

DESIGN OF A FUTURE DRUM KIT

TIANCHEN LIU

MASTER THESIS

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Author

Tianchen Liu
Student ID: 4716817
tianchen_liu@yahoo.com

Supervisory Team

Chair | Jan Willem Hoftijzer
Department: Human Information Communication Design

Mentor | Dicky Brand
Department: Design Aesthetics

Company Mentor | Sven Feustel
Phoenix Design

Delft University of Technology

Faculty of Industrial Design Engineering
Landbergstraat 15
2629 CE Delft, the Netherlands
Tel: +31 15 278 4750
info@tudelft.nl
www.io.tudelft.nl

Phoenix Design

Phoenix Design GmbH + Co. KG
Koelner Strasse 16
70376 Stuttgart, Germany
Tel: +49 711 955 976 0
info@phoenixdesign.com
www.phoenixdesign.com

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Executive Summary

As one of the most popular musical instruments, drum kits play a significant role in modern music. However, there are some problems regarding the design of current drum kits. On the one hand, current drum kits are heavy, space-consuming, difficult to set up and tear down, difficult to transport. It significantly affects the user experience, especially for professional band drummers who do regular tours and need to transport the drum frequently. This inflexibility comes with limitations to the other potential drummers such as people who enjoy drumming but do not have a spacious flat or live in a more flexible lifestyle. On the other hand, drummers are symbols of passion and being emotional. It would be interesting to dig deeper into their inner world to identify their emotional values towards drumming and discover new design possibilities.

Competitor research was conducted to build a solid understanding of the product. Trend research was conducted regarding technology, music instruments, a new way of interaction of music, etc. Interviews with drummers were done to get the first-hand material of the real target users. After analyzing all the insights gained, the design vision was created, which addresses the drummer’s key emotion – curiosity. Related functional needs were also identified: produce richer sounds, easy set-up, flexible transport, and customizable configuration. Design vision, key emotion, and functional needs together form a complete design logic.

The final design – Collector, consists of three key products: drum kit, smart module, smart drumsticks. Drummers could take the smart module and drumsticks alone to go out to collect the sound samples they like for their drum kit. In this way, drummers can build a drum kit with their own unique sound library. Besides, the drum kit itself is designed to be compact and lightweight with a modern, minimalistic design language. It is easy for drummers to set up, transport the drum kit, or customize the drumhead configuration.

This flexibility brings enormous potential to the drumming experience.

The design was evaluated with real drummers and was proved to be both practical and attractive. The concept shows enormous potential to be further developed into a commercial product.

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- CHAPTER 1 -

INTRODUCTION

Background

The drum kit plays a vital role in modern music. A drum kit is a group of percussion instruments, primarily drums and cymbals. The drum kit is spatially arranged for one single person to play, with drumsticks on both hands, left foot for controlling the hi-hat cymbal, and right foot for controlling the bass drum (Figure 1). Although drum is one of the oldest instruments used by humankind ("Drum - History of the Oldest Musical Instrument", 2019), the first modern drum kit did not appear until around 1930 ("The Evolution of the Modern Drum Kit", 2019) and the archetype of the drum kit has not changed much over 90 years.

The idea of the topic originated from the author's personal experience, who has previously been drumming for six years and now seeking whether there is space for improvement for the current drum kit.

This project is a graduation project with a self-initiated topic under the coaching of Delft University of Technology (TUD) and Phoenix Design. Phoenix Design is a Germany design studio with over 30 years of history specialized in product design. Phoenix Design has an internal program called Phoenix Academy that provides students with visionary topics to do their graduation project inside the company. Phoenix Academy acts as a platform hosting visions and studies of Phoenix Design team.



Figure 1 - TAMA Starclassic Maple Japan Exotic Drum Kits (TAMA, 2020)

Initial Brief

The initial project brief was to design a future drum kit for band drummers with mobility while keeping the authentic drumming experience. Based on the author’s personal drumming experience and brief analysis of the current drum market, two problems regarding the design of current drum kits were identified:

Current drum kits on the market are space-consuming and inconvenient to transport. The drum kit must be disassembled and reassembled to be transported from place to place, which is inconvenient, especially for professional band drummers who have tours. Besides, hard cases are needed to protect the expensive drums from potential damage. This issue is much related to band drummers, which is why band drummers are the initial target group to have a clear starting point for the project.

Electronic drum kits that are more portable have already been available on the market. However, the drumming experience is less authentic compared to the traditional physical drum kit since the portable electronic drum cannot simulate the holistic drumming experience (haptic feedback, posture, space, sound, etc.).

According to the defined problems, an opportunity area where the drum kit can offer both the authentic drumming experience and the mobility the traditional drum kit does not have. A mapping of the design opportunity area is shown below.

Initial Design Goal

To design a drum kit for band drummers with portability while keeping the authentic drumming experience in the future scenario.

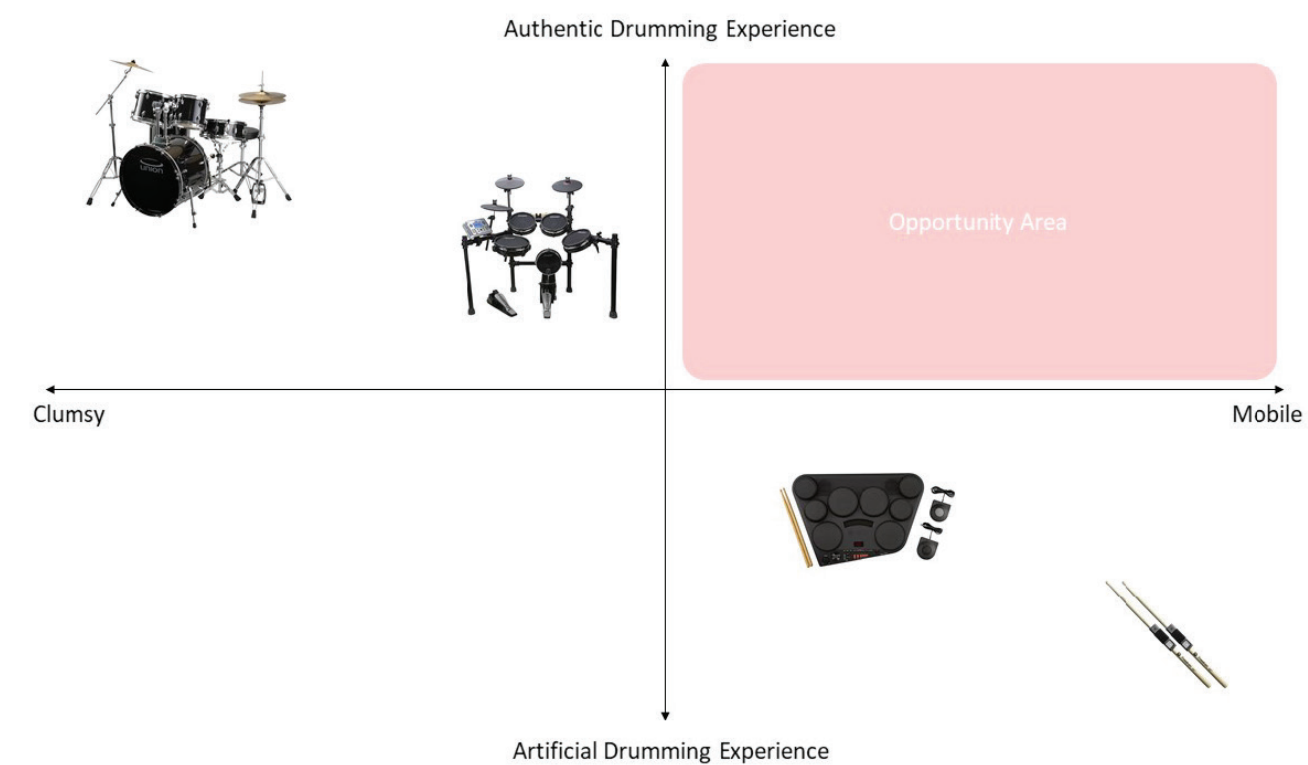


Figure 2 - Mapping of Design Opportunity Area

Initial Scope

The project’s design scope is to explore the interaction between the drummer and the drum kit, and the new mechanism/structure of the physical drum to increase portability in the future scenario.

Interaction Exploration

The core value of the authentic drumming experience should be identified, such as physical feedback, posture, sound, etc. Based on this core element of interaction, the new way of interaction could be explored.

Portability

The final design should tackle this problem through two aspects: volume and assembly. The final design should decrease the volume of the drum (i.e. take up less space in the van while transporting the drum. The assembling and disassembling process should also be simplified to reduce the effort for transporting.)

Future-oriented

The project aims to inspect drumming from a future perspective instead of merely solving the existing drum kit problems. The main focus will be on exploring inspiring visions and ideas towards the future of drumming.

The final design is expected to be a physical product, possibly with the digital experience (app, AR, VR, etc.) The final prototype is expected to be a testable prototype that can validate the most crucial part of the design (e.g. aesthetics, interaction, portability, etc.), which will be defined later. Due to the limited time and resources, manufacture and engineering will not be the main focus.

Besides, a good product should be desirable, feasible, and viable. Desirable means that the concept should solve the problem that current drums have and match drummers’ inner value, which makes them desire the product. Feasible means that the technology applied in the final

concept should be realistic and promising. Viable means that the product should be commercially available and match the target user’s financial capability so that the drum company can earn a profit margin.

Approaches

The initial project design brief is based on the author’s personal drumming experience and initial research, which sufficiently act as a clear entry point of the topic of drumming. However, the information obtained from the initial research is limited, and the personal experience is subjective. As a result, the initial design goal mainly focuses on the problem of the existing drum kits instead of being future-driven. Therefore, the initial design brief will be an entry point for the research phase, and a refined design vision will be formulated after the research and synthesis phase. The actual design will be based on refined design vision. The process of the project is visualized in figure 3.

Purpose of Research

Research is needed to get a comprehensive and deep understanding of the topic based on the entry point – the initial design brief. The project aims to explore the future of drumming. Four research questions are generated:

- 1. How is the drum kit being used now?
- 2. What are the essential elements of the authentic drumming experience?
- 3. What is the emotional value of the drum towards the drummer?
- 4. What is the drummer’s vision of the future drumming?

