Simple mechanisms

and how to use them

2021
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Bachelor project
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LUND UNIVERSITY

Simple mechanisms - and how to use them
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Degree Project for Bachelor of Fine Arts in Design
Main field of study Industrial Design
From Lund University School of Industrial Design, Department of Design sciences

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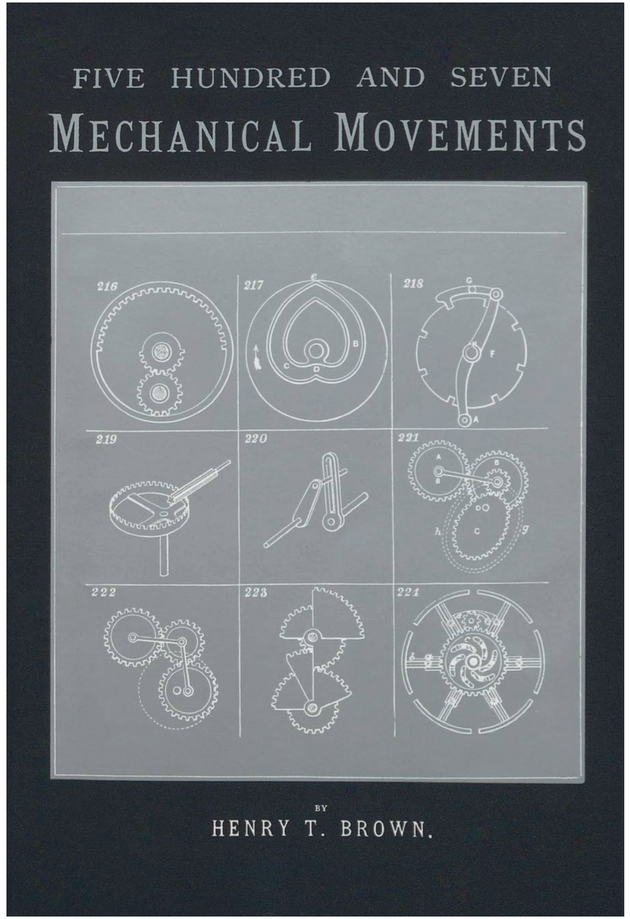
"Simple machines can be regarded as the elementary "building blocks" of which all more complicated machines are composed."[1]



First published in 1868, it is a collection of 507 types of mechanisms, illustrated and explained by Henry T. Brown. Similar attempts had been made previous to this such as Christopher Polhems mechanical alphabet, but this covered a much larger amount of mechanisms. Larger collections has been released afterwards as well.

The book is interesting in itself since it is almost exclusively consisting of numbered illustrations and an opposing page of explanations. I stumbled across this when I discovered 507movements.org. The numbering is part of what felt like a challenge to me, as if the mere existence of them makes you want to try to see how many you can make.

In essence, this project revolves around my two biggest anxieties, what I am going to do with my life and the collapse of human civilisation as we know it.

To some extent I feel like I have figured out the first, and in this project I'm going to, quixotically or not, attempt to use that as a springboard in order to deal with the latter.

Background

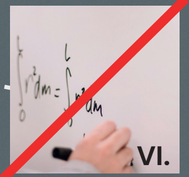
As a child I loved building things on my own as well as with my grandpa. I still do of course, but my point is that this was something I picked up very easy, and further was able to continue developing on my own.

Since I grew up in a very academic, and urban, household, I never understood that this was something that was a skill, something I could develop further. I was never discouraged of course, but neither of my parents probably even knew this themselves, so how could they tell me?

Apparently I had my own “morakniv” at the age of three, so either someone was not being responsible, or someone understood that I could handle it.

School was, as for a lot of us, hard for me as a kid, and I imagine that it would have helped to understand that I was good at other things that also mattered. And to have the opportunity to further develop those skills. There are many types of intelligence, why have some been prioritized over others? Should we not strive to help each child fulfil their potential?

In short, it seems like as if we have forgotten that mechanics and similar topics are essential to modern life, and my opinion is that there are many reasons for why it is about time for us as a society to revive it.



Lost my way

What I thought I would become at any different points in my life.

As shown on the previous page, it took me quite a while to figure out in what direction I wanted to take my life. At the age of 25 is when it just clicked that I was both really good at and thoroughly enjoyed working on cars. Usually I would have been the one having to put in an extra effort in order to keep up with everyone else in almost all fields of life. But for the first time I understood what it was like to be on the other side of that equation. In fact, going from a sort of perpetual underdog position to experience this made me feel guilty in some misguided way.

I think everyone deserves to find that thing that they just have an inherent talent for. I cant help everyone with this, but I can help the ones that are like me. Or that is at least the ambition of this project.

I. Lawyer

At 17, while still in high school I saw myself becoming a lawyer

II. Journalist

Later I was drawn to the field of journalism. However, I worked in IT for a newspaper, and that killed the dream thoroughly.

III. Biomedical research

Much later I had the idea of doing a bachelor in biomedical research, but

IV. Wrenching cars

I bought a broken down SAAB 9-5 intending to fix it. I did, several times in fact, yet it is still broken today. However, I made me realise I had a talent for wrenching on cars, specially considering I had zero prior knowledge.

V. Mechanical engineering

Because of my new found love of building thing, and more specifically cars, I changed direction once again and applied to engineering school thinking that it would mostly be about physics, which I am at least Ok at.

VI. Math

A couple of weeks in, I realised my mistake. Engineering is mostly math. It turns out I have a finite limit to how far I could take my math skills. After two years of acting every practical and design related course and not making even a single step of progress in maths, I gave up

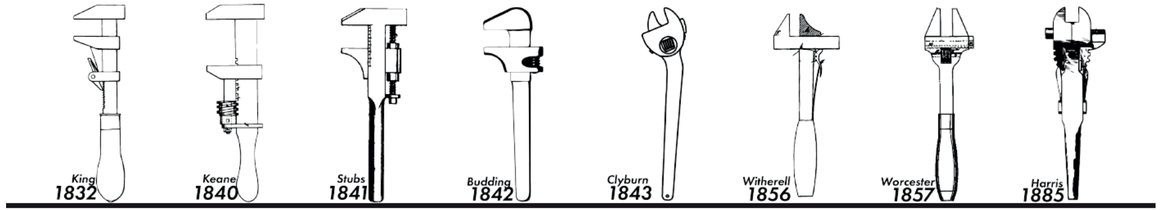
VII. Wrenching boats

I applied to design school and bet everything on that I was going to be admitted. I spent a summer travelling the west coast fixing peoples boat and car engines with enough success to earn a living.

VIII. Industrial Design

I was admitted to the school of industrial design, and it did not take me long to realise that I was finally home. It was in so many ways a combination of all the things I was good at, with none of the things I am really bad at. When I went back to school 4 years earlier, I had no idea what industrial design was, and further I did not even know I had a knack for fixing almost anything mechanical. Of course the journey since then has not exactly been without trials, but nothing that is worth it ever is.

Lost past



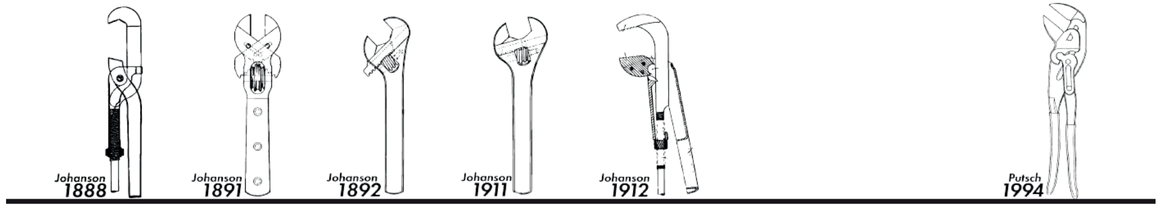
Sweden used to have quite an disproportional amount of success in the field of mechanical technology, compared to our small population size.

The reasons for this are outside of the scope of this project to explore, but one thing is important to state. We don't seem to have as much going on nowadays.

This is of course a claim that would need a certain amount of proof, which again falls outside of the scope. But, anecdotally I could bring up that we recently lost one our two car manufacturers. Most of the high quality domestic tool manufacturing has either been outsourced or sold. If you buy a Bahco tool today, the original "Skiftnyckel" brand, it will most likely be made in Portugal, or another country, but not Sweden.

This is a field of study that used to matter a lot to us as a culture, and I think it can do again. We have a heritage that we could actually celebrate. I have no nationalistic ambitions, and I don't that is a concept that matters very much in academia any more, but it is something to gather around something to share in a positive way.

I think I simply feel a sense of loss over an era I never experienced first hand, and my hope is that we can bring some of it back, not to replace modernity, but to be a bigger part of our current development.



Christopher Polhem was a famous Swedish mechanic scholar (if that is a word) who lived during the 1600's. He seemed to have a knack for taking things apart and putting them together again, but he lacked a formal education. He seems to have gotten in to university on that skill alone. So evidently it was a skill that was valued highly enough to be some sort of replacement for our "högskoleprov".

My point is simply to show an example of how much this sort of intelligence has dropped in perceived value, since then. When was the last time an aptitude test in school contained a clock repair section?

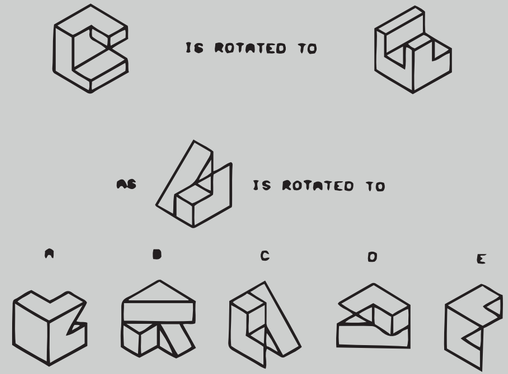
Spatial visualization

The ability to see objects in your mind is what we refer to as Spatial visualization and just like anything else some find it easier than other, but more than that, it is something we can practice.

