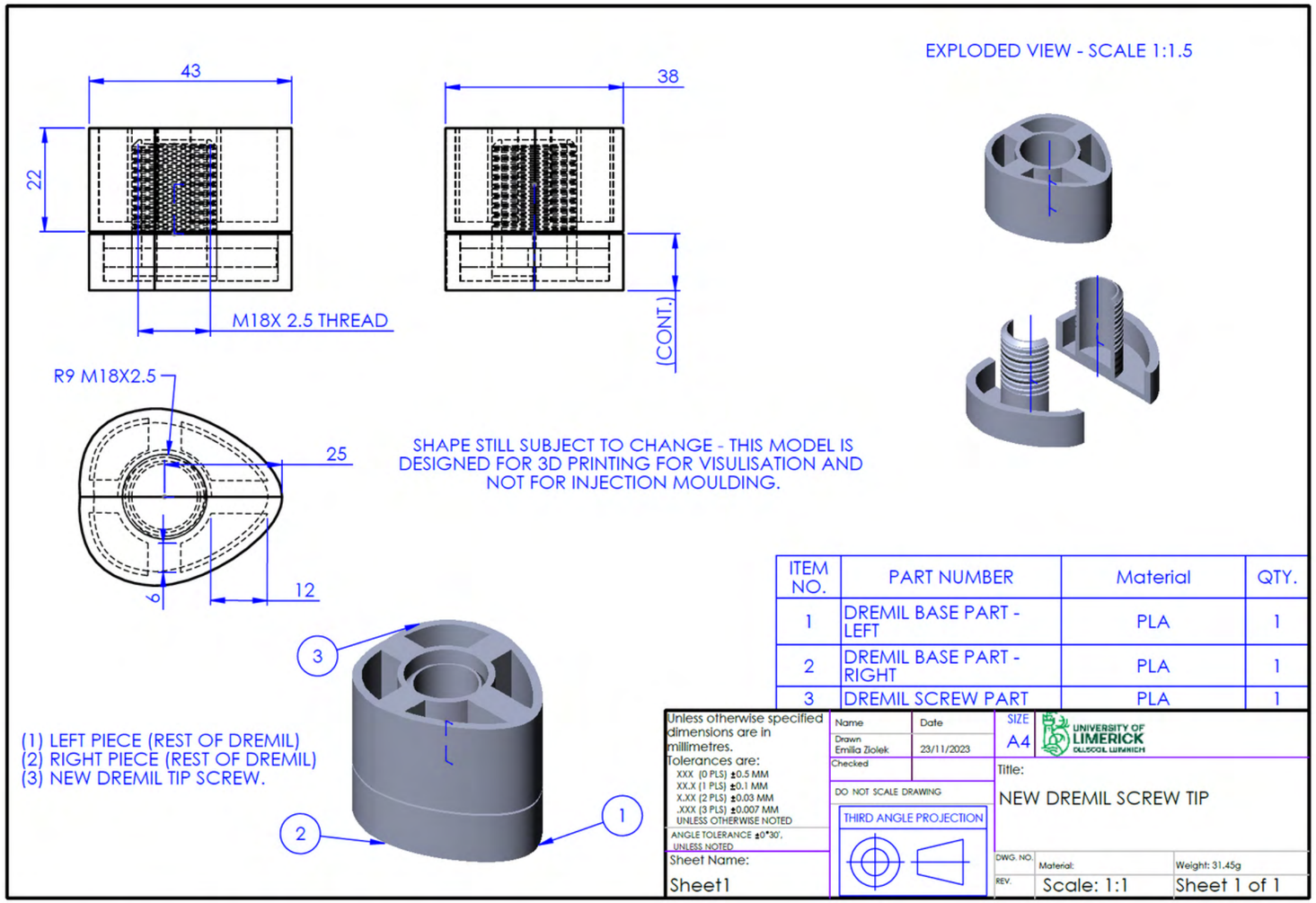
2

3



4

Working Drawing FOR 3D PRINTING



ITEM NO.	PART NUMBER	Material	QTY.
1	DREMIL BASE PART - LEFT	PLA	1
2	DREMIL BASE PART - RIGHT	PLA	1
3	DREMIL SCREW PART	PLA	1