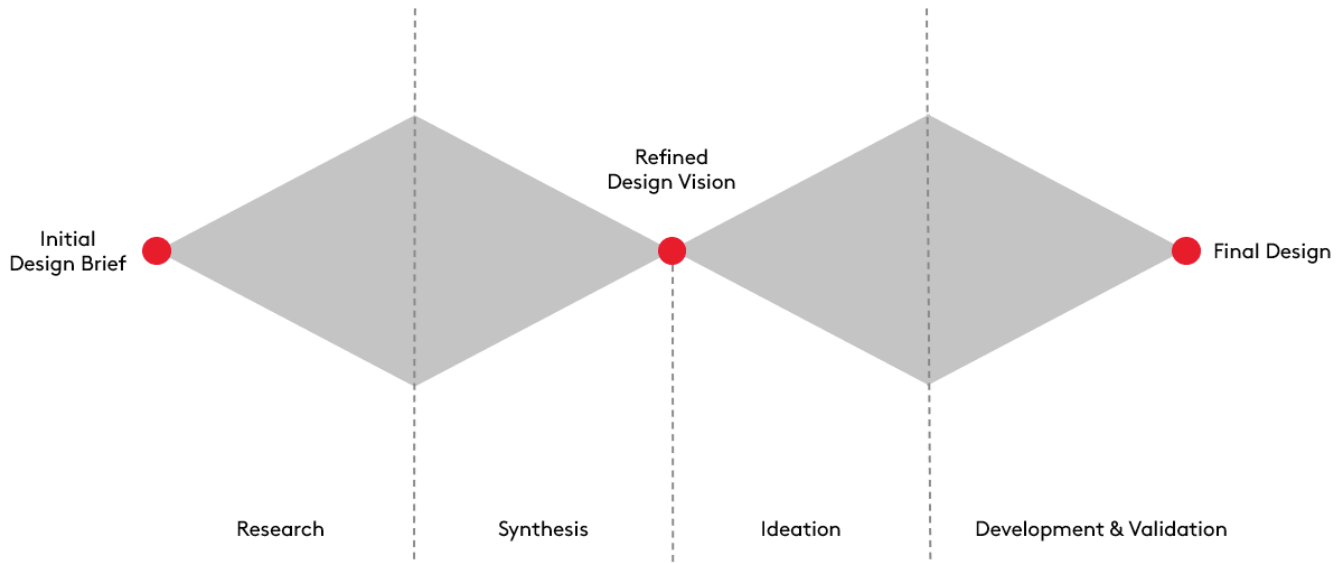


Figure 3 - Project Process Overview

- CHAPTER 2 -

EXPLORATIVE RESEARCH

Approaches

Reflecting on the four research questions, explorative research consists of three main topics: trend research, user research, and other inspirations.

Timeline aims to get a foundation for envisioning the future of drumming by investigating the history of the drum kit as well as current products on the market.

User research aims to gain in-depth insights from the real drummers and prove the initial assumption.

Other inspirations consist of other inspiring products or design concepts (not necessarily drum design or musical instrument design).

Insights are summarized in this chapter, which acts as the small conclusion points from the research. The insights are summarized after each paragraph. These insights will later be used in the synthesis phase to be analyzed to form the design goal, design vision, and design guidelines. An overview of the structure is shown in figure 4.

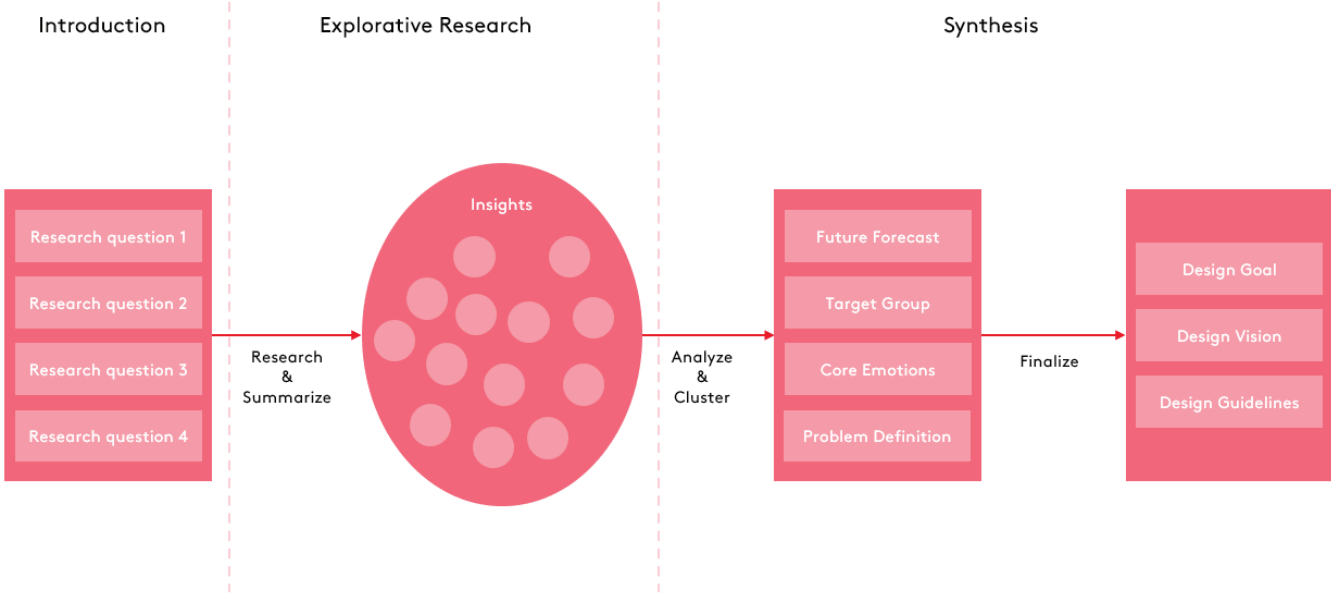


Figure 4 - Approach Process Overview

Timeline

There are three topics involved in timeline: History, Market Research, and Fair Visit.

History

The first drum occurred around 30,000 years ago when humans figured out how to stretch an animal skin to make sound, but the drum kit was only developed in the last 200 years (Perlmutter, 2019). The history of drum kit development is visualized in figure 5.

As shown in the figure, the modern drum kit's primary archetype only appears in the 1950s when the foot pedal was applied to enable the drummer to use both their hands and feet to play multiple parts simultaneously (Perlmutter, 2020). It is unique for the drum kit that involves all four limbs comparing to other percussion instruments (Insight 1).

Insight 1: One unique feature of playing the drum kit is that it involves both hands and feet.

In 1960, when rock music began stepping on the stage, many drummers used a maximum approach to fir the music style, not only on drumming but also on the gears. Besides the regular drum kit, they will add different auxiliary percussion instruments, such as temple blocks and tubular bells, to have richer sounds and more impressive performance on the stage (Insight 2).

Insight 2: Drummers will add different auxiliary percussion instruments besides the regular drum kit to pursue richer sounds.

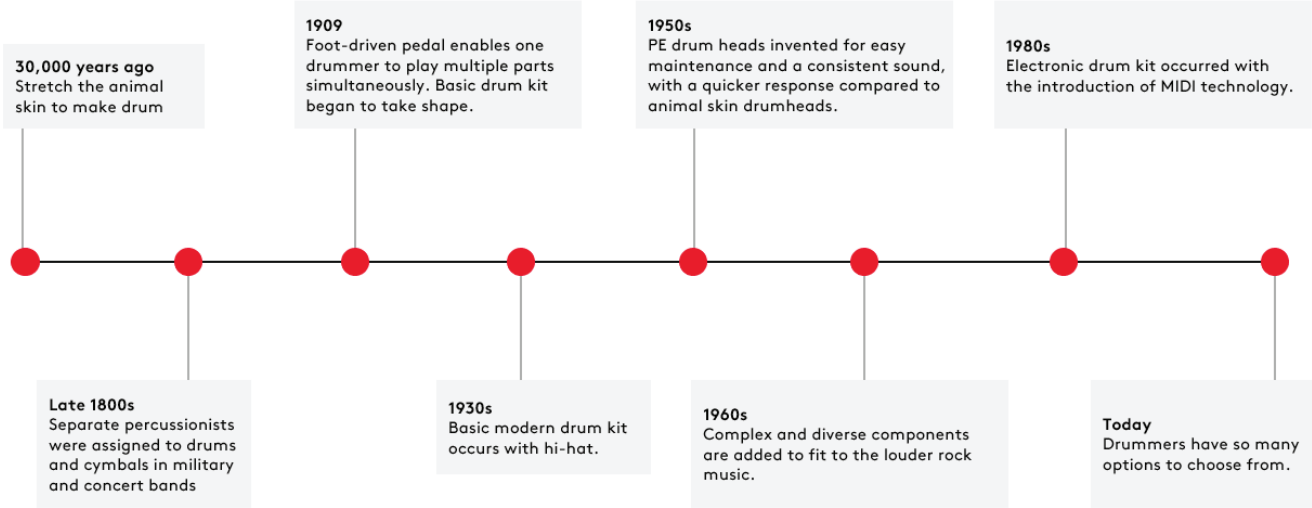


Figure 5 - History of Drum Kit Development

Market Research

Brands of both acoustic drum kits (TAMA, MAPEX, REMO, YAMAHA, DW) and electronic drum kits (ROLAND, CARLSBRO) were researched and analyzed. Insights are summarized as below.

Acoustic Drum Kit

Different Configuration

Besides the must-have components (one snare drum, one hi-hat, and one bass drum), other parts (toms, cymbals, etc.) depend on the drummer's choice. Various pre-defined configurations are provided (figure 6).

Insight 3: The most basic configuration includes one snare drum, one hi-hat, and one bass drum.

Insight 4: There are several most popular basic configurations according to different music styles.



Figure 6 - Different Configurations Offered by TAMA (TAMA, 2020)

High Customizability

The drum kits on the market are highly customizable. Companies offer many different options for drummers to choose (drum shell material and finish, size, drum head, etc.).

Insight 5: High customizability is a crucial factor for drummers to consider when purchasing the drum kit.

Key Selling Points

The drum kit's key selling points are the quality of the sound, the engineered components, and the drum shell's material.

Insight 6: Drummers have a strong preference for authentic material use, which implies high quality.

Silence Drum

There are already drum kits specially designed for quietly practicing at home. Fabrics replace the material of the drumhead, and metal cymbals are drilled with holes in a pattern (figure 7). In this way, the sound volume decreases significantly when drumming.

Insight 7: How to reduce the volume of sound is crucial for drummers who drum at home.



Figure 7 - Silence Drum Kit at a Drum Store at Rotterdam

Pancake Drum

Special pancake drums are already available on the market (figure 8), which takes a much smaller volume, shown in the figure below. The particular claw-hook spur system ensures the stability of the drum when standing.