Engineering students who took a class in spatial visualization the first year had a measurably higher completion rate in terms of graduating five years later. It seems like it might be very beneficial to at least some fields or in my opinion, most fields.

Lost art

"Christopher began studying at Uppsala University in 1687. He managed to repair two astronomical clocks for his entrance examination."



Lost future

We are currently at a peculiar moment in history. We are (almost) in agreement that we are facing some really heavy challenges in the not so distant future. On top of that the last four years has shown us that liberal democracy might not be as robust as we thought, that we are incapable of dealing with challenges as a collective and our supply chains break down at the mere mention of trouble.

Some would say that the dream of a post scarcity life is dying for the small amount of people which had it within their grasp at all. In short, things are going to change, and no one knows quite how. In fact, the lack of a shared vision for what we want to achieve is also one of our bigger issues.

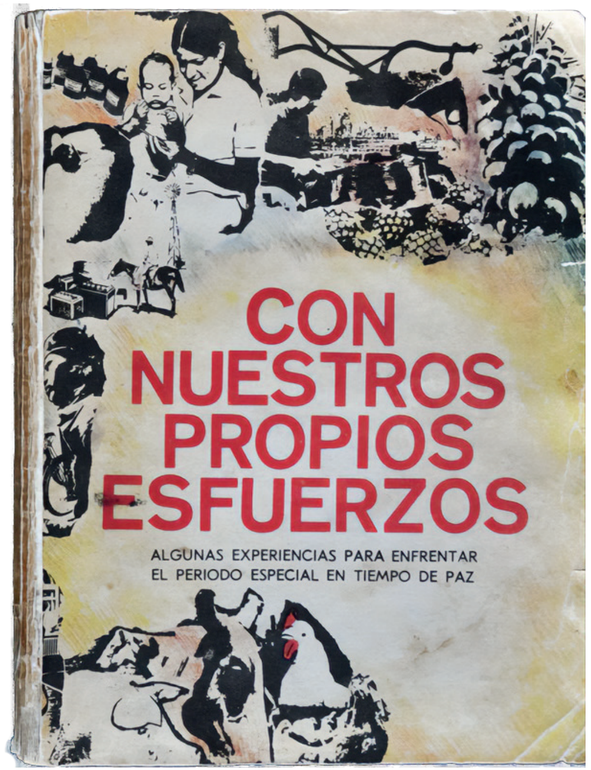
Rather than dreading anxiety laden things such as the end of human civilisation, which I have done for half my life, we can choose to engage with it, and focus on acceptance. That is how you constructively deal with anxiety. This is not the same as giving up on fixing it. Climate change is not a binary state, it is a sliding curve and we should be prepared for several possible scenarios.

What if your wind generator breaks down.
What if you need to clear a road from fallen trees after a storm.
Would you even know how to do that?
How would you use mechanical advantages for this?
What parts of a car could you use to build a wind turbine?

When I say prepare, I do not mean in the post apocalyptic movie way, we do not need more guns and bunkers. Survivalism/prepping is very much a white male myth. No man is an island no matter how hard you try.

One of our main evolutionary advantages is our ability to cooperate, our brains has significant portions of it dedicated to communication. We thrive in communities, and in a community you want to be useful. (Something that should be evident to most now when we have all spent more than a year in social starvation.) In a future where we live in smaller more independent communities, we can no longer rely as much on specialists. A good example of this is how people living in the countryside have to be more versatile and know how to help both themselves and their neighbours. You need to have the tools, literally and figuratively, to repair the things you need in order to survive.
The writer Max Brooks (son of Mel Brooks) writes in some of his speculative fiction that the biggest shame in these smaller communities is to be seen as not contributing. Being an asset for your friends is very rewarding.

One person will be a medic, one does emotional labour, and I want to help people with an aptitude for the mechanical to develop this side of themselves. In our current post manufacturing urban tech society a lot of children can grow up without ever being properly exposed to these concepts. There is no natural arena for people to learn these mechanical skills anymore and this could be an issue in the future when quite suddenly these skills might become very necessary again.



Con Nuestros Propios Esfuerzos & El Libro de la Familia

After the fall of the Soviet union, Cuba lost their main trading partner, and entered into an era later known as the "Special Period During Peace". In short it was economic crisis that lasted throughout most of the 90´s. USA enforced a trade embargo which made it impossible to get many of the goods they needed for everyday life, and something had to be done.

The Cuban government published this book as a way to instruct their citizens how to make their own means of production as well as consumer goods from the parts scavenged from other products.

It is an interesting way to decentralize production. In times of scarcity resourcefulness is key, and this is a way too enable and empower people to utilize their abilities.

This is in no way commenting on the Cuban government in any other aspects. They have a lot of other issues, but this is nonetheless an interesting example of what can be done.

"As a surgeon becomes desensitised to wounds, Cubans became desensitised to designed objects. They stopped seeing the original purpose of the object, instead thinking to it as a collection of parts. This is the first Cuban expression of disobedience in their relationship with objects, a growing disrespect for an object's identity and for the truth and authority it embodies. People of Cuba also invented, designed and produced the tools and machines to create and modify objects coming from the domestic industrial production, because the Cuban houses became archives, storage places, warehouses, workshops, design studios, production places and shops. They created a completely new market with reinvented industrial products transformed thanks to a craft approach, in a communist country where the concept of market was forbidden. "[9]
(Rognoli and Oroza, 2015)

Definition

Make a kit that teaches mechanics in an exploratory way using the smallest amount of parts possible.

Teaching fundamental building blocks rather than specific applications. Life is where you apply it

kids playing

adults playing

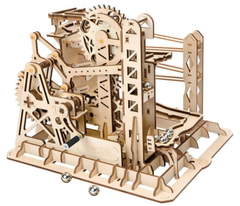
It´s not Lego.

It is learning and getting excited about understanding these things on an intuitive level.

kids + adults playing

Process

Passive Research



I began by creating some mood boards of tangentially related products to what I was trying to achieve. It ranged from Lego, to Brio and Fischer-teknik.

This is a book that has inspired me throughout the whole process. I bought it a couple of years ago while on a year long surf trip. On a day with no waves anywhere to be seen I had run out of excuses not to read it. I sat down in a hammock and proceeded to devour the whole thing in less than a day

In the book the author is trying to explain how to forecast waves, and since waves are created by the wind it is essentially meteorology, a famously complex subject.

In order to make it more digestible, bite sized if you will, the author begins with imagining a completely empty earth, no water no land, like pictured above. Then he adds air, and proceeds to explain all the implications of that, such as the Coriolis effect. When you completely understand that, he adds water, and thoroughly explores what the implication of that is on all the thing we have already learnt.

In this way the whole book manages to explain quite complicated concepts in a way that the readers *will have such a grasp of it that they can apply their new found knowledge in real life.*

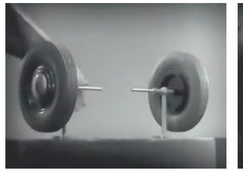
Will not only have an understanding, but a fundamental ... to the point that makes it possible to use it in real life. This is my goal. I want people to come away from this with such an understanding that they will be able to make use of it in real life situations, whatever they may be.[5]

Differentials

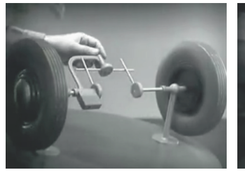
I regularly forget how a car differential works. To me there is just a little bit too much going on at the same time for me to easily be able to visualise it. When this happens, I always go back to watching this one clip from 1937 that just explains it in a brilliant way. They start at a point which is easy for anyone watching to visualise, and then step by step add more complexity until we reach the point of understanding how a differential works, and why it works that way.

This is an informative commercial Chevrolet put out in 1937 to generate interest for their new and improved differential.

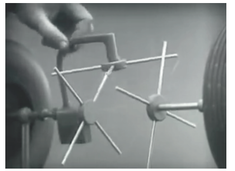
When a car turns, the outside wheel needs to travel much further than the inside one.



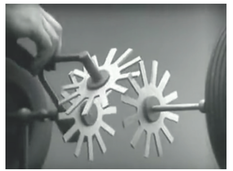
If neither wheel is driven, and they spin independently of each other this is not a problem. But if we want to drive both wheels while turning, how do we do that?



With the addition of spokes and a bar, both wheels can now be driven. But it only work if both wheels spin at the same speed.



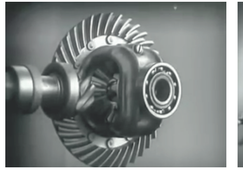
If we put the driving bar on a pivot, power will always be applied to the wheel with the least amount of resistance. This is now conceptually a differential



If we add as many spokes as possible for a smoother ride, we reach a point at which it becomes a spur gear.

In order to reduce strain we maximize contact area between the gear teeth.

In order to drive the bar, we attach it to a much larger gear connected by a smaller gear to a source of power, I.e. the engine.



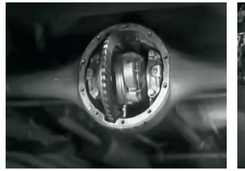
For even more contact area and strength, we can cut the gears with a curve. This also makes them quieter.

The drive shaft goes from the engine in the front to the differential in the back is what transfers power to the big gear.

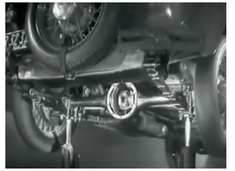
In order to not impede with passenger space, the drive shaft from the engine must be lowered

Currently the drive shaft sits in the centre of the differential.