Unless otherwise specified dimensions are in millimetres.
Tolerances are:
XXX (0 PLS) ±0.5 MM
XX.X (1 PLS) ±0.1 MM
X.XX (2 PLS) ±0.03 MM
.XXX (3 PLS) ±0.007 MM
UNLESS OTHERWISE NOTED
ANGLE TOLERANCE ±0°30', UNLESS NOTED
Sheet Name: Sheet1

Name | Date
Drawn: Emilia Ziolek | 23/11/2023
Checked

DO NOT SCALE DRAWING

THIRD ANGLE PROJECTION

SIZE A4

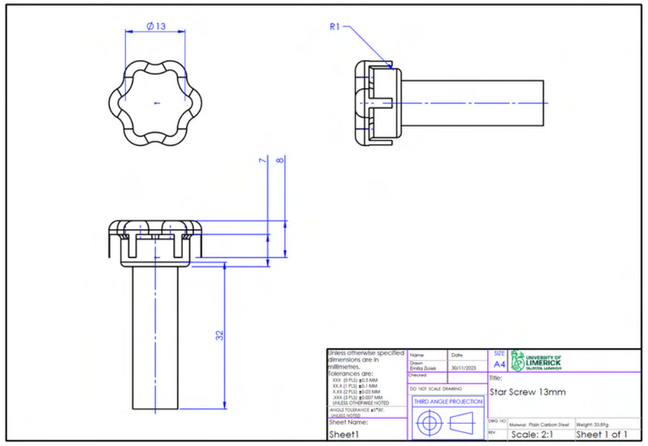
UNIVERSITY OF LIMERICK
OLLSCOIL LUIMNIGH

Title: NEW DREMIL SCREW TIP

DWG. NO.
Material: Weight: 31.45g
REV.
Scale: 1:1 Sheet 1 of 1

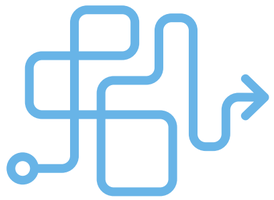
SOLIDWORKS Educational Product. For Instructional Use Only.

Working Drawings/ Detailed Drawings on part manufacture for Stakeholders and Engineers.

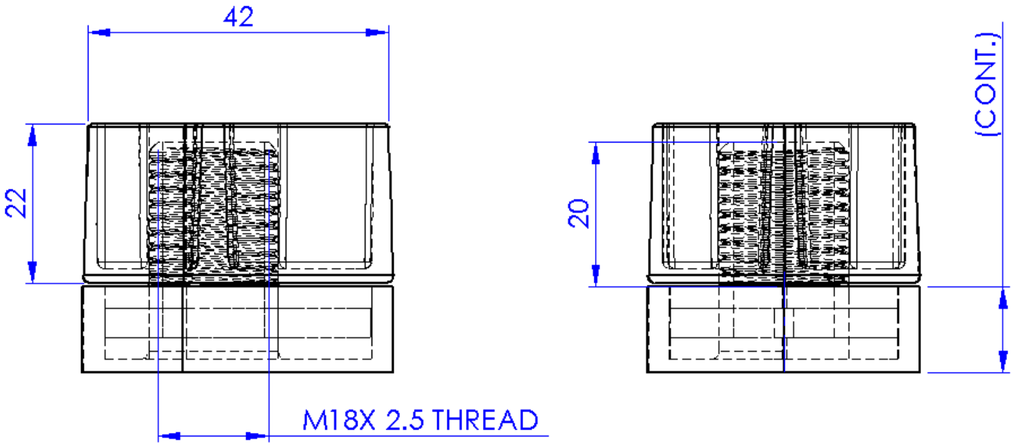


The ‘Star Screw’ is a standard part in screw assembly.

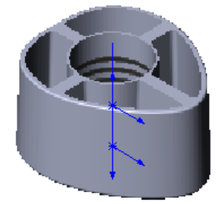
Working Drawing FOR INJECTION MOULDING

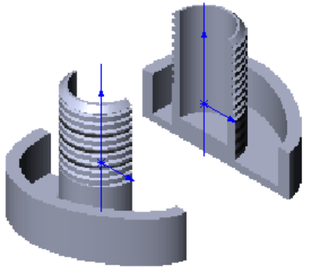


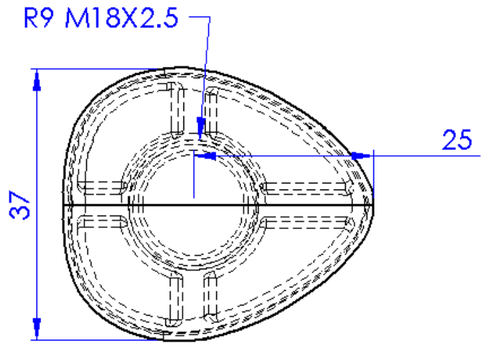
Working Drawings/
Detailed Drawings
on
part manufacture
for Stakeholders
and Engineers.