However, since it still uses the acoustic way to make the sound, the sound it produces is much different from the acoustic drum with a chamber of standard size. Therefore, although it is easier to transport and takes less space, it is not popular on the market.

Insight 8: Compared to taking less space, the sound quality is more important for drummers.



Figure 8 - Pancake Bass Drum (ZZOUNDS, 2020)

Electronic Drum Kit

Technical Feeling

Unlike acoustic drum kits, the electronic drum kit gives a strong feeling of technical product because of several reasons: too many wires, no use of authentic materials, the use of black plastic and rubber, the terminal, etc.

Insight 9: The use of black rubber, the terminal, and wires strongly emphasize the product's technical feeling.

Low Structural Customizability

The electronic drum set has low structural customizability since the structure is hard to add more drums or cymbals.

Insight 10: Low customizability is one disadvantage of the electronic drum kit.

Low Visual Customizability

There is less room for the customization of visual appearance since the drum shell is much smaller than the regular acoustic drum. The overall appearance consists of simple neutral colors, which makes it look technical.

Insight 11: It is more difficult for drummers to show their identity in a visual way on the electronic drum kit.



Figure 9 - Roland Electronic Drum Kits (Roland, 2020)

Hybrid Drum Kit

Besides acoustic drums and electronic drums, hybrid drums are also being used by some drummers. There are three different types of "hybrid" way of drumming which are listed below.

Combine the Acoustic Components and Electronic Components

Drummers will choose different components to suit their needs. For example, as is shown in figure 10, the hybrid drum kit consists of electronic toms, cymbals, and acoustic bass drum.



Figure 10 - Hybrid Drum Kit (Pearl, 2020)



Figure 11 - Roland RT-30HR Dual Acoustic Snare Drum Trigger (Roland, 2020)

E-trigger

Specialized add-ons are already available on the market, like Roland RT-30HR Dual Acoustic Snare Drum Trigger. Drummer can fix it on the drum then the sound could be collected and transferred into e-sound. It offers the possibility that the drummer could produce the sound of an electronic drum through the acoustic drum.

Separate e-drum pad

Some drummers will put a separate e-drum pad beside the acoustic drum to add the sound they need.

Insight 12: Sometimes, drummers need both the sound from both the acoustic drum kit and the electronic drum kit, which indicates that drummers are pursuing richer sounds.

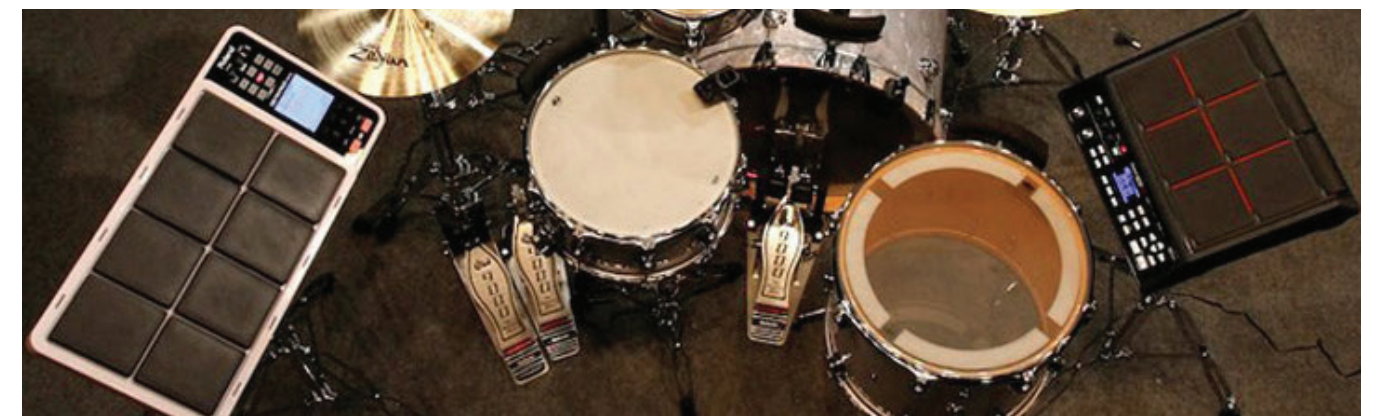


Figure 12 - Trigger Pad beside Regular Acoustic Drum Kit (Roland, 2020)

Virtual Drumming

There are already products available on the market, which allows drummers to do virtual drumming (figure 13). The smart sensor is embedded in the device, which needs to be attached to the drumstick. Together with the app, the drummer can drum against the air in front of them. The drummer could calibrate the sensor and also customize their own drum configuration through the app.

Insight 13: Besides the acoustic drum kit itself, the drumstick is another entry point for the digitalization of drumming experience, which is developing quickly now.

Figure 13 - Freedrum Virtual Drum Kit (IMBOLDN, 2020)

Fair Visit

Music China is the leading musical instrument in Asia, which took place in Shanghai from 28 Oct to 31 Oct 2019. A visit was taken to the fair, and insights regarding the current market and the trend are summarized.



Figure 14 - Music China, Shanghai

CMF(Colour, Material, Finish) as Highlight

The drum shell is a highlight for the drum kit, and there is a wide variety of options to choose from (Figure 15 & 16). The shell of the drum already acts as a fashion and trendy element. This highlight also applies to all the musical instruments, not only the drum kit (Figure 17).

Insight 14: Visual elements (e.g., the color, material, and surface finish, etc.) act as a highlight for the musical instrument.



Figure 15 - GIOCO Drum at Fair with Shiny Coated Shell



Figure 16 - GIOCO Drum at Fair with Wooden Coated Shell



Figure 17 - Guitar at Fair with Different CMF

Blurring Boundary

The electronic drum tries to mimic the acoustic drum as much as possible. The electronic drum begins to look like an acoustic drum, as is shown in figures. For example, in figure 18, the drum shell is added to the electronic drum. In figure 19, the electronic cymbal's structural components are almost the same as the acoustic cymbals to mimic the real reaction. The border between the acoustic drum and electronic drum is becoming blurry.

This trend also happens in other musical instruments like the piano. The hybrid piano keeps the traditional mechanism for the key, but the sound comes from the embedded speaker.

Insight 15: The border between the acoustic drum kit and the electronic drum kit is becoming blurry.



Figure 18 - Hybrid Drum Kit at Fair



Figure 19 - Electronic Cymbal at Fair

New Archetypes

New archetypes of the electronic drums were spotted on the fair. Different shapes of frame structure are applied (Figure 20). Even a new folding mechanism is tried (Figure 21).

Insight 16: New archetype of the electronic drum kit is still being developed.



Figure 20 - Electronic Drum Kit with New Archetype at Fair



Figure 21 - Electronic Drum Kit with New Folding Mechanism at Fair

Authentic CMF

Since most musical instruments are experiencing the trend of digitalization, some electronic musical instruments try to apply the authentic material to make the e-instruments feel authentic. For example, the electronic piano (figure 22), uses the authentic wood material as if it is a real acoustic piano.

Insight 17: Musicians still have a preference towards the authentic material even for electronic music instruments.



Figure 22 - Electronic Piano with Wooden Finish at Fair

Home Context

Home is an essential context for musicians to practice sometimes. Therefore, how to deal with the relationship between the instruments and home furniture has been a popular topic. In the fair, YAMAHA presented their interior piano “Be-side”, which acts as a table when not in use. It provides an excellent example of how to merge the musical instruments into the home context.

Insight 18: There is a trend that tries to merge the musical instrument into the home context.



Figure 23 - YAMAHA Interior Piano “Be-side” (YAMAHA, 2020)

Switch of States

There is a brand called ALPS at the fair, which designs the foldable guitar (figure 24). Folding mechanism is applied, which enables the guitar to transform from the “not in use” state to a “play” state. For example, usually, when not in use, the guitar will be hung on the wall as a decoration with a clear “not-in-use” state. This change of state applies to the piano as well when the cover of the piano is closed, which turns the piano from a musical instrument into something static and decorative. This feature is inspiring since there is no difference in the drum kit between the “in-use” state and the “not-in-use” state.

Insight 19: Bringing in the concept of “state change” to the drum kit could be an exciting idea, especially in the home context.



Figure 24 - ALPS Guitar at Fair

User Research

To get a real knowledge of the drummer's life, interviews were conducted, and drummers were recruited. The primary source of the drummer is from the author's network.

Recruitment

The band drummer was chosen to be the initial target user as a starting point, but there are other different types of drummers. Different types of drummers should be involved to get a comprehensive understanding of the topic. Firstly, a list of different drummers was created to have a clear direction of recruitment:

- Professional Band Drummer
- Student / Amateur Band Drummer
- Bar Drummer
- Orchestra Drummer
- Drum Teacher
- Beginner
- Amateurs
- Other stakeholders: drum shop owners, etc.

Ideally, all types of drummers are supposed to be involved in the interview. However, due to the limitation of the network, not all types of drummers are available for interviews. A list of drummers (7 in total) interviewed is shown in the table below:

Preparation

In order to conduct the interview efficiently, corresponding materials were prepared. The materials include:

Name	Age	Nationality	Gender	Type
Haoxin Weng	25	Chinese	M	Beginner Hobbyist
Shutong Wang	21	Chinese	M	Professional Drummer
Yitian Wang	59	Chinese	M	Drum Teacher
Jiayi Zhang	26	Chinese	F	Drum Teacher
Zhijian Xu	20	Chinese	M	Amateur Drummer
ChaoYang	25	Chinese	M	Professional Drum Student
Sam	32	Gaerman	M	Amateur Drummer

Table 1 - Drummer Recruitment Overview

Recruitment Brief

A recruitment brief was created to help brief the interviewee about the topic of the project and the aim of the interview (see appendix 1).

Interview Questions

A list of questions was prepared for reference during the interview. The questions were created around the four main research questions mentioned in the introduction chapter (see appendix 2).

Mood Pictures

Mood pictures were prepared to trigger emotional feedback during the interview. The Mood pictures include a series of abstract pictures that allow the audience to interpret it from different perspectives (see appendix 3). When there are difficulties describing the emotional feelings during the interview, they could refer to the mood pictures and use it as a trigger to talk along. Therefore, deeper emotional values could be dug out.

Freedrum

A pair of freedrum smart drumstick was bought and brought to the interview for the drummer to try on (shown in page 18) and talk about their experience of this new way of virtual drumming. This product is used for the drummer to talk about their opinion towards the authentic drumming experience.

Recording Pen

A recording pen was used to record the whole interview. The recording will be transcribed later for the synthesis.

Interview

Interviews were conducted, photos were taken and the sound was recorded under the permission of participants.