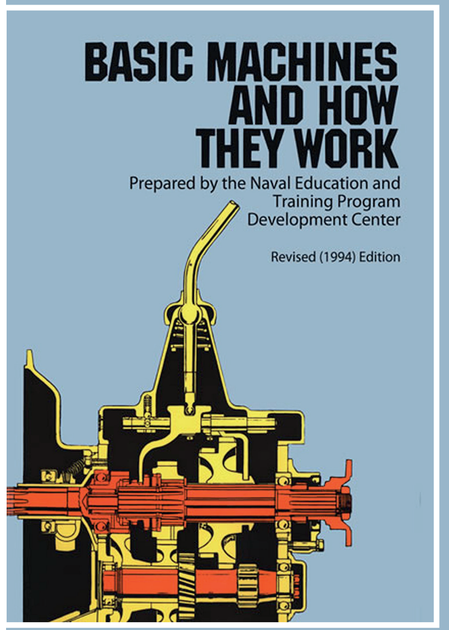
The shaft is moved down to power the gear from a lower position. This also gives us increased strength as well as more space in the cabin.



This is what the differential looks like sitting in its casing, partially opened up.



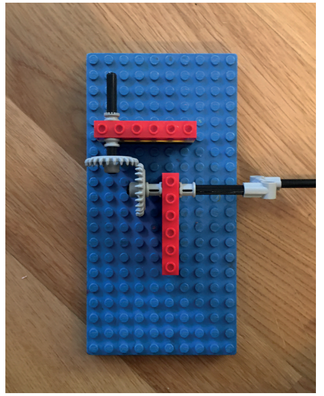
And finally this is where the whole assembly sits in a rear wheel driven car. [6]



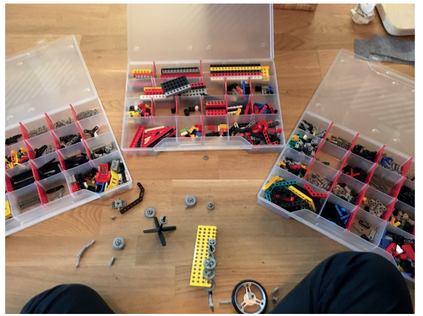
Since USA´s navy recruits from all different walks of life, they have to be able to teach anyone the fundamentals in order for things not to explode. The book is written in an interesting way because of that and served as further inspiration for my project.

Active Research

Space rail turned out to be the least enjoyable so far. It was like a combination of and Jenga.



This stage consisted mostly of testing different toys. My mom sent me and my brothers forsaken Lego collection and I spent some time testing out how to build the 507 movements. I gave me some valuable insights on how not to do some things, further, it made me more clearly see what made my idea new and fresh, and not just a lesser copy of Lego.



Takeaways

Fewer parts
No fasteners
Make it bigger
Visually less chaotic
Clearer framework

Design exploration

Sketches that move ~~don't~~

Blender

Sketching is a tool for conceptual exploration. It does lack some practicality when it comes to dynamic mechanisms though.

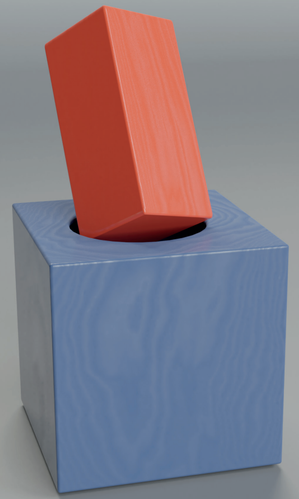
I searched a long time for a piece of software in which I could casually test mechanisms with a somewhat correctly simulated physics engine.

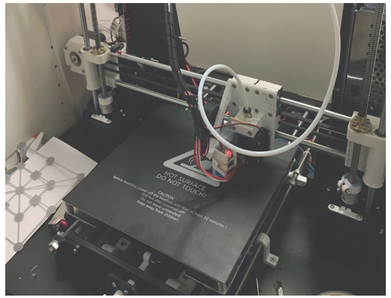
Ultimately I decided to proceed with Blender, an open source 3d modelling suite with a built in physics engine.
The idea was to quickly test how I could build a number of the mechanisms from the book to test out concepts.

I started modelling some of the mechanisms, but it was ultimately a quite tedious process. It was good as a way of opening up towards the creative process, but in general it seems like physics simulation in software is quite a lot worse than you would think.

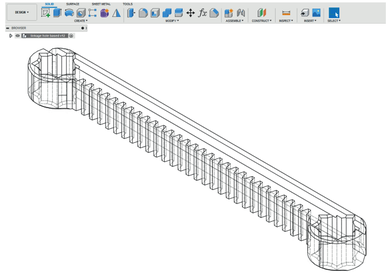
I used what I had learned and moved on to CAD modelling in Fusion 360

The CAD to 3d-print to missed tolerances loop



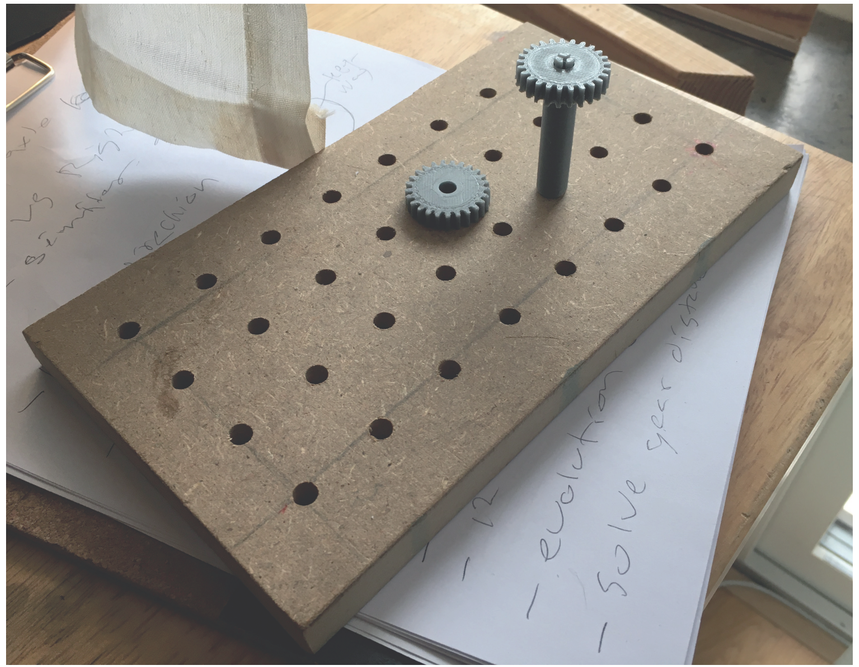


I started printing parts as soon as possible in order to have something tangible to relate to.



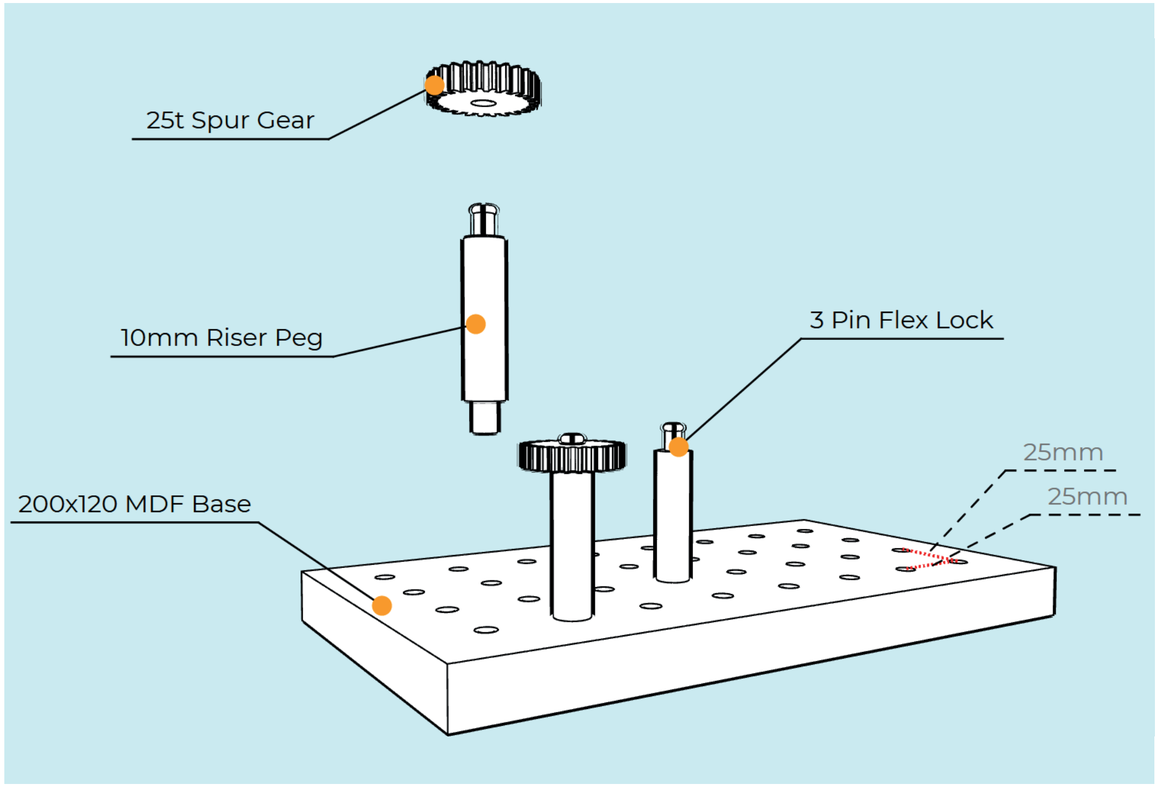
I designed a number of very basic parts and started testing them. Initially, and throughout the whole process one of the biggest challenges was to get the tolerances right on all the parts that interact with each other. It took a lot of trial and error, but ultimately I got it down to within 0.02mm of the correct size. But of course all that changes as soon as you for example change plastic filament to a new type. Hence the Cad to 3d print to missed tolerance loop.