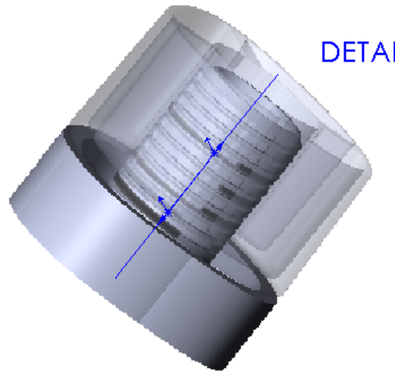
EXPLODED VIEW - SCALE 1:1.5







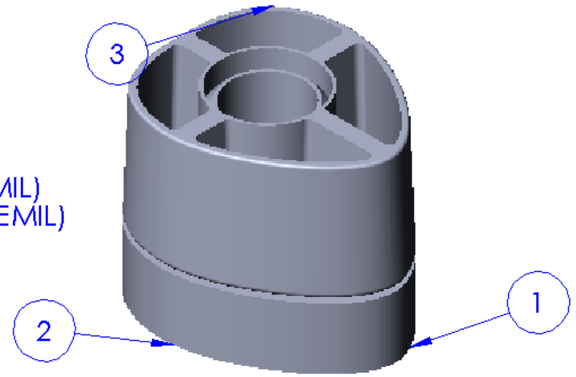
DETAILED VIEW



ALL DRAFT ANGLES 2° UNLESS STATED OTHERWISE.
ALL RIBS ARE 30MM UNLESS STATED OTHERWISE.

ITEM NO.	PART NUMBER	Material	QTY.
1	DREMIL BASE PART - LEFT	PLA	1
2	DREMIL BASE PART - RIGHT	PLA	1
3	DREMIL SCREW PART	PLA	1

(1) LEFT PIECE (REST OF DREMIL)
(2) RIGHT PIECE (REST OF DREMIL)
(3) NEW DREMIL TIP SCREW.



Unless otherwise specified dimensions are in millimetres.
Tolerances are:
XXX (0 PLS) ±0.5 MM
XX.X (1 PLS) ±0.1 MM
X.XX (2 PLS) ±0.03 MM
.XXX (3 PLS) ±0.007 MM
UNLESS OTHERWISE NOTED
ANGLE TOLERANCE ±0 °30', UNLESS NOTED

Sheet Name: Sheet1

Name	Date
Drawn Emilia Ziolek	24/11/2023
Checked	

DO NOT SCALE DRAWING

THIRD ANGLE PROJECTION

SIZE A4

UNIVERSITY OF LIMERICK
OLLSCOIL LUIMNIGH

Title: NEW DREMIL SCREW TIP

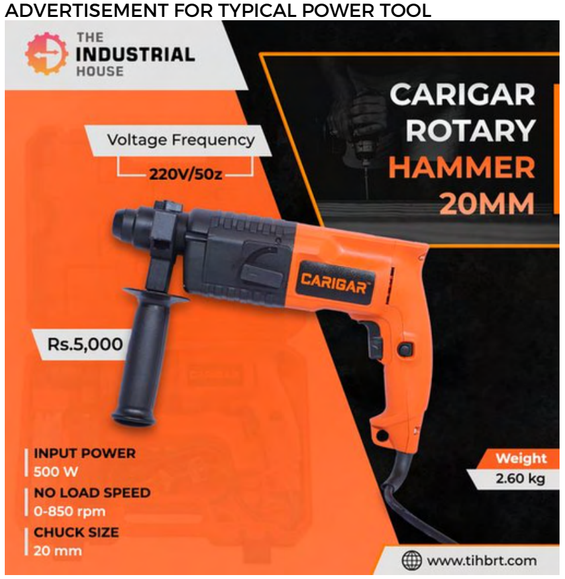
DWG. NO.
REV.
Material:
Weight: 25.89g
Scale: 1:1
Sheet 1 of 1