Figure 25 - Participant Trying Freedrum

Processing of Results

After the interview, all the recordings were transcribed into small cards with quotes (figure 26). For each card, there is a title, the related quote, and the corresponding interviewee. Around 400 cards were created in total. The cards were used for clustering to get deeper insights. The insight cards were then clustered into different topics.

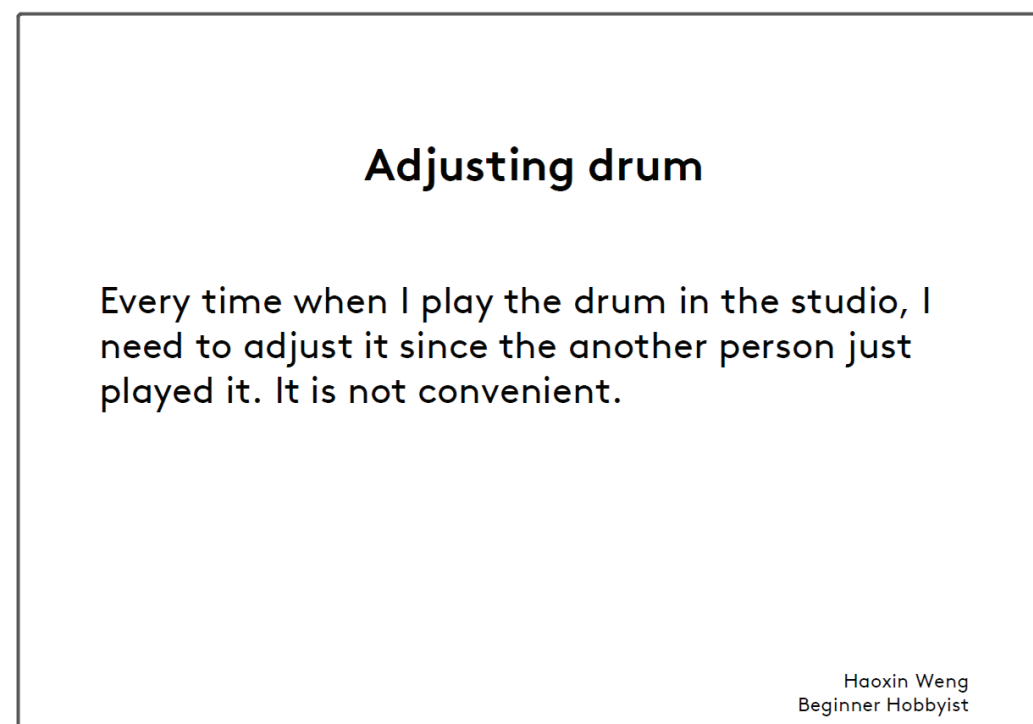


Figure 26 - Example of the Insight Card



Figure 27 - Author Clustering Insights

Results of Interview

Insights were summarized here with related quotes from insight cards to back up.

“We need to tune the drum before the show.”
“I want the drum to be able to easily tuned. E.g., one button to change the tune.”
“It is difficult to tune for the acoustic drum kit.”
“Electronic drums do not need to tune and can change to many different sound libraries.”

Insight 20: The drummers wish the drum kit could be easily tuned.

“I wish that I can play the same drum for lifelong.”
“I am playing the same drum all the time. I think the drumhead will sound better along the time.”
“It will be best to always play on the same drum.”
“I need to buy different drums. I want only to buy one drum and play the same drum, once for all.”

Insight 21: The drummer always wants to play their own drum kit if possible.

“There is always some new sounds when drumming.”
“Electronic drums and acoustic drums each have their own limitation in the sound they create.”
“Even famous jazz bands in the USA will use e-drums because they need those special sounds which can only be produced by electronic drums.”

Insight 22: Drummers want to pursue richer sounds.

“The set up for a real drum kit is very time-consuming.”
“Every time you need to assemble and disassemble the drum kit if you want to move it.”
“You can get quicker in setting it up, but it requires years of experience.”

Insight 23: The current drum kit is difficult to set up and tear down.

“I remember helping you move your drum when you were a kid. It is a pain in the ass because you live on the top floor.”
“I sold my pearl drum before because I cannot move it, but now I bought another pearl drum.”
“I want the drum to be portable and move them around in a good way without sacrificing the sound and the look.”
“The drum is heavy for me to transport.”

Insight 24: The current drum kit is difficult to transport.

“When I play at home, even I placed a mattress. Still, the neighbor downstairs can hear it because of the resonance produced by the bass drum.”
“I did not consider buying a real drum: 1. It is too big, and I have no room for it. 2. It is too loud.”
“The sound is probably the biggest problem for the real drum.”

Insight 25: The drum kit is too loud and takes too much space at home.

“When assembling the drum again, I need to re-calibrate all the drum position again.”
“The position and configuration are quite fixed for the e-drum.”
“Whenever I play the drum in the studio, I need to adjust it since another person just played it. It is not convenient.”
“It would be nice if my drum can adjust itself to fit the style of the music and context, just like a chameleon.”

Insight 26: The drummers do not like to spend too much time adjusting each component’s position.

“Real drum is covered with metal, wood. The electronic drum is covered with rubber, which feels techy/artificial/fake.”
“Sound range of electronic drum can be controlled by setting and seems smaller. The real drum has a wider sound range and is fully controlled by myself.”
“Hitting the cymbal of the real drum has strong tactic feedback, and my wrist can feel it. Electronic drums are weaker and feel ‘faker’.”
“I feel less tension on the electronic drumhead compared to the real drum.”

Insight 27: Drummers love the authentic biofeedback of the acoustic drum kit.

“I started by learning the real drum. When I play the electronic drum, it will feel fake since it is smaller in space.”
“The suitable drum size and space ensure the free and smooth movement of drumming.”
“This feeling of space and position is important for a real drumming experience.”
“The big space of the drum kit makes it look impressive.”

Insight 28: The drum kit must take up certain space to give the drummer a feeling of boldness.

“The connection design between the pedal and bass drum is not holistic. The products are not a whole.”
Insight 29: Drummers wish the drum kit could have a more holistic design language across all the components.

“The audience wants to see the physical drum instead of drumming in the air.”
“The ‘freedrum’ is drumming against the air. It is impossible to have that “feel”. You must hit against something, and this “something” has to be ‘the drum’.”
“I feel weird while playing ‘freedrum’. It can only be used for “playing”. It cannot be for serious performing.”
“To play this ‘freedrum’, the feeling is that I need to be very careful. It is different from the real drum where I can fully “drum” on.”
“‘Freedrum’ cannot practice your wrist.”

Insight 30: What drummers expect is a physical product.

“I will also have a look at the drumskin material, what kind of wood it is.”
“The natural materials make it look cool and high class.”
“Real drum is covered with metal, wood. The electronic drum is covered with rubber. The rubber material feels fake.”
“I feel the CMF(color, materials, and finish) affects my authentic feeling more than the volume.”

Insight 31: Drummers appreciate the use of authentic materials.

"Other percussion instruments are too simple, not complex enough, not fun. The possibility is limited."

"African drum is very limited regarding the style. Maybe only folk music."

"I start playing the drum because it looks cool and also fun."

"Drum kit is visually cool and huge. I feel satisfied after I "conquer" this huge drum."

"E-drum does not look cool because it looks too technical."

Insight 32: Drummers appreciate the coolness and complexity the acoustic drum kit implies, both visually and functionally.

"It seems easier to learn with large movement instead of small hand movements on other instruments."

"When I was a child, I feel the drum is more free and powerful compared to the piano, which is strict."

"Playing the drum kit gives me a feeling of coordination."

"The difficulty of drumming is coordination. It requires your four limbs to do a multi-threaded operation."

"One important aspect of drumming is hand-foot coordination."

Insight 33: Drummers appreciate the percussion interaction, and that defines the instrument as a drum.

Other Inspirations

Other design concepts or products in the music fields were also investigated as a source of inspiration.

Synth Play

Synth is a sound installation using giant inflatables to create an abstract way of making music, designed by Yurisuzuki studio. It changes the traditional way of producing music. The sensor is embedded in the vast inflatable. Physically interacting with the inflatables will set off the sensor inside, which will manipulate the music. The whole installation includes five units, and each unit controls a parameter of the sound system. Synth Play uses basic movements to create a musical interface. By physically interacting with the installation, people can create a sensory experience, encouraging themselves to create music in an unusual way (figure 28). The way of creating music has been extended from using musical instruments to other physical interactions.



Figure 28 - Synth Play by Yuri Suzuki (Yuri Suzuki, 2020)

Oddball

Oddball is a bouncing ball that acts as a percussion trigger that allows the user to create music on the go. Oddball was developed by students at the Royal College of Art, which later developed into a start-up company. With the embedded pressure sensor, the user could throw, smash, flick, tap it to create the music of their own. The sound produced by different interactions could be pre-defined in the app. In this way, Oddball allows the user to create music by the physical interaction with the ball, which also provides the freedom for the user compared to using the traditional bulky musical instruments (figure 29).

Insight 34: In the future, the way of creating music will not be limited in using the musical instrument but extended to various kinds of physical interactions.



Figure 29 - Oddball (Kickstarter, 2020)

FabricKeyboard

FabricKeyboard is an experimental project developed by the MIT media lab. It is a musical instrument made from multi-layer textile sensors. When placed flat, the fabrics can act as a regular keyboard. Besides, the e-fabric is responsive to touch, pressure, stretch, proximity, and electric field. The user can manipulate the sounds by manipulating the fabric by pressing, pulling, twisting, and even by waving their hands above the material (figure 30).

Insight 35: The use of smart fabrics can significantly increase the flexibility of the musical instrument, both in broadening interaction and the increasing portability.