First iteration



Takeaways

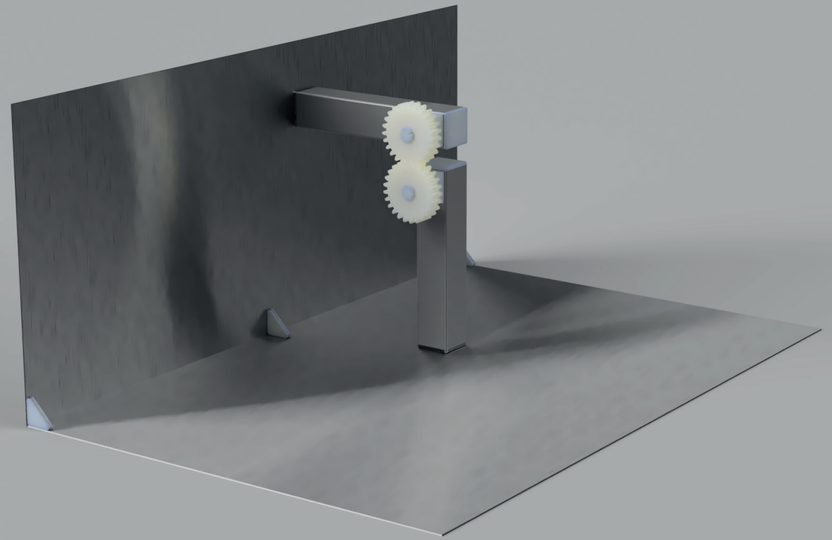
- Limiting platform
- No angular stability



Second iteration

Takeaways

- Lack of limitations can limit creativity
- Low angular stability

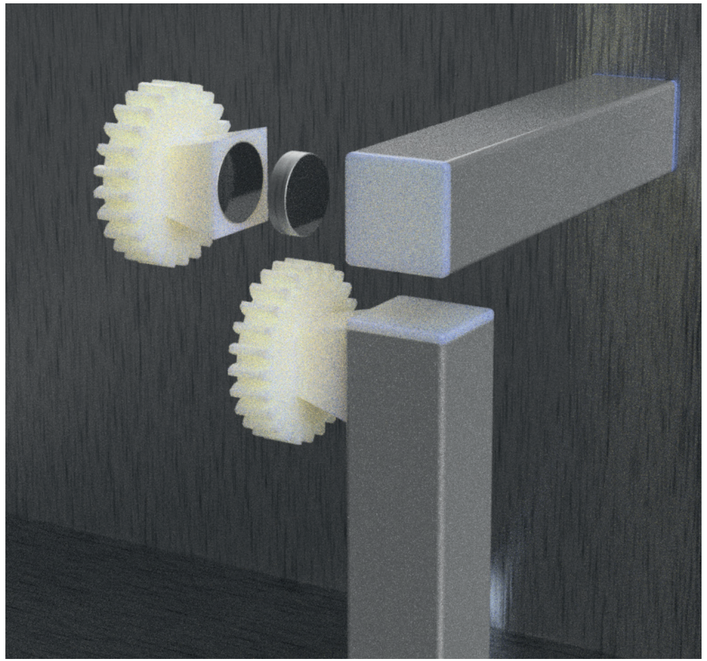


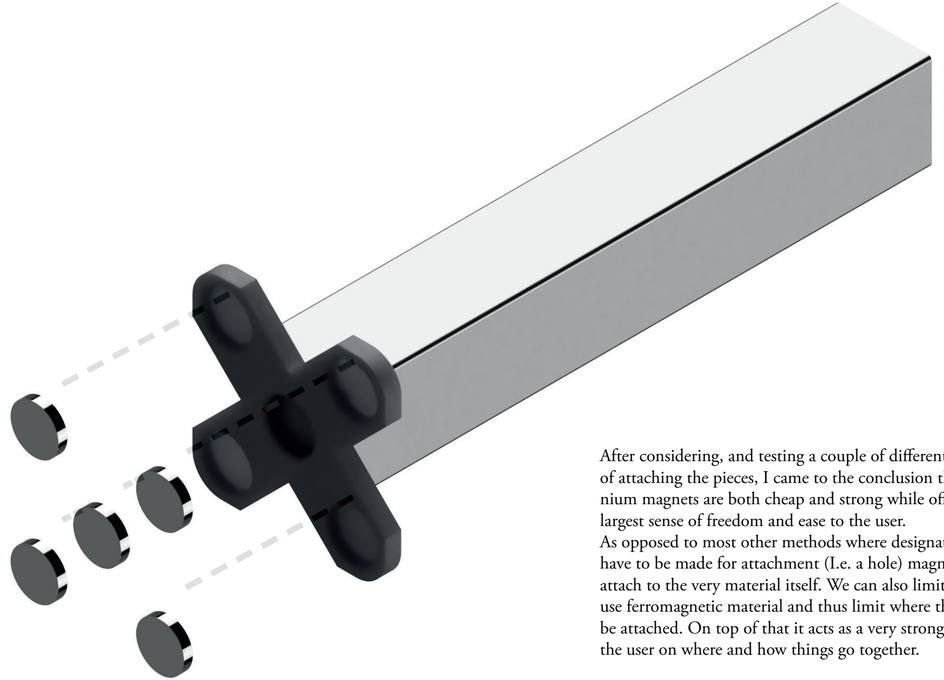
Features

Modular steel plates that can be built in 3d.

Welding style magnets

Magnets

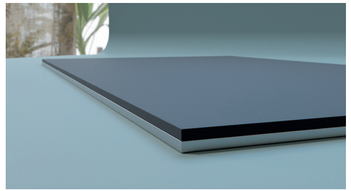


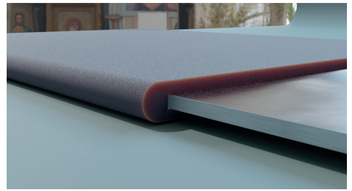


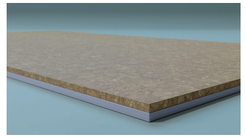
After considering, and testing a couple of different methods of attaching the pieces, I came to the conclusion that neodymium magnets are both cheap and strong while offering the largest sense of freedom and ease to the user.
As opposed to most other methods where designated areas have to be made for attachment (I.e. a hole) magnets can attach to the very material itself. We can also limit where we use ferromagnetic material and thus limit where things can be attached. On top of that it acts as a very strong signifier to the user on where and how things go together.

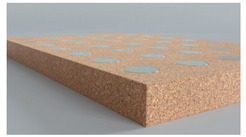
Third and final iteration

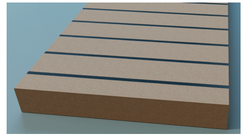
Framework/Platform







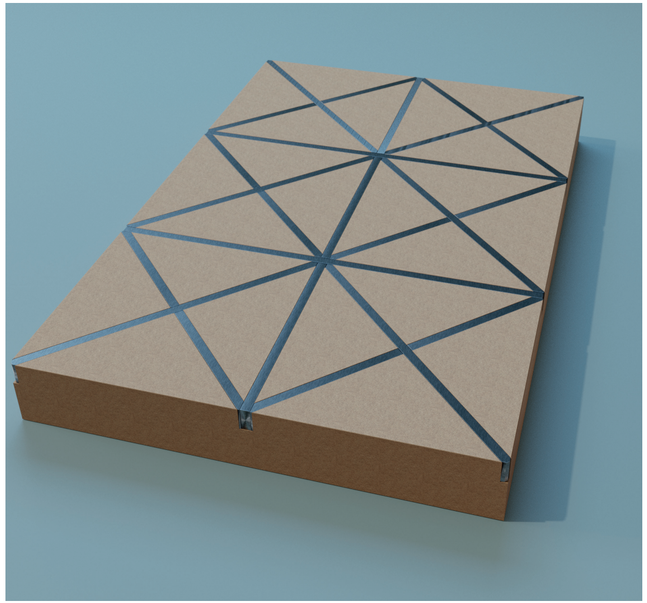




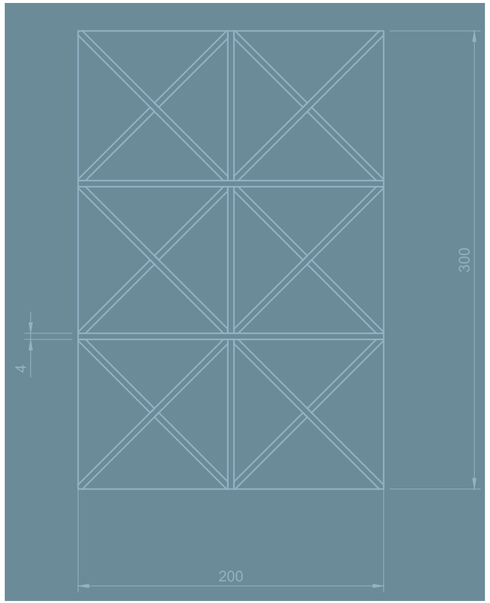
Takeaways

- Limiting platform
- No angular stability

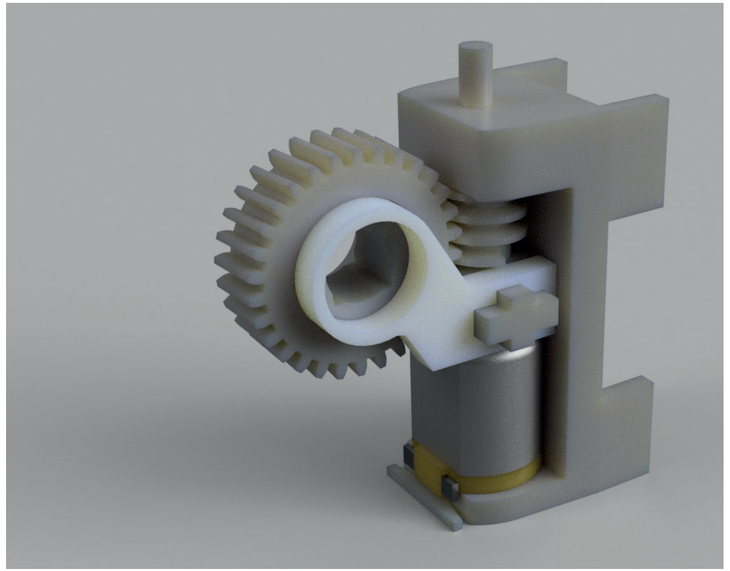
Creativity encouraged by making you push up against boundaries