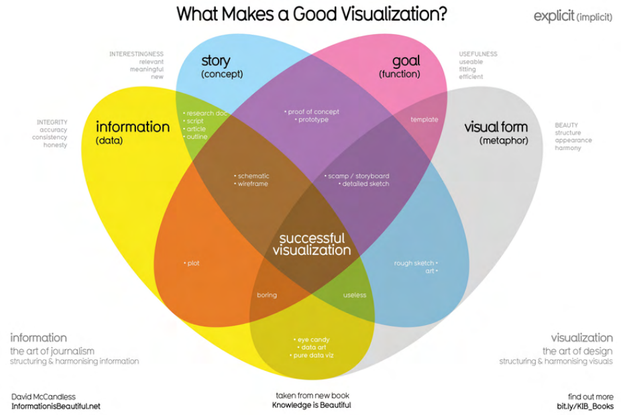
Final Viosulisation
MOODBOARD

INFO BASED

SIMPLE INFORMATION

ADVERTISEMENT FOR TYPICAL POWER TOOL





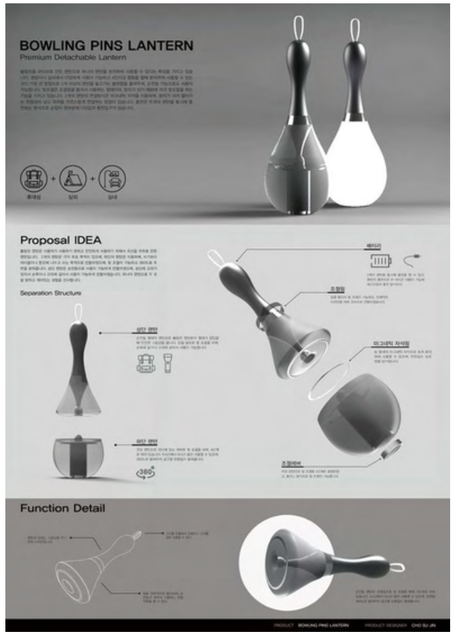
DETAIL OREINTATED

GOOD COLOUR SCHEME

ENGAGING CONCEPT

PAGE STRUCTURE

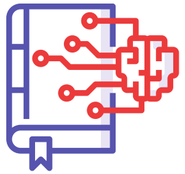
DETAIL OREINTATED



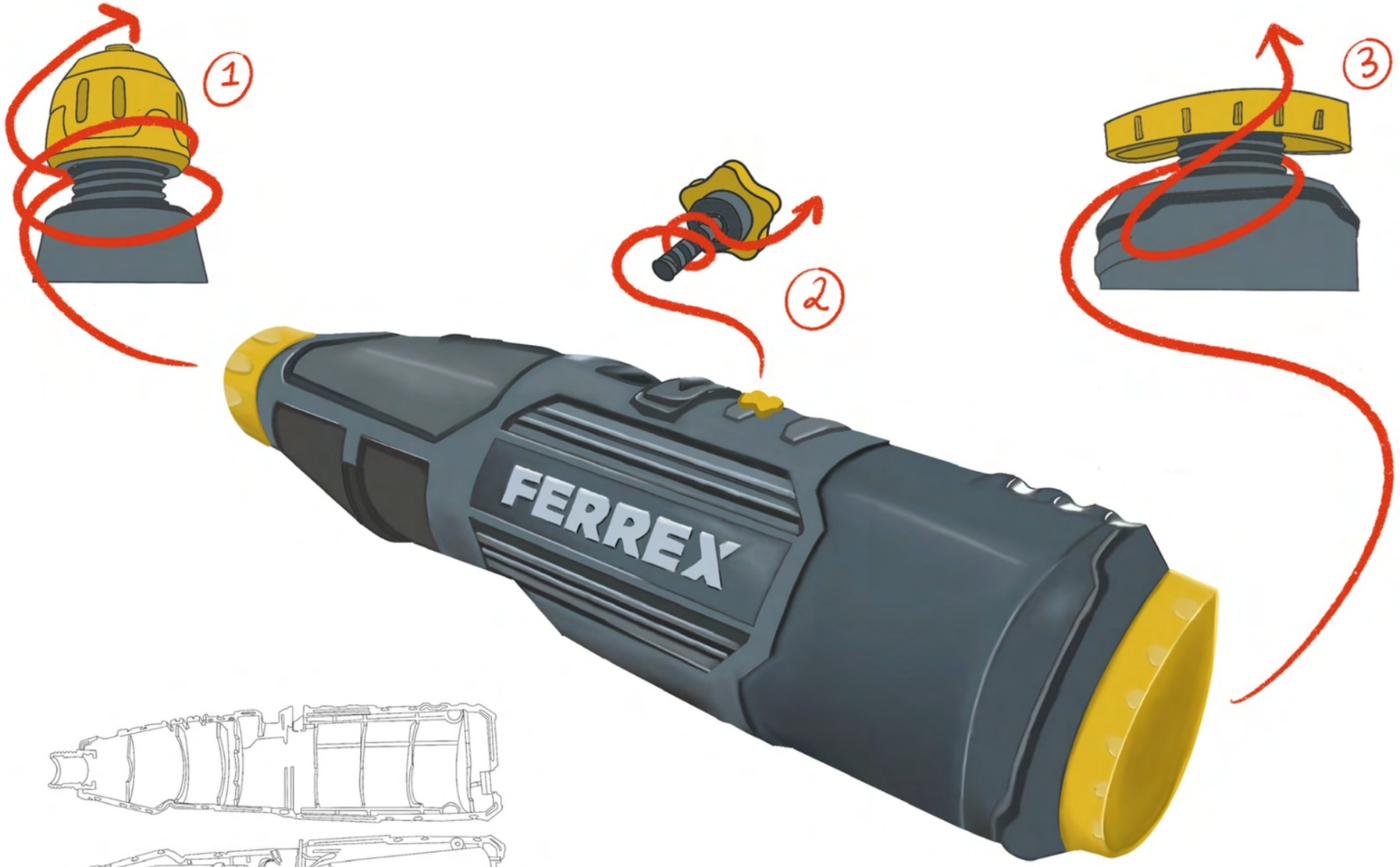
Final Visualisation
FIRST CONCEPT

I started by rendering the newly designed dremil and looking at what are the key features that I want to include.

Visual and cohesive instructions for Users, potentially making it engaging.

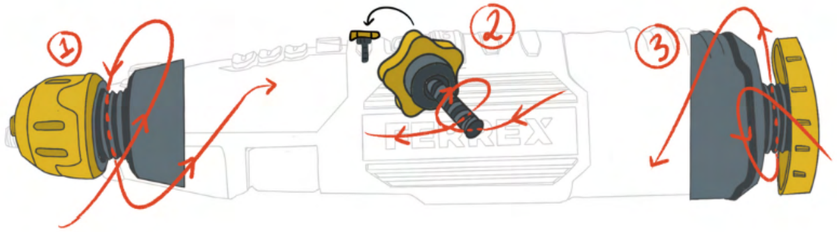


Combine the two for a visually engaging but detailed process book for Lecturers.



Final Visualisation
SECOND CONCEPT

I rendered some other ‘product posters’ for the product, ones that could be used for marketing or hung up in places, while these were fun to do, I wasn’t quite happy with them yet.



Final Viosulisation

THIRD CONCEPT

The third idea went a little bit back to basics so that I could make sure there was enough information for the user to understand. I also made the background interesting to process.