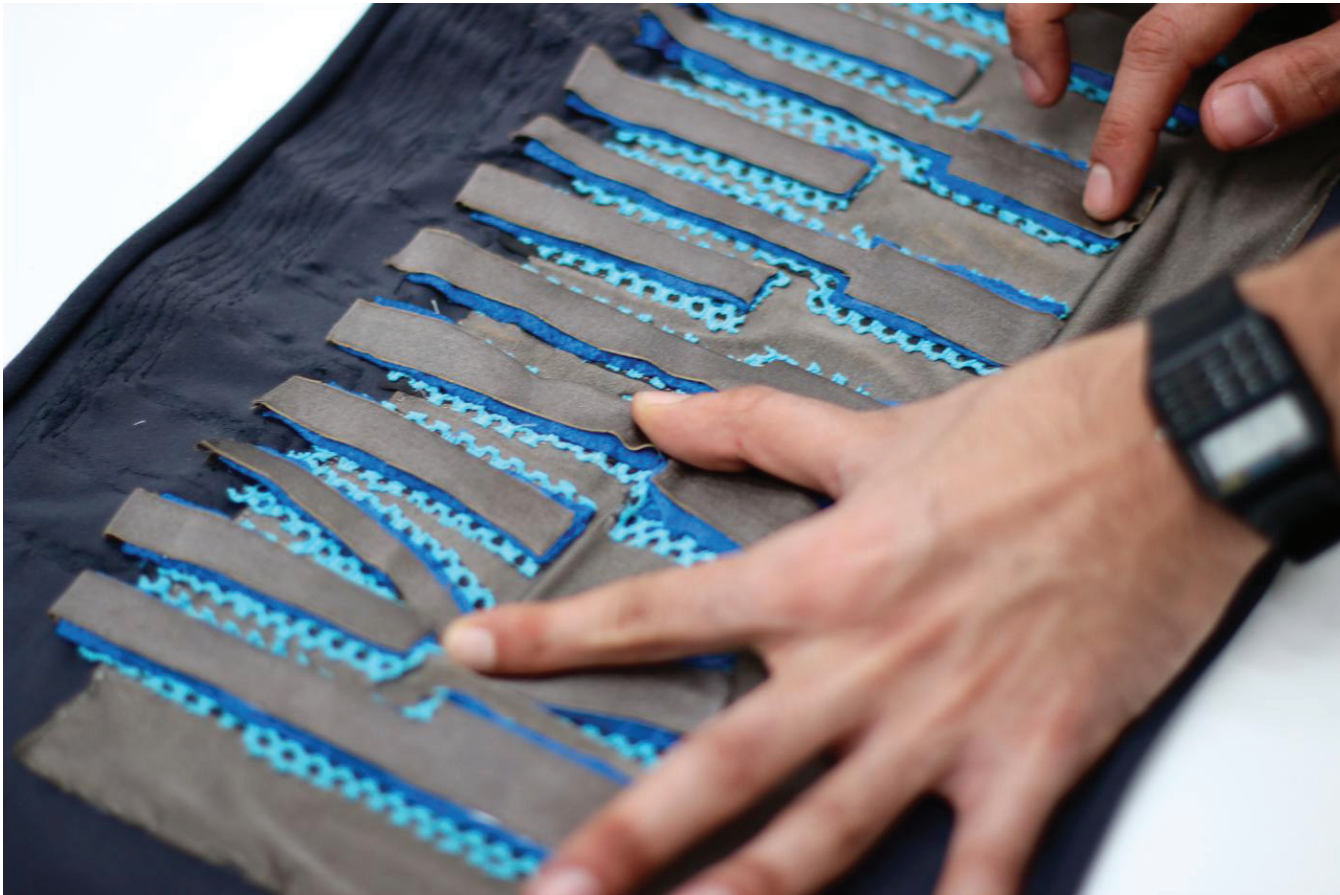


Figure 30 - FabricKeyboard by MIT Media Lab ((MIT Media Lab, 2020)

All the insights extracted are summarized in the following pages. These insights will be used for analysis in the synthesis phase.
P.S. Not all of the insights will be used in the synthesis phase. Some of them may be the inspiration for the ideation and concepts in the later phases.

List of Insights

- Insight 1: One unique feature of playing the drum kit is that it involves both hands and feet.
- Insight 2: Drummers will add different auxiliary percussion instruments besides the regular drum kit to pursue richer sounds.
- Insight 3: The most basic configuration includes one snare drum, one hi-hat, and one bass drum.
- Insight 4: There are several most popular basic configurations according to different music styles.
- Insight 5: High customizability is a crucial factor for drummers to consider when purchasing the drum kit.
- Insight 6: Drummers have a strong preference for authentic material use, which implies high quality.
- Insight 7: How to reduce the volume of sound is crucial for drummers who drum at home.
- Insight 8: Compared to taking less space, the sound quality is more important for drummers.
- Insight 9: The use of black rubber, the terminal, and wires strongly emphasize the product’s technical feeling.
- Insight 10: Low customizability is one disadvantage of the electronic drum kit.
- Insight 11: It is more difficult for drummers to show their identity in a visual way on the electronic drum kit.
- Insight 12: Sometimes, drummers need both the sound from both the acoustic drum kit and the electronic drum kit, which indicates that drummers are pursuing richer sounds.
- Insight 13: Besides the acoustic drum kit itself, the drumstick is another entry point for the digitalization of drumming experience, which is developing quickly now.
- Insight 14: Visual elements (e.g., the color, material, and surface finish, etc.) act as a highlight for the musical instrument.
- Insight 15: The border between the acoustic drum kit and the electronic drum kit is becoming blurry.
- Insight 16: New archetype of the electronic drum kit is still being developed.
- Insight 17: Musicians still have a preference towards the authentic material even for electronic music instruments.
- Insight 18: There is a trend that tries to merge the musical instrument into the home context.
- Insight 19: Bringing in the concept of “state change” to the drum kit could be an exciting idea, especially in the home context.
- Insight 20: The drummers wish the drum kit could be easily tuned.

Insight 21: The drummer always wants to play their own drum kit if possible.

Insight 22: Drummers want to pursue richer sounds.

Insight 23: The current drum kit is difficult to set up and tear down.

Insight 24: The current drum kit is difficult to transport.

Insight 25: The drum kit is too loud and takes too much space at home.

Insight 26: The drummers do not like to spend too much time adjusting each component's position.

Insight 27: Drummers love the authentic biofeedback of the acoustic drum kit.

Insight 28: The drum kit must take up certain space to give the drummer a feeling of boldness.

Insight 29: Drummers wish the drum kit could have a more holistic design language across all the components.

Insight 30: What drummers expect is a physical product.

Insight 31: Drummers appreciate the use of authentic materials.

Insight 32: Drummers appreciate the coolness and complexity the acoustic drum kit implies, both visually and functionally.

Insight 33: Drummers appreciate the percussion interaction, and that defines the instrument as a drum.

Insight 34: In the future, the way of creating music will not be limited in using the musical instrument but extended to various kinds of physical interactions.

Insight 35: The use of smart fabrics can significantly increase the flexibility of the musical instrument, both in broadening interaction and the increasing portability.

- CHAPTER 3 -

SYNTHESIS

Overview

Following the structure shown at the beginning of the explorative research chapter (figure 4). All the insights were clustered into four topics (Future Forecast, Target Group, Core Emotion, and Problem Definition), which lead to the establishment of the Design Vision, Design Goal, and Design Guidelines. Each topic has several conclusions based on the interpretation of the related insights, which were listed right afterward. The details of corresponding insights can be checked on the list of insights (page 37 & 38).

Future Forecast

As described in the introduction chapter, this project is future-oriented, which means that the project's outcome is expected to be at a conceptual level and envision the drum kit in the future context instead of only solving the existing problems drummers currently encounter. The predicted next trend is forecasted based on the insights gained from the explorative research. Here, two future trends are identified below.

“The future of musical instruments will be the fuse of the digital and the physical.”

From the explorative research, it is found that acoustic musical instruments and electronic musical instruments both have strong points and weak points compared to each other. This fact applies not only to the drum kit. Musicians appreciate the authenticity the acoustic instruments bring, which is also a symbol of high quality. In the meantime, the development of digital technology brings massive potential into the music industry. In the future, the electronic musical instrument and the acoustic instrument will begin to fuse until when a delicate balance between the digital and the physical is found.

Related insights: 6,12,13,15,16,17,20,22,27,30,34,35

“Musicians will eventually become the designer of their own instrument.”

During the market research, increasing customizability is found out to be a big trend not only in the drum kit but also in other musical instruments. This customizability includes customizability of the product's visual appearance (e.g. the drum shell with different colors, materials, and finishes), functional module (e.g. different material for the drumhead for desired sounds), and the configuration (e.g., different amounts of toms and cymbals). To sum up, in the future, musicians will have more freedom in customizing their own instruments, both visually and functionally, which fit their own habits and could match and represent their identity.

Related insights: 2, 5, 10, 12

“The musical instrument will mainly be differentiated by way of interaction.”

As the use of electronics flourishing in the music industry, the drumbeat can be produced through other musical instruments such as a keyboard or in the software. The limitation of the way of producing sounds will be liberated and extended to more physical interactions or entirely digitally. The definition of the musical instruments will be broadened. The musical instruments are more likely to be defined by their interaction with the user. For drummers, what determines the musical instrument as a drum is this authentic percussion interaction with freedom.

Related insights: 1, 15, 33, 34

Target Group

At the start of the project, band drummers were set as the starting point for the target group, which was vague for the final design vision. After explorative research, personas were made to analyze the target group in-depth to define the target group better. In the persona, necessary information, related photos, quotes regarding their values and needs were demonstrated.

Due to the limited network, resources, and time, the drummers recruited cannot cover the vast spectrum of drummers. Some types of drummers that are representative were still missing. Therefore, online research (interviews, articles, and documentaries) was conducted to generate the missing personas and have a more comprehensive understanding of drummers.

Three additional drummers were added, of which the information was gained through online research. They are:

- Jojo Mayer (Professional drummer, drummer of the band - NERVE)
- Chad Smith (Professional drummer, drummer of the band - Red Chili Pepper)
- Kashikura Takashi (Professional drummer, drummer of the band - TOE)

Seven personas were made based on the collected information (see appendix 4).

A mapping was then done to find the appropriate target group for this project (Figure 31). The horizontal axis represents the openness of the drummer's mind since the drummer can be either conservative (e.g., the old-fashioned drum teacher) or open-minded (e.g., professional avantgarde exploring drummer). The vertical axis represents the skill level of the drummer since drummers of different skill levels will have different user contexts, encounter different problems, and the needs will be different accordingly.