Limitations can make it easier to grasp

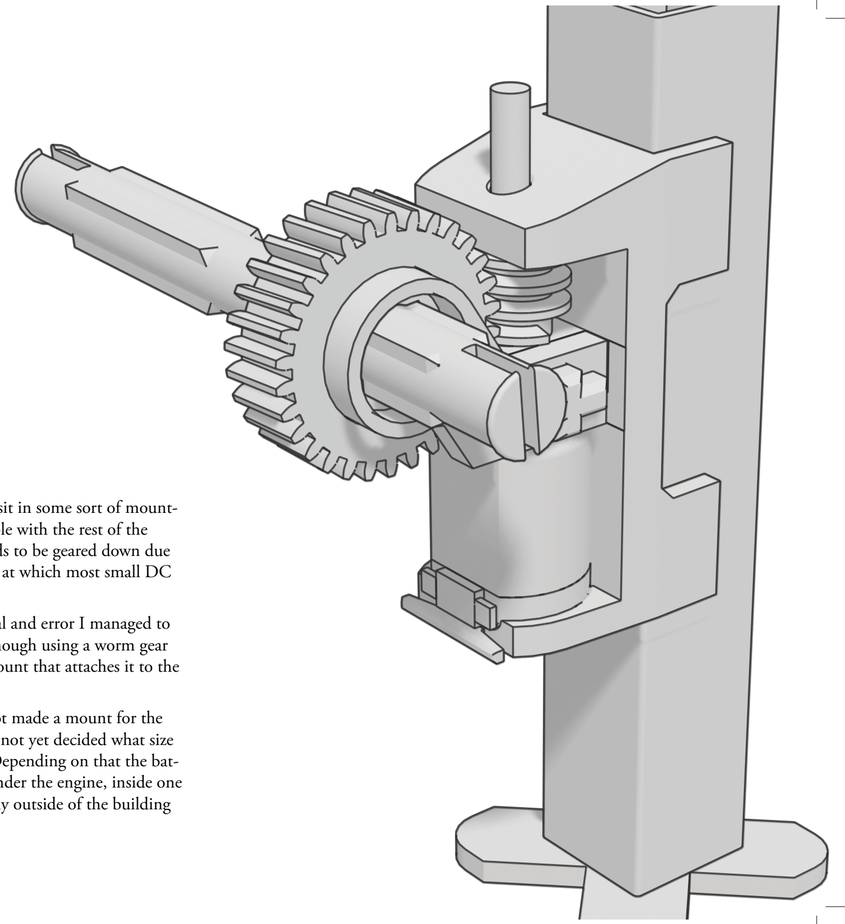


Motor



The decision on whether to incorporate a motor was not an easy one. On one hand it somewhat takes away from the raw stripped down feeling of this kit, but on the other hand, it offers some distinct possibilities.

There is a certain satisfaction in building something, turning it on and then just lean back and observe. On top of that there are some mechanisms that requires small distances between themselves, and you can end up building yourself into a corner where you physically can´t reach the crank anymore. Further, some people, due to age or otherwise lack the motor control needed to get in there without starting to knock things over. And this is a kit meant to be accessible to everyone, so it was ultimately an easy decision to include an engine in the end.

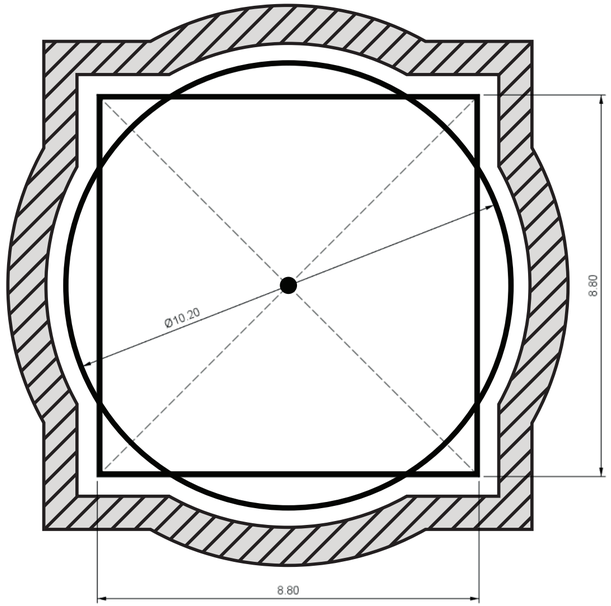


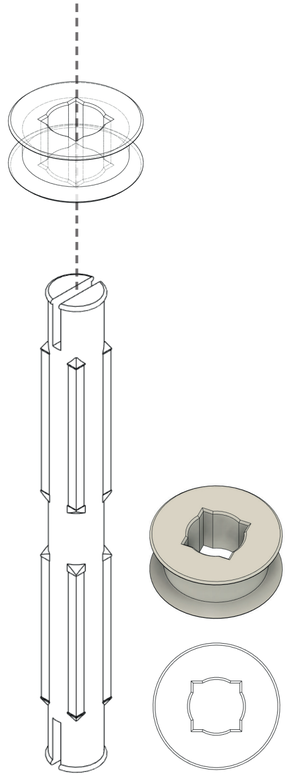
The engine needed to sit in some sort of mounting in order to be usable with the rest of the system and it also needs to be geared down due to the excessive speeds at which most small DC motors rotate with.

After a weekend of trial and error I managed to gear it down almost enough using a worm gear setup built into the mount that attaches it to the steel profiles.

I have intentionally not made a mount for the battery because I have not yet decided what size of battery is needed. Depending on that the battery could be stored under the engine, inside one of the profiles or simply outside of the building are.

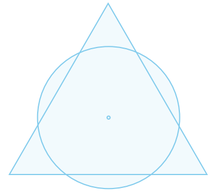
The “Squarcle”





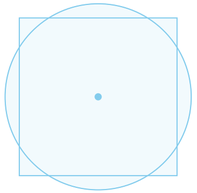
In order to make a versatile component, I wanted to be able to have both free and driving rotation from the same axle. This meant that I had to figure out a geometry that would allow for both.

120°, 240° and 360°



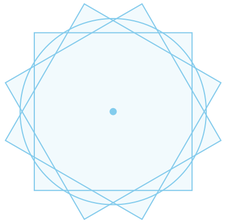
At first I was testing out a triangle + circle combo, but when solidly mounted with the triangle, you are restricted to 1/3 rotations, which is not only limiting in terms of mounting options, it is also not the sort of fraction our number system is based on.

90°, 180°, 270° and 360°



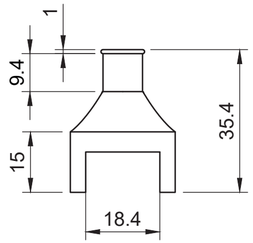
We often find dividing and thinking in terms of half’s much more intuitive, and even more so in our base-10 numeral system. All of this made me try suing a square + circle, thus giving more mounting options and a more manageable system.

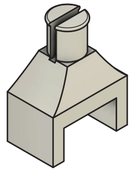
30°, 60°, 90°, 120°, 150°, 180°, 210°, 240°, 270°, 300°, 330° and 360°

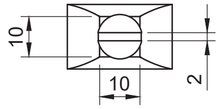


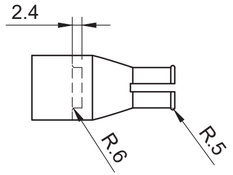
Ultimately I tried inserting as many squares as possible without removing the outer dimensions of the circle completely. However, I did not realise that I had managed to find a combination that was based on 1/3 rather than 1/4 of a turn rotations, which is usually a bit more confusing. So this is something that

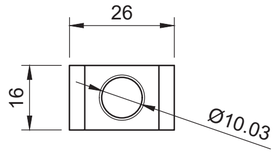
2:1











Created by	Hannes Laurin
Created date	2021-05-24
Title	Pegholder

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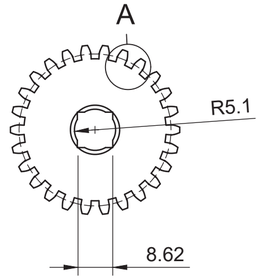

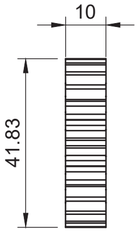

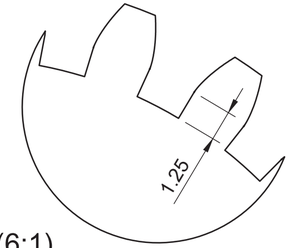

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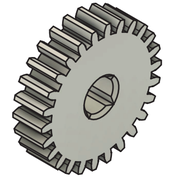
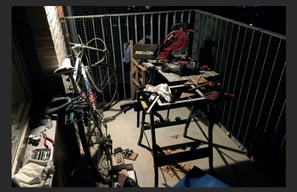