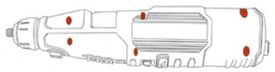
Final Visualisation

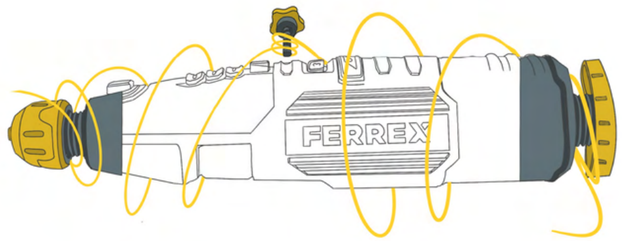
FINAL CONCEPT

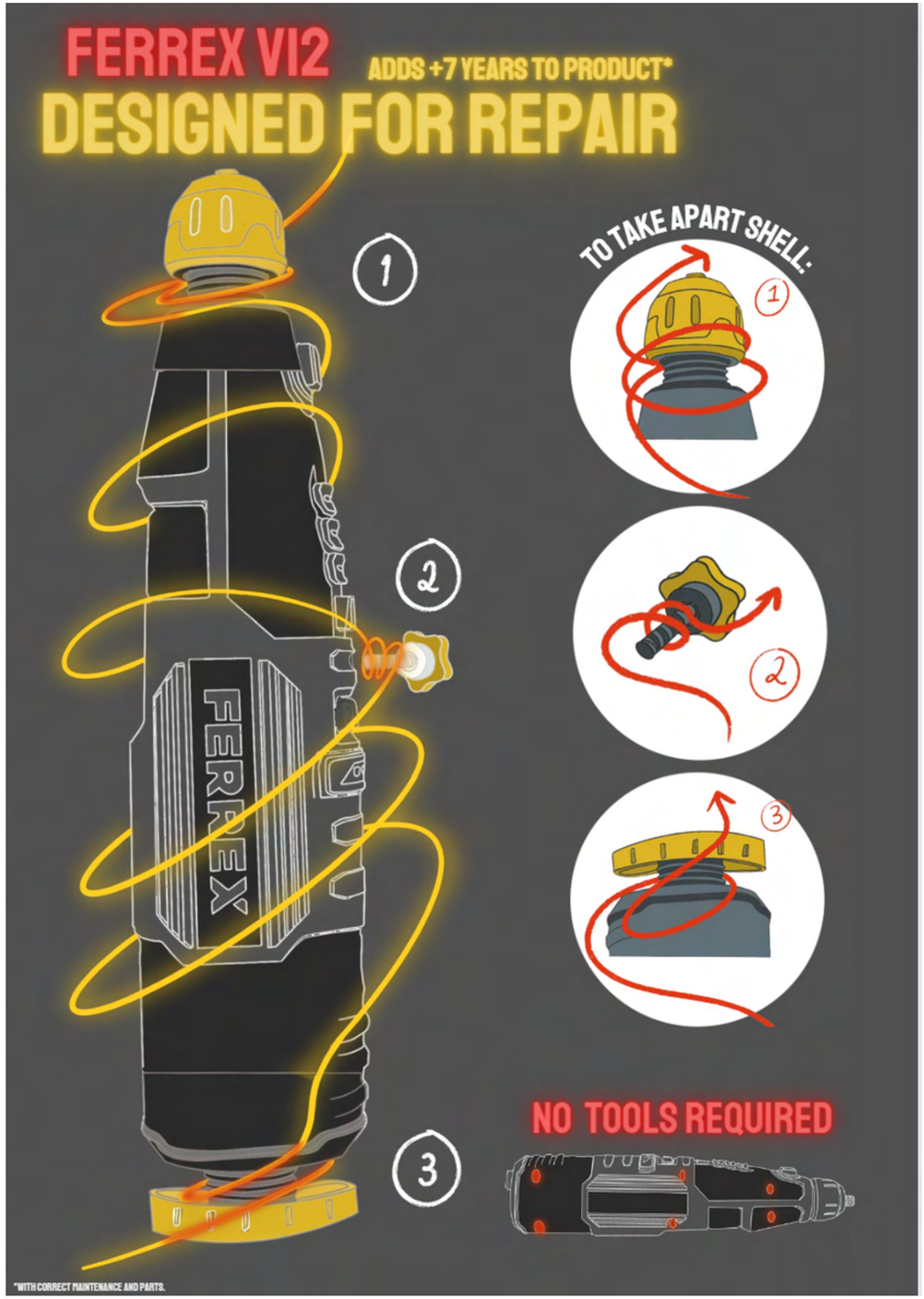
I really wanted an interesting and eye-catching concept for my final visualization, and I feel that this captures everything I wanted perfectly.

I began by experimenting on white paper and seeing how I could make the final design cohesive and interesting.

The message is to get people curious about the relation of these three components and what they unlock.







Use of clearer instructions for the user to understand more.

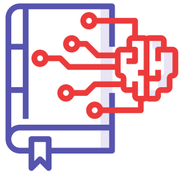
Dark background makes more colours pop and is unique.

Use of ‘neon’ colours to pop-out at the user.

Use of swirly lines to encompass the whole product and point to the features.

Showing the previous concept and how no hand tools are required to open the object if they are unavailable to someone, along with showing how the disassembly of the device has been surfaced.

Visual and cohesive instructions for Users, potentially making it engaging.



Combine the two for a visually engaging but detailed process book for Lecturers.

Final Visualisation

FINAL CONCEPT

Before I left the concept alone I decided to make a reimagined and more abstract version of the visualisation.