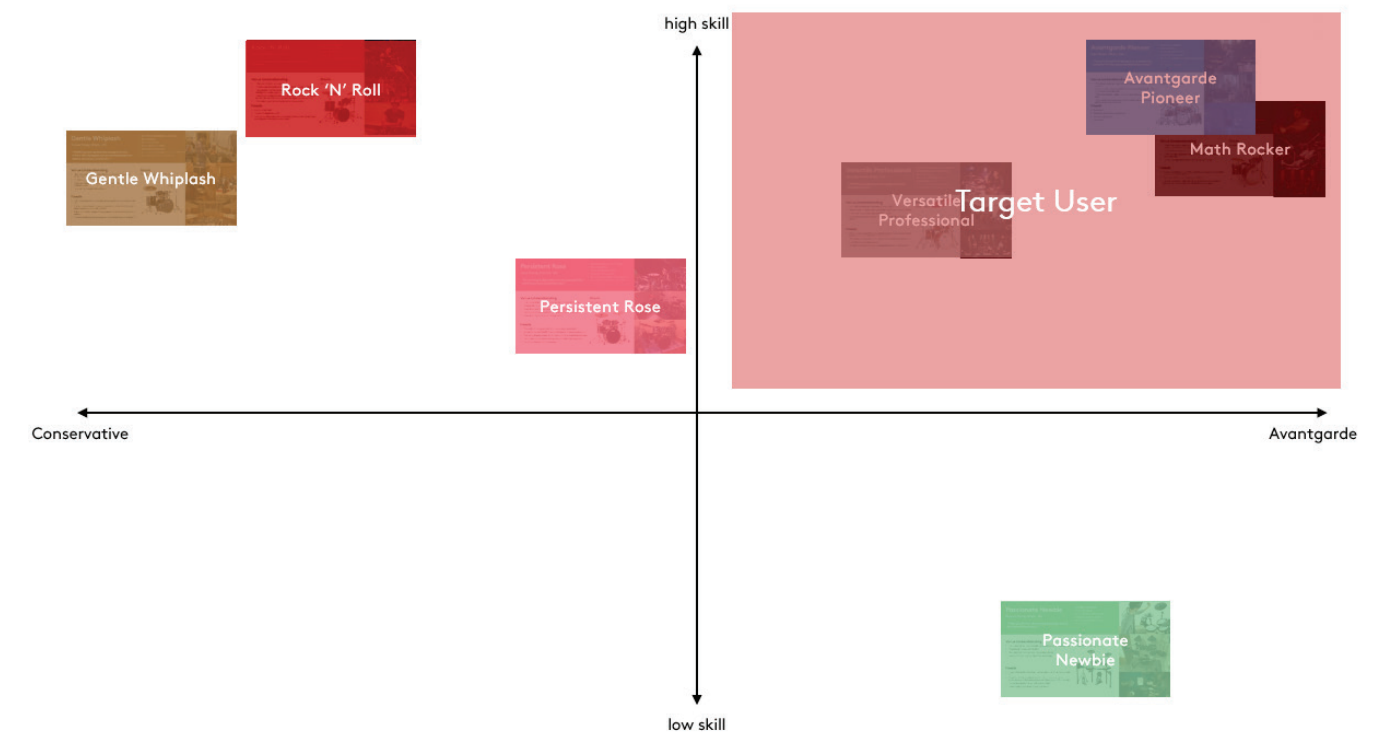


Figure 31 - Mapping of Personas

As shown in the figure, drummers with middle to high skills and a more open mindset were selected to be the target group. There are two main reasons why they were chosen:

For the horizontal axis, during the research, it was found that drummers with a conservative mind have an extreme obsession with the acoustic drum kit and the way it is now. They tend to refuse the applying of new technology on the drums, which is against the megatrend identified in the future forecast (insight 15) and eliminates many opportunities for concept generation in the later phase. Therefore, drummers that are more open-minded were selected.

For the vertical axis, during the research and out of the personal experience, the common problems that beginner drummer (middle to low skill level) encounter are the learning of contents and skills. They focus less on the product itself (the drum kit) but more on the learning experience. The world of professional drummers holds more of the author’s interest. Therefore, drummers with middle to high skills were selected.

In the mapping (figure 31), the target group is not one selected persona but a range. To have a clear understanding of the final target group, an integrated virtual persona was created to summarize all the essential descriptions (figure 32).

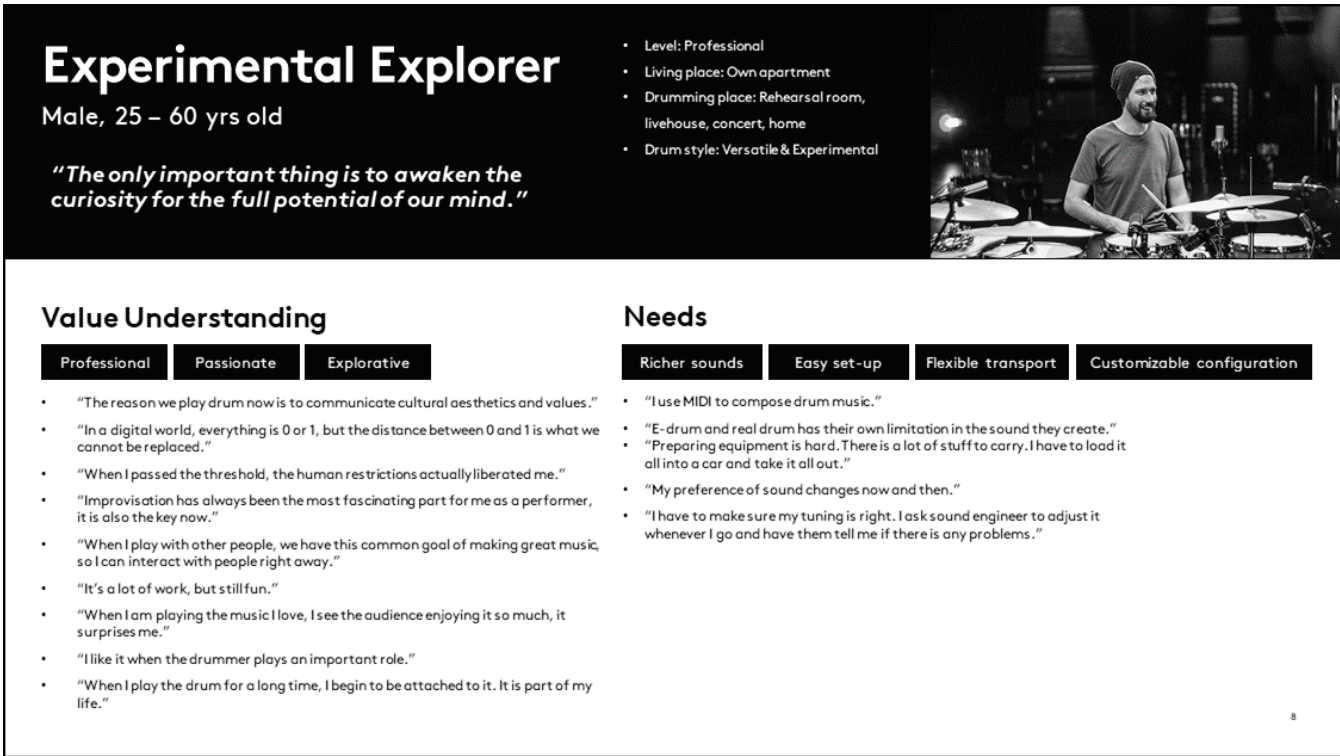


Figure 32 - Target Persona

Problem Definition (Functional Needs)

Two critical problems regarding the current usage of the drum kit were identified during the explorative research:

“Both acoustic drum kit and electric drum kit have their own limitation in producing richer sounds.”
Drummers have this inner motivation to explore and try different sounds. Electronic drum kits offer the possibility of producing artificial sounds. Acoustic drum kits provide the ability to produce the sounds that rely on the authentic interaction with the actual material. Currently, both the electronic drum kit and the acoustic drum kit are limited to the sound production. They are always searching for the possibility to enrich and build their unique library of drum sounds. This needs will be referred as “Richer Sounds” in the following design process.
Related insights: 2, 8, 12, 22

“Current drum kits are not flexible regarding mobility and configurability.”
The flexibility of both acoustic drum kits and electric drum kits does not meet the drummer’s expectation to enable them to play on the same drum kit in different contexts with less effort. There are three critical obstacles to flexibility.

1. The current drum kit is difficult to set up (mobility). The current drum kit has a complex composition of functional components (drum heads, cymbals, standing legs, connection parts, etc.). It is time-consuming and inconvenient to set it up when the drummer moves the drum from one place to another (e.g. from the rehearsal studio to the concert stage). This needs will be referred as “Easy Set-up” in the following design process.
2. The current drum kit is difficult to transport (mobility). After tearing down. The drum kit consists of many components, and the components are heavy and space-consuming for transport. This needs will be referred as “Flexible Transport” in the following design process.
3. It is difficult to change the configuration of the drum kit (configurability). Drummer’s preference for sounds and configuration can change along the time. However, it is difficult for them to update their drum kit or change the drum kit (e.g. the number of drumheads) based on their seasonal taste. This needs will be referred as “Customizable Configuration” in the following design process.

Related insights: 10, 21, 23, 24, 35

Core Emotion (Emotional Needs)

Design is everywhere, and people are surrounded by it (consumer products, digital services, websites, public space, etc.). People are experiencing a constant stream of emotions during the user-product interaction (Desmet et al. (2016)). In this project, an emotion-driven approach was applied to create a design that contains a user experience that can create strong resonance with the user in the emotion level.

Behind every problem the user has, there are always personal motives behind the problem. These motives have many layers, and as it can go deeper until it reaches one of the human’s fundamental needs. This layered structure of analysis can be built using the laddering technique (Gutman, (1982)), of which the basic principle is to build linkages between motives of different levels. The purpose of laddering is to reveal the motive-hierarchy and how these motives link to the emotional value and, eventually, fundamental needs. An example of laddering is given below (see figure 33). Fundamental needs are universal needs human share regardless of cultural background, age, gender, etc. (Ford & Nichols (1987)). A full overview of fundamental needs can be found in appendix 5.