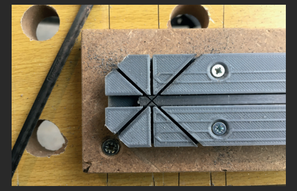
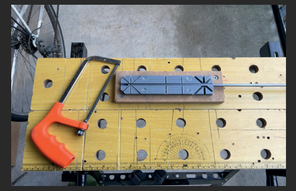
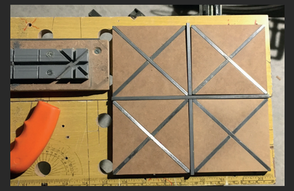
Gear specification	
Module	1,5
Number of teeth	26
Pitch diameter	39 mm
Pressure angle	20°

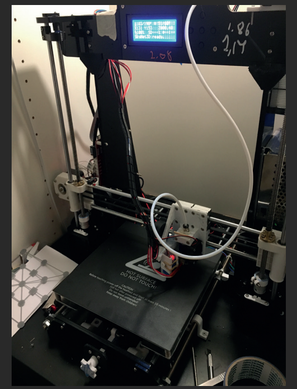
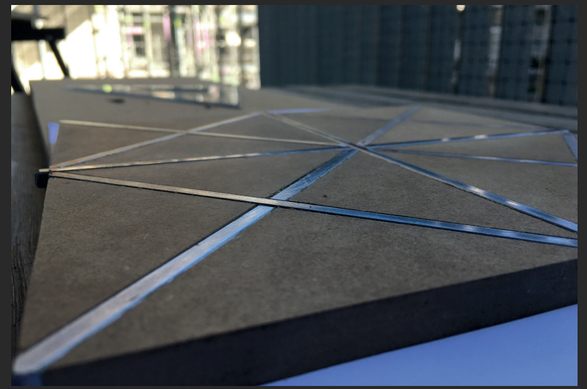
Realisation

Balcony Building





A lot of time and effort was spent on trying to figure out what materials I could work with using the tools I had access to from home. Luckily I have too many tools at home.

The hardest part was to figure out how to make the baseplate. Normally I would have used a cnc to cut the mdf and a water jet cutter to make the metal grid, but this was obviously not possible due to Covid.

In the end I used an electric mitre saw, a hack saw and a bastard file as my main tools.

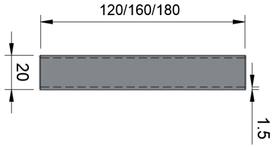
One invaluable asset was the ability to print extremely exact jigs in my 3d printer, this was the one thing that made it possible for me to get down to <1mm tolerances.

The metal grid and mdf pieces are glued together using contact glue, which seems to hold up pretty well.

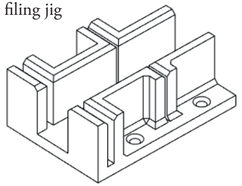
Since the design as well as material choices were severely restricted by covid I have not tried to make it in a way that would be similar to how a mass manufactured version would be. But I have of course had that in mind during the design process.

3D printed jigs

Steel profile

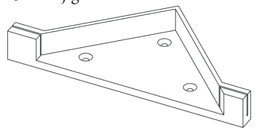


90° Cutting & filing jig

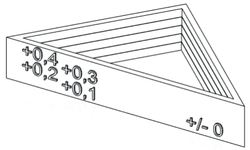


MDF

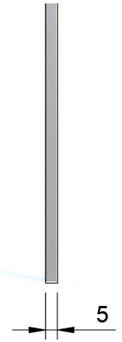
45° saw jig



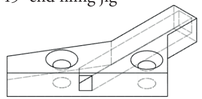
Tolerance tester



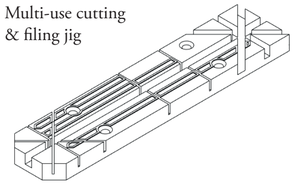
Steel rod



45° end filing jig

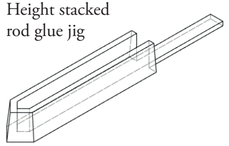


Multi-use cutting & filing jig

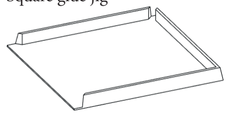


Glue

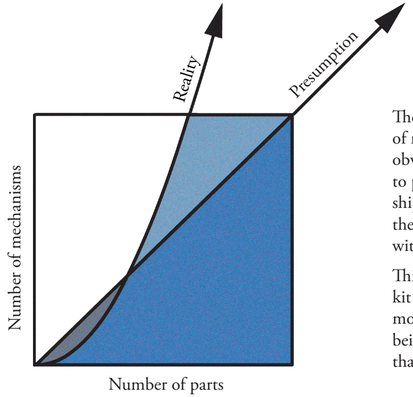
Height stacked rod glue jig



Square glue jig

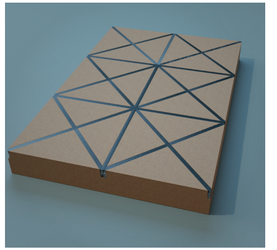


Product



The more parts you have the larger number of mechanisms you can put together. This is obvious to most people, but it would be easy to presume that this would be a linear relationship. That is not the case though. In reality, the number of mechanisms grow exponentially with the number of parts.

This is why I have decided not to make my base kit too small. The difference of having a few more parts might mean the difference between being able to put together fewer mechanisms than the number of parts or a lot more.



Considering the base plate will be the biggest investment, I want it to be possible to have a lot of fun with the base kit and not risk people giving up on the product or feeling cheated that they have to buy expansion packs to even get going.

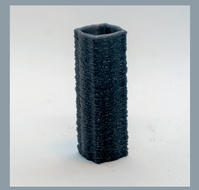
In the base kit in the box you will be able to get really creative and at the same time get excited about the possibilities the expansion packs give.

List of parts

and box dimensions in mm

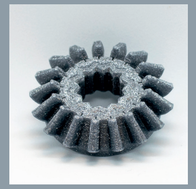
Multi use axle
100x10x10

Small Multi axle
55x10x10



Axle extender
37x12x12

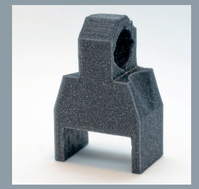
Partial gear
30x32x10



45° Bevel gear
Ø36x10

Small spur gear
Ø33x10

Large spur gear
Ø41.5x10

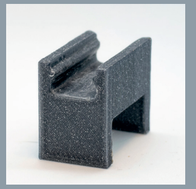


Axle mount
26x16x40

Pin mount
36x26x16

Universal joint
90x20x20

Universal joint, disassembled



Rack gear mount
22x16x26

Rack gear mount
30x26x16

Rack gear
16x10x160

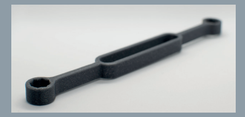
Assortment of mounting

Linkages

Slotted cam
16x10x68

Short linkage
96x16x10

Short linkage
10x16x60



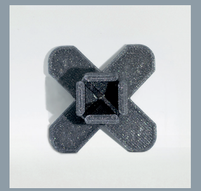
Slotted linkage
16x10x170

Leveraged linkage
175x10x16

Leverage angle linkage
150x60x10

90° slotted linkage
175x75x10

Pins and feet



45° foot mount
40x40x23

90° foot mount
40x40x23

Side view of foot mount

Round pin
Ø10x22

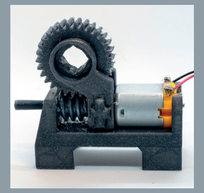
“Squarcle” pin
Ø10x22

Round flex pin
Ø14x22

“Squarcle” flex pin
Ø14x22

Wheels and etc.

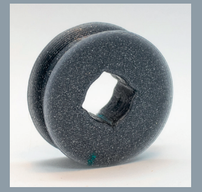
Cam linkage
20x10x36



Motor & worm gear
26x60x60

Elastic rope
Ø4x44

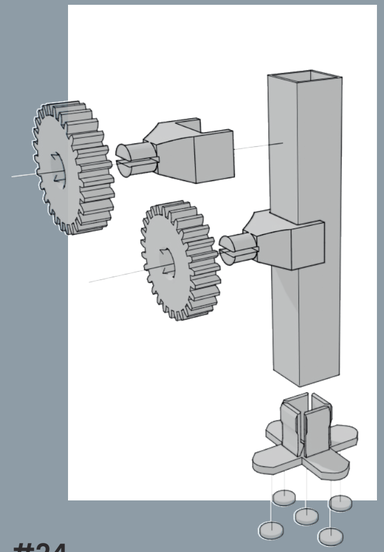
Multi use wheel
Ø78x10



Large wheel
Ø30x10

Small wheel
Ø

Wheel and lever



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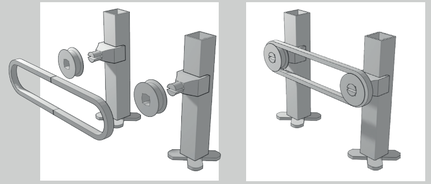
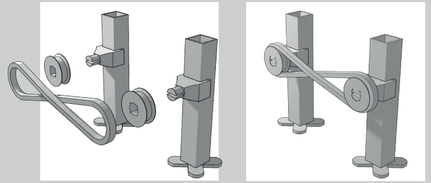
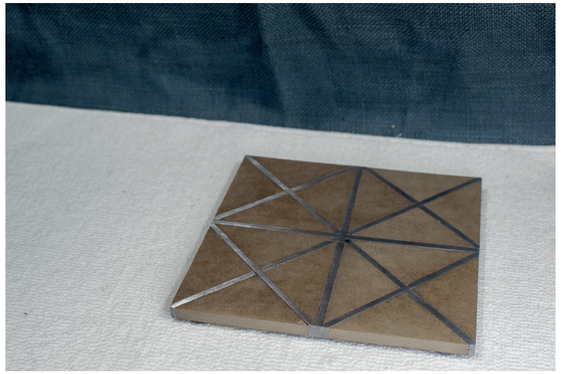