Message:

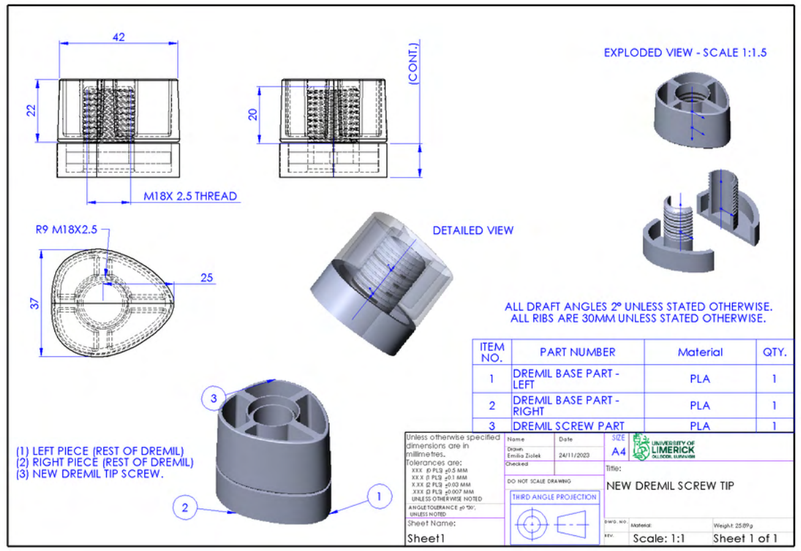
- **This repair is quick! (Like a rollercoaster!)**
- **You will have fun! (Like at a theme park)**

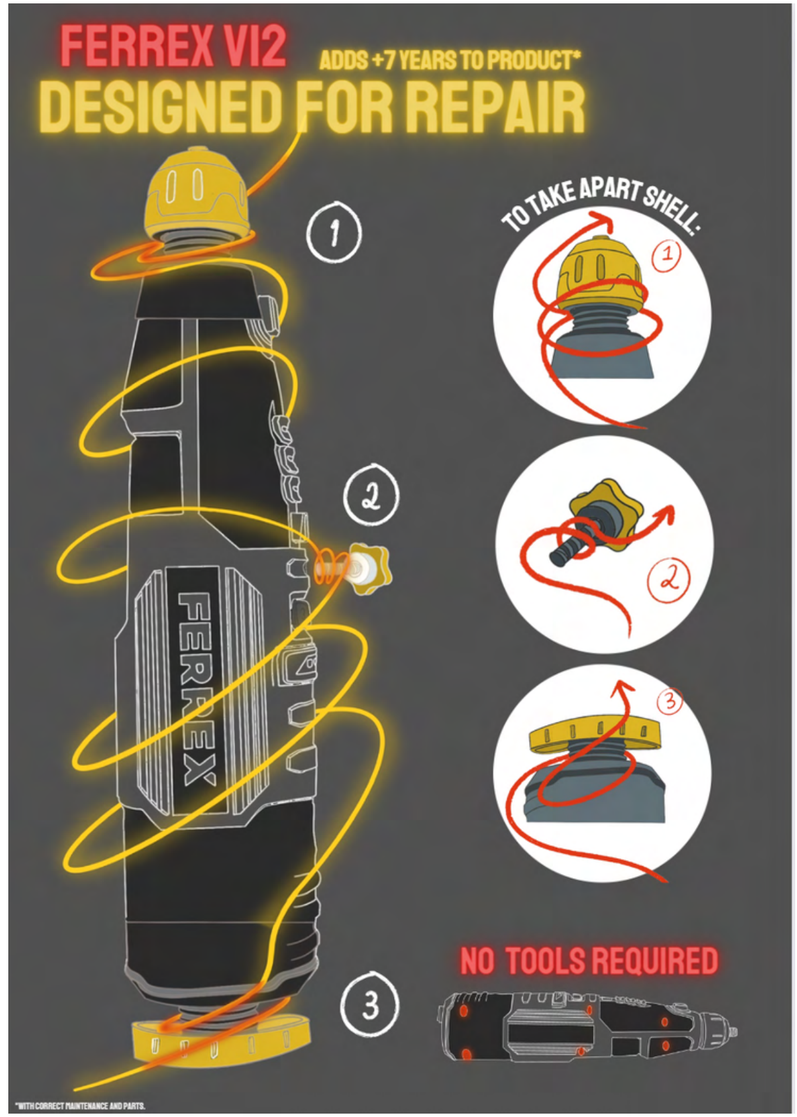
Final Visulisation
ALL MEDIUMS

Disassembly Hotspot/Model -I identified and picked what I found had the worst impact on time on the device: ‘Screws take too long to unscrew’. I managed to shorten the time for screws from 45 seconds to 25 seconds and you don’t need to use a screwdriver. I also chose to surface as the tactic as now it is much quicker to access the internal components,

Week 1/Visulisation Research -
I remembered to follow my visulisation research closely, especially regarding the legislation and the repairability index. With my latest visulisation, I took inspiration from looking at things differently and seeing how they all connect.