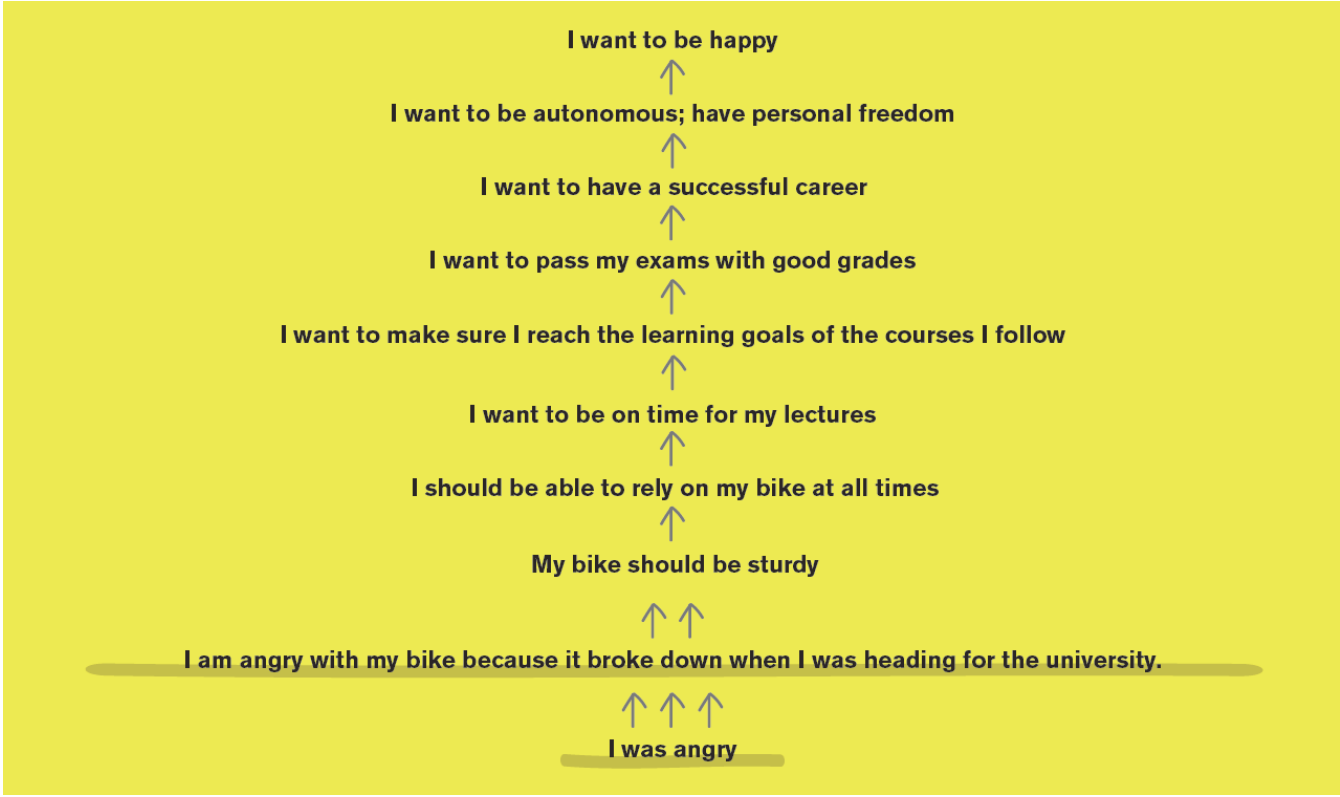


Figure 33 - Example of An Emotion-based Motive Ladder (Desmet, P.M.A., 2020)

Based on the insights summarized from the previous chapter and original quotes from the interview, a similar structure was built for the two defined problems (figure 34).

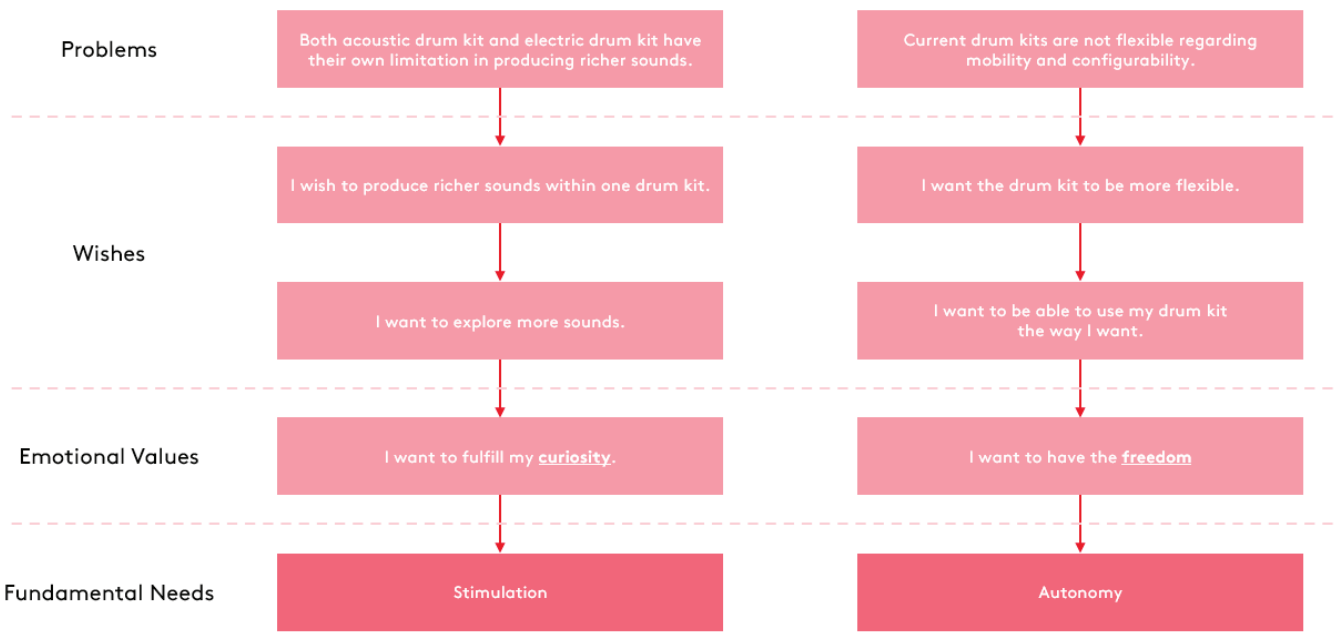


Figure 34 - Emotion-based Motive Ladder for Drummers

As shown in the figure, two chains of motives were built, starting with the two defined problems. Here, two core emotions, each with its own corresponding fundamental need, were identified:

Curiosity (Fundamental Need: Stimulation)

Stimulation refers to being mentally and physically stimulated by the novel, varied, and relevant impulses (Desmet et al. (2018)). Drummers are curious and eager to try out and experiment with different sounds that their drumhead can create. This curiosity is continually driving them to explore different drumming techniques, different configurations, different drumheads.

Freedom (Fundamental Need: Autonomy)

Autonomy refers to being the cause of your own actions and doing things your own way (Desmet et al. (2018)). Drummers are pursuing personal freedom and do not want to be restrained by the current drum kit’s inflexibility. They wish to use their own drum kit the way they want.

To sum up, curiosity and freedom are the two core emotional values identified, which will help build the design vision.

Design Vision

Reflecting the structure with conclusions embedded, Design Vision and Design Goal were established. Design vision describes the imaginary future scenario, in which the design will bring the user to a reasonable level of abstractness approaching from the perspective of emotions. Design vision aims to act as the emotional guideline during the design process and provide the basis of the design story.

“Drummers should be able to freely explore the world of sound to fulfill their curiosity.”

Figure 35 - Design Vision (Pexels, 2020)

Design Goal

The design goal acts as an explicit summary of design purpose, which contains defined problems, target groups, and context. The design goal is more concrete and detailed compared to the design vision. The design goal aims to act as the rational guideline to ensure the design solves the intended problems.

I want to design a hybrid percussion instrument for professional explorative drummers with more sound possibilities, better mobility, and configurability, which allows them to produce richer sounds, perform in different scenarios and customize the configuration with less effort.

Design Guidelines

Design guidelines were created to evaluate the concept later in the process.

The final design must be a physical product.

The final concept could be a physical product with a digital app but cannot be a completely digital product.
Related insights: 30

The use of authentic material is a must for the final design.

For the final design, the use of the authentic material (e.g., wood) is a must. It does not mean that all the components should be wood but means that a good balance between the authentic material and synthetic material (e.g., plastic) should be reached.
Related insights: 6, 9, 11, 17, 31

The final design should be tuned more quickly, with less effort than the usual acoustic drum kit.

Related insights: 20

The essential user-product interaction has to stay the same.

For the final design, the user will still use the drumstick with percussion interaction on the surface of the product (drumming). In the meanwhile, their feet will control the pedals. This four-limb (hands and feet) and second-hand (drumming with the drumstick) interaction will stay the same.
Related insights: 1,33

The user should be able to change the configuration of the product (if the final concept is a drum kit).

The user can change the number of percussion surfaces (whether it is the tom drum or the cymbal) to fit their drumming habit.
Related insights: 3, 4, 10

- CHAPTER 4 - DESIGN

Overview

The design process is full of challenges and not as smooth as expected. There were much back and forth along the process to find the design directions that is satisfying. Although the process is messy in between, the overall direction is always correct with the guidance of the design vision and design goal generated in the synthesis phase. The footprint of the ideation phase could be visualized, as shown below (figure 36). This chapter will describe the methods used during the ideation phase to generate concepts.

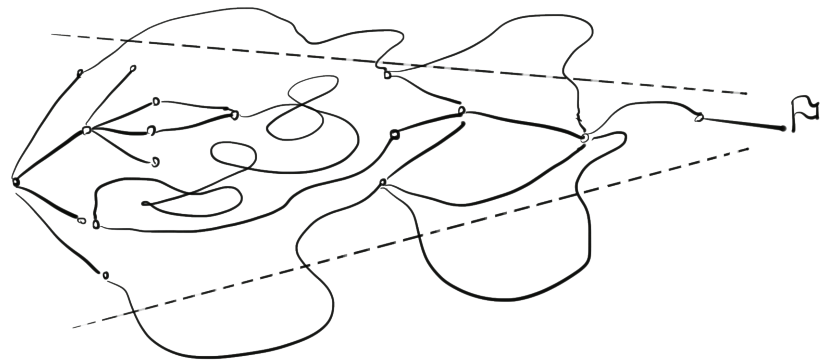


Figure 36 - Design Phase Footprint

Structurally, the overall ideation process consists of one creative session, preparation, and three rounds of design circle. Design methods were applied in between such as creative facilitation, mood board, metaphor, etc. The methods used will be described along the process. An illustration of the ideation process can be visualized as below (figure 37). The ideation started with a creative session trying to generate some innovative initial ideas towards the design problem, and the final design idea was chosen after the session. Then some preparation work was done before starting designing. A quick model was built, and an additional interview with the real drummer was conducted to discuss and improve the user journey of the chosen design idea. After the preparation, the design circles began. For each design circle, two or three rough concepts were created, followed by a design critic session. In a design critic session, the concepts were presented to three or four designers inside the company. Critical questions were asked, and feedback was given for the next step. Three concepts were finalized after the third round of the design circle.