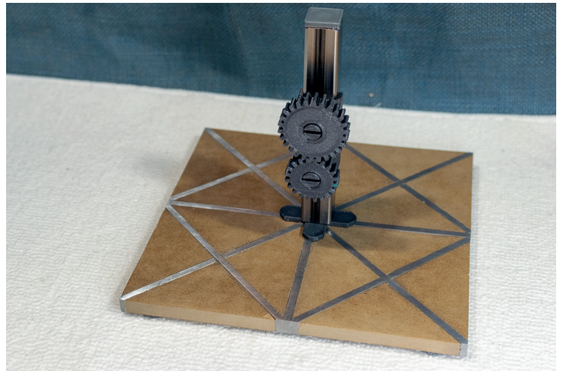
#1

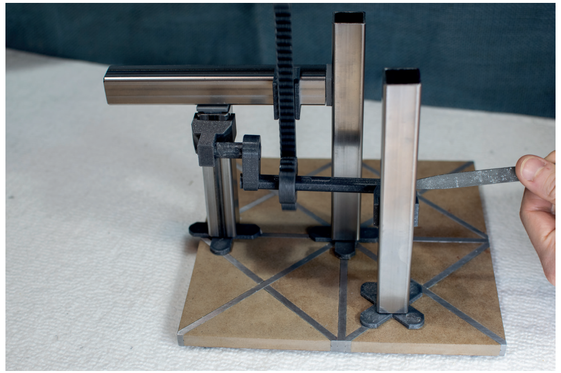


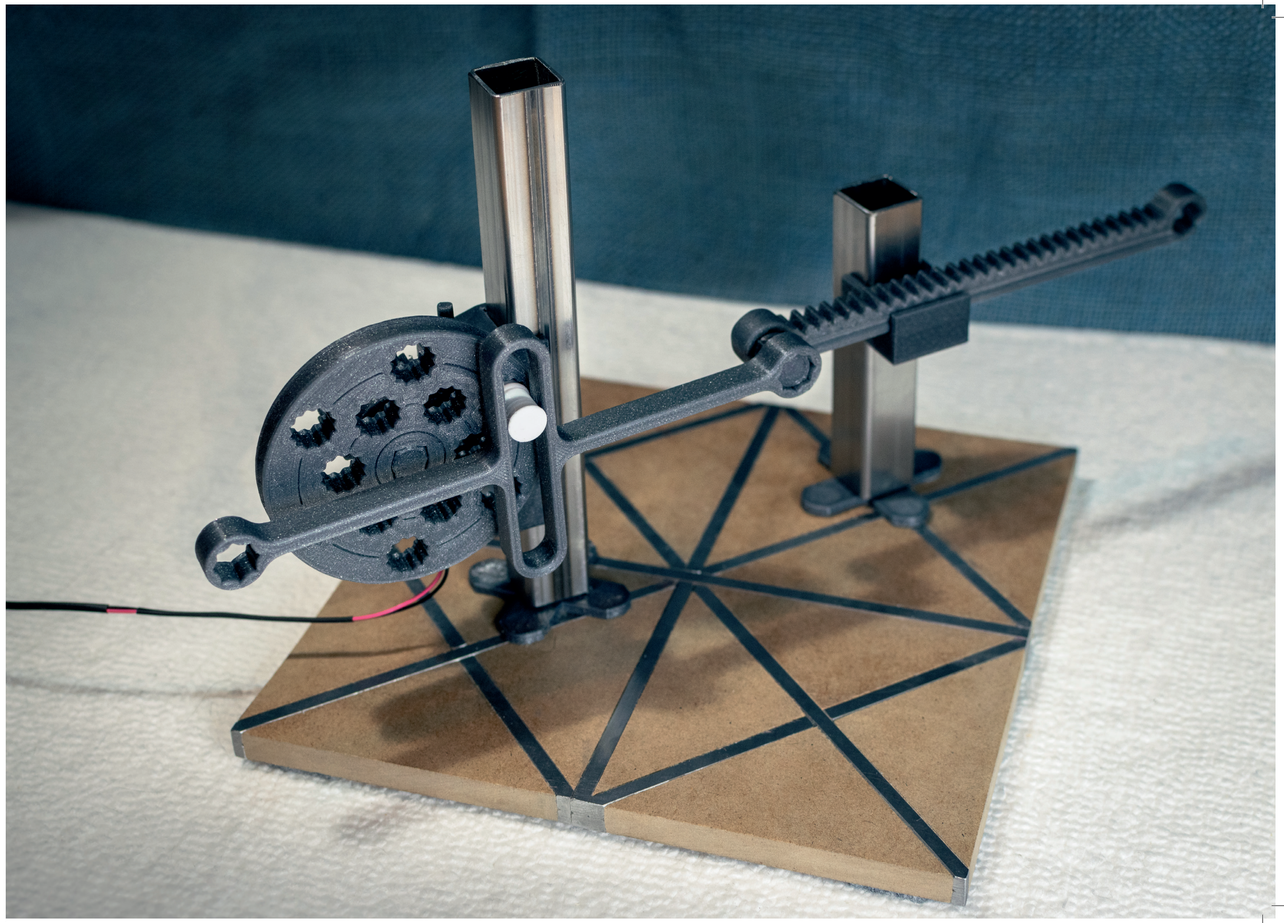
#2

Finished prototype









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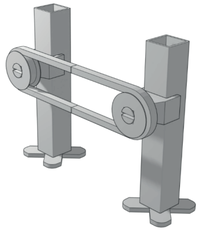

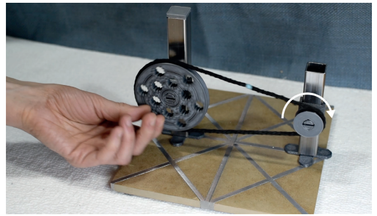

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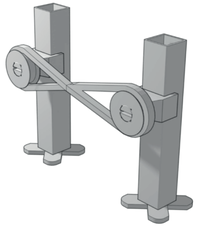

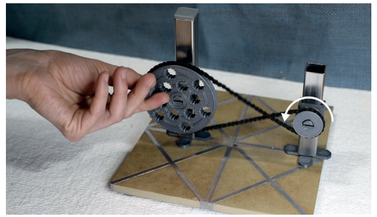

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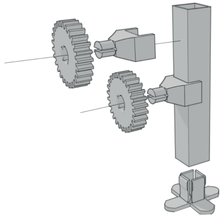

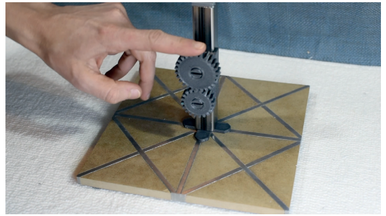

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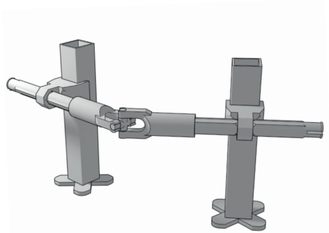
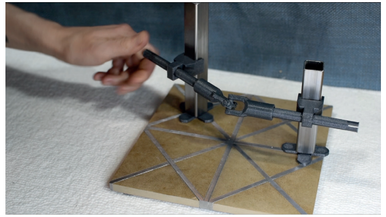
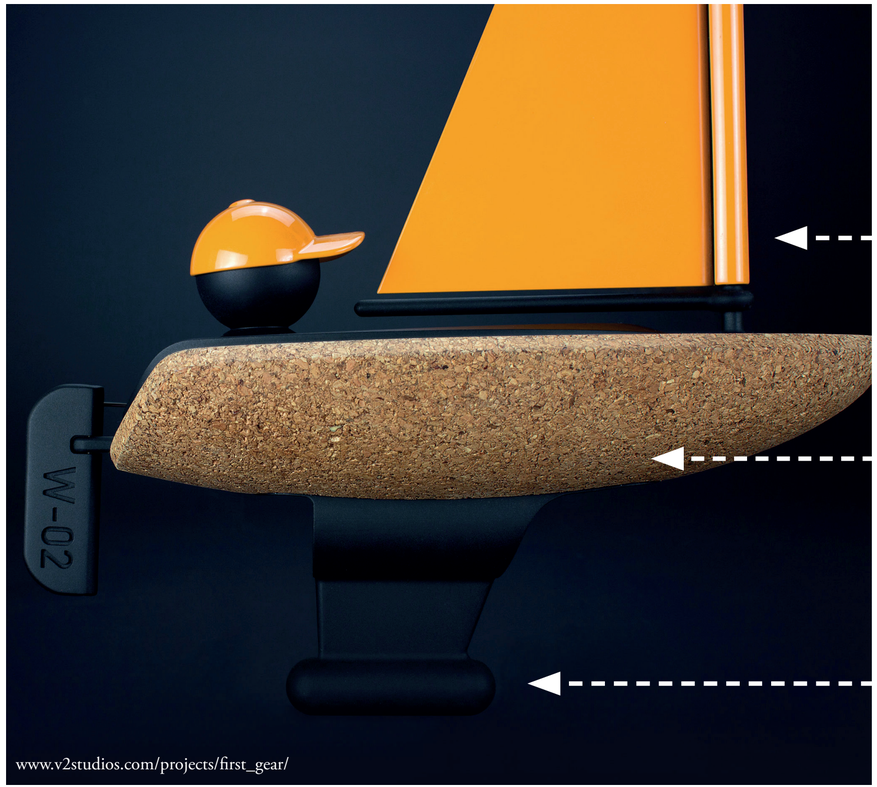


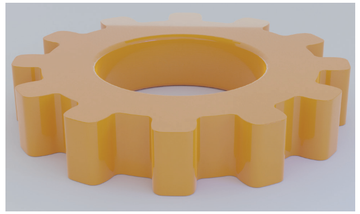


CMF *(Color, material and finish)*

While 3d printing I tried a hole bunch of different plastics. Ultimately I choose Glitz grey PLA and PETG because it masked the artefacts of the printer and not in regards to what material that would be in line with my ideas on CFM for the actual product.