Ethnography - I see that all my mediums are easy to understand and accessible to use for the target market.





Further Steps

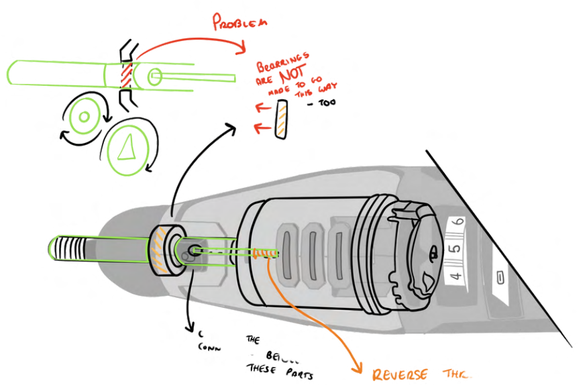
WHAT DID I NOT GET TO DO?

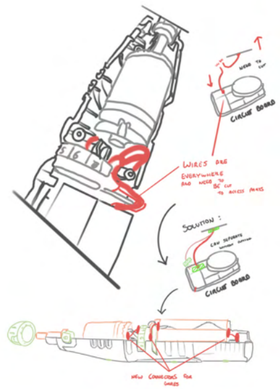
DIFFERENT MATERIAL SELECTION: Recycle & Reuse

The dremel could get a revamp of the current materials that it uses; Thermoplastics, the most commonly used type of material for injection molding, can technically be recycled infinitely, though additives in some formulations can reduce quality and the number of times recycling is feasible. In addition to recycling and reuse of traditional plastics, newer compostable, degradable, and biodegradable plastic materials are expanding material options. These innovative plastics decompose into organic components such as water, carbon dioxide, and biomass which are easily recycled. Compostable plastics can be especially environmentally friendly as they leave no toxic chemicals behind.

OTHER COMPONENT REMANUFACTURE FOR REPAIRABILITY:

If I had more time I would redesign more features of the dremel, like the spindle being removable and the wires not being soldered but also removable.





REPLACEMENT PARTS INFORMATION: Repairability Index

I did not have enough time to identify the replacement part information - I needed to do research and investigate where the parts could have been sold, how much they would cost, and how easily accessible they would be. With more time I would have completed this research and fully comprehended the repairability index I mentioned in Week 1. Including creating a mockup of DPP (Digital Product Passport) that the manufacturer and consumer could receive.

GIVE AN EXAMPLE FOR A REPAIR PROCESS: A Narrative

If more time was provided nearer the end of the project I would have provided a small product design story on how the user would receive the product, identify failed parts after prolonged use, and how to go about operating it - looking into the user experience and conducting a theoretical thematic analysis to see if any improvements could be made. A similar story could also be brought through on the working drawings the manufacturer would receive.

Reflection

WHAT DID I LEARN?

Overall I enjoyed doing this project, especially focusing on a real product with existing issues, identifying them, and proficiently improving it one feature at a time. It feels realistic in a professional working environment. The key learning points would be:

- **Technical Proficiency**: I developed hands-on skills in disassembling and reassembling mechanical and electronic components of the device. Along with using different strategies for identifying issues with the product like Hotspot mapping etc.
- **Problem-Solving**: I enhanced my abilities by identifying and addressing common issues associated with the dremel. Along with further development in critical thinking skills in diagnosing problems and determining effective repair solutions.
- **Documentation and Communication**: I improved my documentation skills by creating clear and concise repair guides with visualisations. My communication skills also got better by effectively conveying technical information to various audiences.

I also enjoyed the potential of this project, where we could really choose the direction that we were going in. Going into the research of visualisation for an audience and investigating why people interpret things the way they do through the provided literature (from lecturers and online) was what I found really interesting. While I admit that the technical aspect of this project was a bit difficult, with help from my peers and lecturers I fell that I made a sufficient solution that is displayed in an innovative way to the target audience.