In order to reach this decision I printed out these templates that showcased the different properties of the material.





glossy/colored

While doing some research on the topic of material choices in toys I came across this really clever line of radio controlled toys designed by V2 Studios in London.

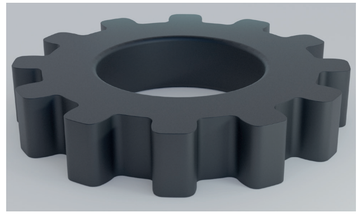
At first I couldn't quite put my finger on why this combination of materials worked so well. But then I figured out that it can be quantifiable as a combination of one glossy/colored, one natural/textured and one matt/subdued material. In essence, they haven't just used different colors,

natural/textured

instead they changed every aspect of the CMF with each new material.

One material will for example have a glossy surface, one the textured and in between the matt, this giving them a very different feel. Next they choose cork as a form of bumper/floating device, it clearly signifies that this is where you can grab the boat, this is not a fragile part.

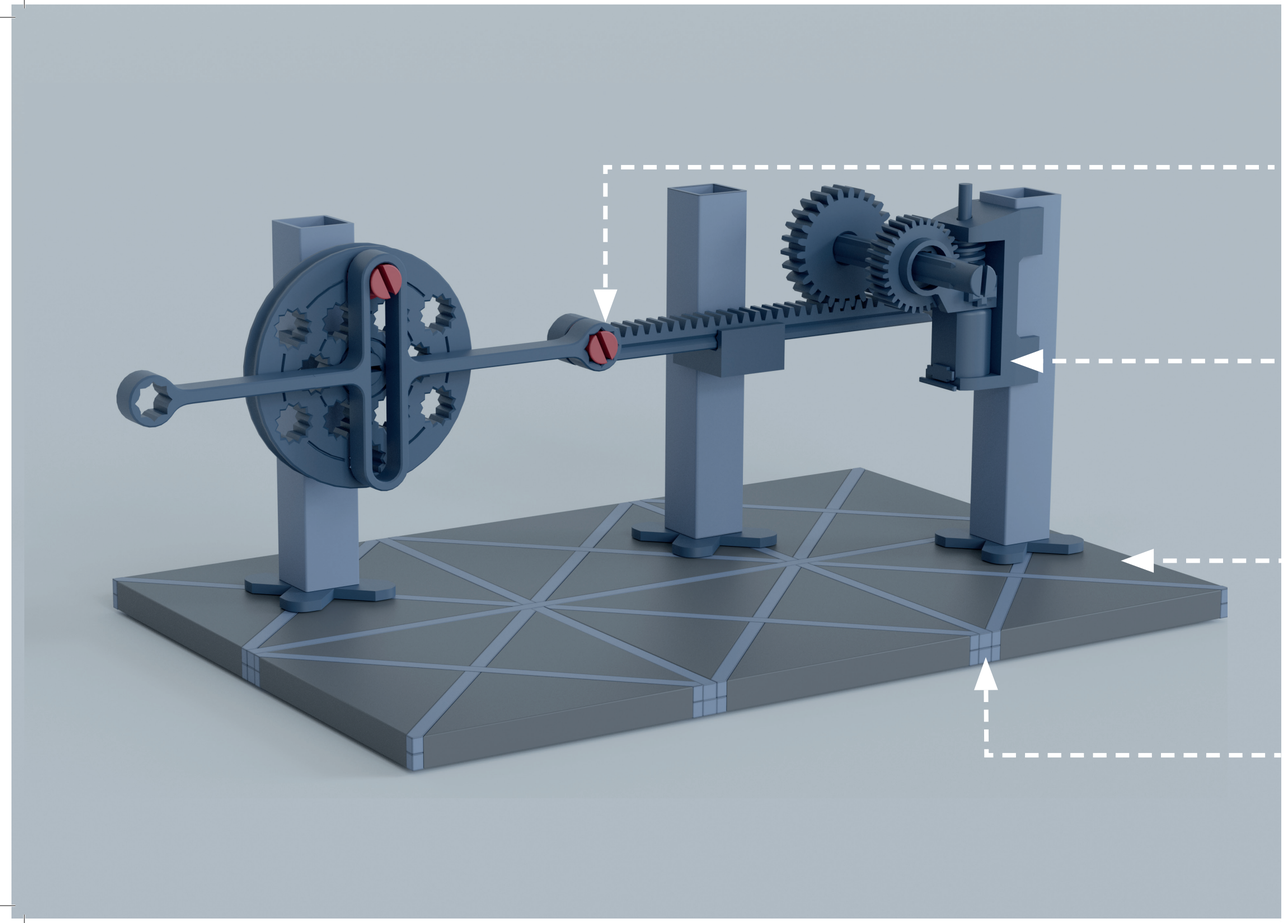
I think this form of CMF approach is not just a very visually pleasing option, it also lets us build



matt/subdued

in a lot of signifiers into the product, and hopefully make it very clear on a next to a subconscious level what part goes where and so on.

I do not intend to copy their way of thinking straight up because I think it might need to be extended in order to work with my significantly more complex end product. Through some experimentation I think I have come to a somewhat satisfying conclusion.

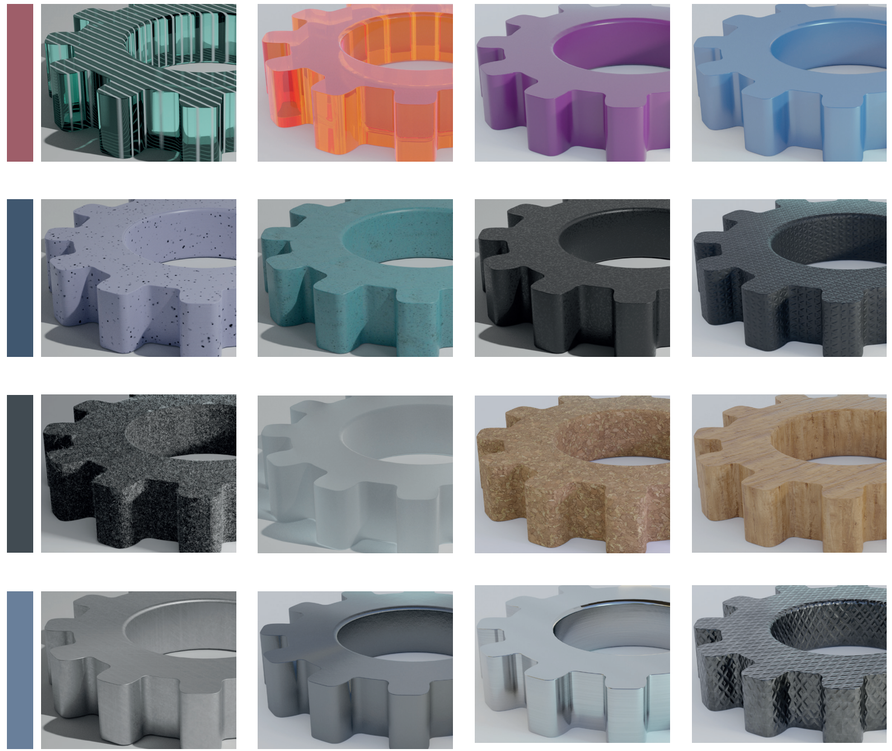


glossy/colored

matt/subdued

natural/textured

(ferromagnetic)



Future

The Future

I have already expanded quite a lot on the future in this project, but if I lower my gaze somewhat I think there could be a future for this idea. But at its current state, there is a lot of work until it could become a viable product.

I have considered whether I should simply put the project into the open source and see what other people will make of it. But at the same time I am quite keen in following through and try to sell this at either smaller scale in places like Design-torget and museum gift shops or if an already existing actor on the market showed interest the sky is the limit. No matter what I think the concepts around this project is something I will continue to work on, let it ruminate and see what comes further down the line.

I learned a lot, and even further, proved that I could make a working proof of concept with both limited time and resource of a kit I would myself have loved to have as a kid.

Release into the wild

Let kids and adults play test,
what breaks, what survives

CMF *(Color, Material and Finish)*

More time
Corona limits
More affordances

Expansion packs

Water
Electricity
Pneumatics

Endnotes

1 “Simple Machine - Wikipedia”. En.Wikipedia.Org, 2021, https://en.wikipedia.org/wiki/Simple_machine#cite_note-Asimov1988-3. Accessed 3 May 2021.

2 https://images.unsplash.com/photo-1581091226825-a6a2a5aee158?ixlib=rb-1.2.1&ixid=MnwxMjA3fDB8MHxwaG90by1wYWdlfHx8fGVufDB8fHx8&auto=format&fit=crop&w=1350&q=80

3 The Road Warrior, directed by George Miller, Kennedy Miller Productions, 1981

5 Butt, Tony. Surf science: An introduction to waves for surfing. 2014.

6 Youtube.com. 2009. Around The Corner - How Differential Steering Works (1937). [online] Available at: <https://www.youtube.com/watch?v=yYAw79386WI> [Accessed 3 May 2021].

www.v2studios.com/projects/first_gear/