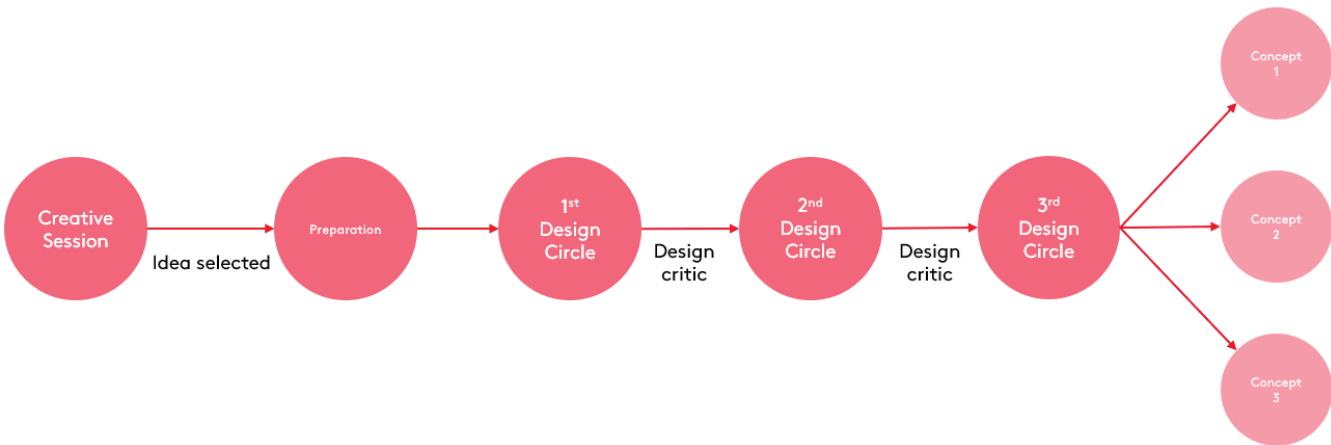


Figure 37 - Design Phase Process Overview

Creative Session

At the start of the ideation phase, two creative sessions were conducted inside the company (Figure 38). Since there are two problems included in the design vision, one wish was addressed for each session. The creative session aims to find a new perspective towards the defined problem to find some innovative ideas. The process of the session was designed based on the Creative Problem Solving (CPS) model (figure 39, Tassoul, 2012). The session aims to reach the end of the second diamond in the figure. The detailed document can be found in appendix 6.

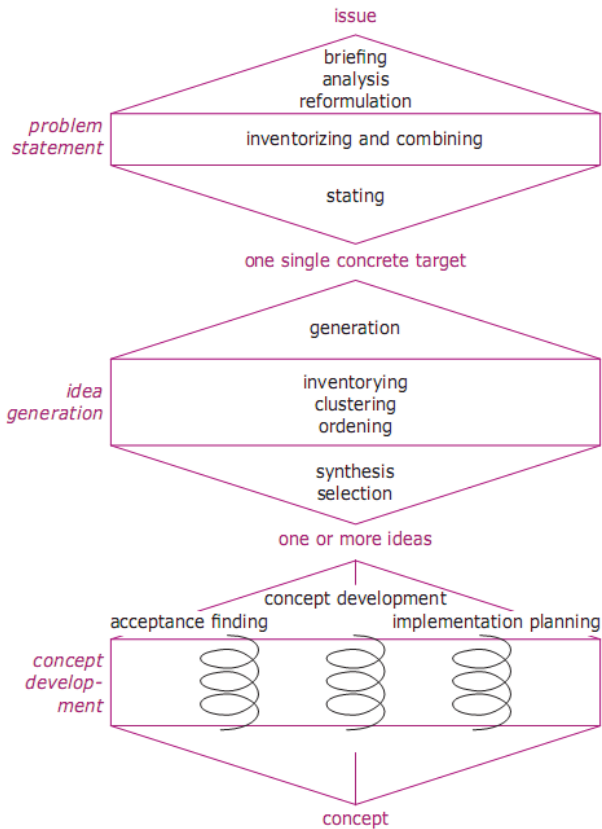


Figure 39 - CPS Model (Tassoul, 2012)



Figure 38 - Ideation Session

Setup

Participants

5 participants (4 designers at Phoenix Design + author)

Duration

1 hour

Material

Presentation documents, printed out mood pictures

Procedure

1. Briefing

Introduce the project background, the aim and the expected outcome of the session, and the rules

2. Redefining the problem

One “How to” question was provided based on the wish. Participants were asked to rewrite a “How to” question on the post-it from a new perspective, which could solve the original “How to” question. Then all the post-its will be stuck on the wall and clustered into different topics. After discussion, one topic was selected, and the group created a new “How-to” question.

3. “Shedding the known”

“Shedding the known” means collecting all the “obvious” answers. The method used here is “Brainwriting”. Participants were asked to write down or sketch all of their ideas on the post-it towards the new “How to” question.

4. “Purge”

“Purge” means coming up with ideas that are not “obvious”. The methods used in the session including “Hidden Presumptions” and “Superhero Act”. The detail of the method can be found in appendix 6. The mood pictures can be found in appendix 7.

Results

Both the newly-defined “How to” questions and the ideas were collected, evaluated, and clustered (figure 40).

Five exciting ideas were generated from the results. There are three ideas for problem 1 and two ideas for problem 2.

Problem 1: Richer Sounds

Fun Drumming

The idea started with one of the new “How to” question (How to make drumming more fun). Another layer of interaction or real-time interaction could be added for the drummer to control the sound they created.

Negative Creation

During the session, one participant said that she once learned to paint with the eraser. She used the erase to draw out what she wants to draw on a paper covered with pencil marks. This description raised an interesting question about whether the drumming could become a similar activity: the sound is created negatively. However, this idea is quite abstract compared to other ideas.

Sound Capture

For every drummer, the sound they want is different. What if they can capture the sound that they want by themselves? For example, they could use a pair of smart drumsticks, which can act as a sound collector. In this way, drummers are liberated to explore the outer world to build their own sound library.

Problem 2: Same Drum

Smaller Emotion Touchpoint

Now it seems that the drummers are emotionally attached to the whole drum kit, which is enormous. Maybe this emotional touchpoint could be reduced. For example, the touchpoint could be reduced to only the snare drum by designing.

Easy to Transport

This is a practical direction to solve the problem. A new structure or new mechanism could be found to make the drum kit more easily to be transported.

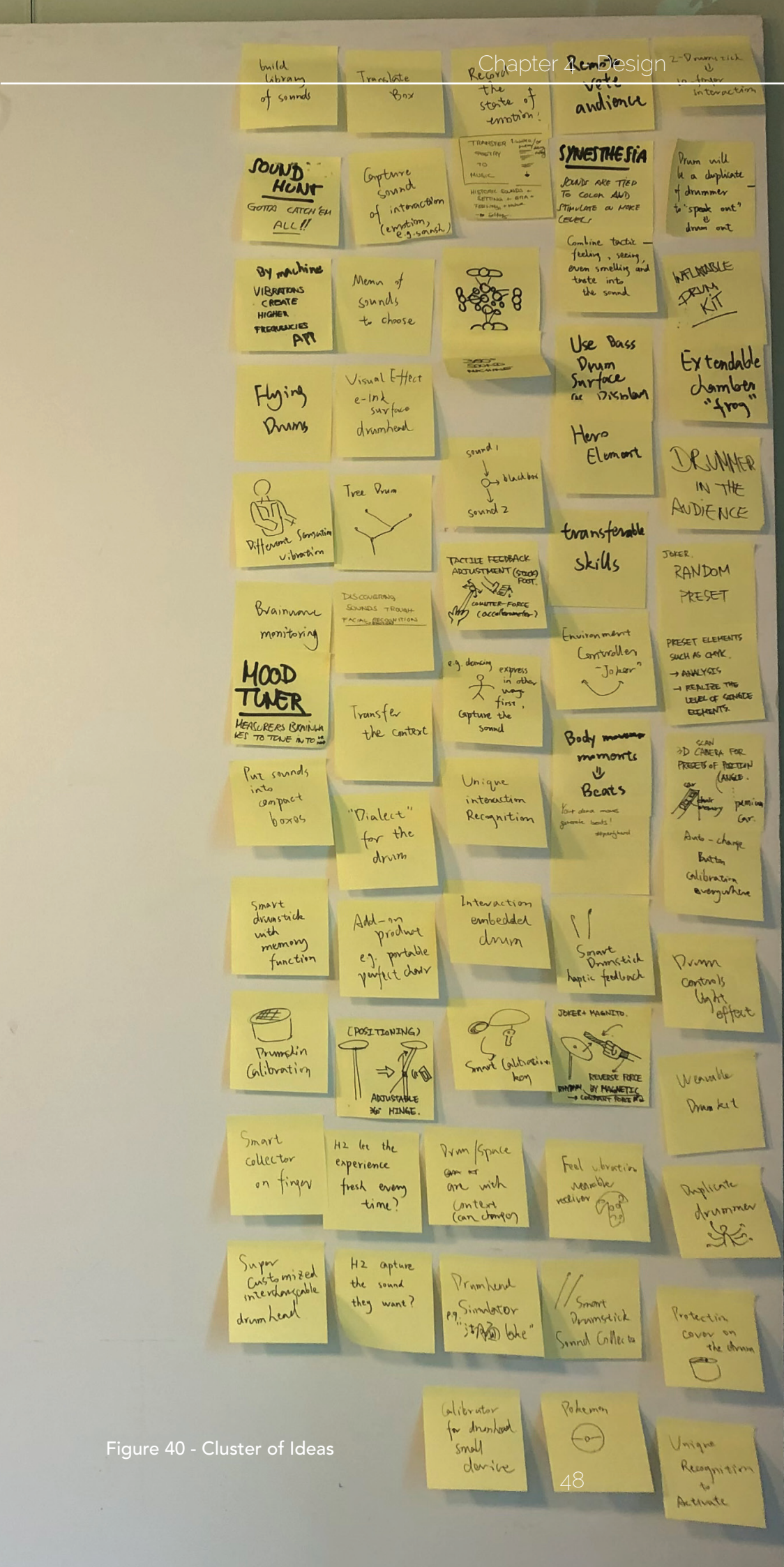


Figure 40 - Cluster of Ideas

Final Idea

The ideas were mapped based on the practicality and the level of innovation (figure 41) and discussed with other designers and real drummers.

For the first problem (how to enable drummers to produce richer sounds), the idea of sound capture is both innovative and practical. It allows the drummer to become the sound collector and the sound designer of his own drum kit with the available sound recording technology.

For the second problem (how to enable the drummer to always play on the same drum kit), from the mapping, it seems that “smaller touchpoint” should be chosen. However, after discussing with the real drummer, they are obsessed with possessing the whole complete piece of instrument. This small touchpoint is not convincing to be further developed.

To sum up, the final idea consists of two main features:

- 1. *Smart drumsticks that can collect sounds.*
- 2. *A drum kit that is easy to transport.*

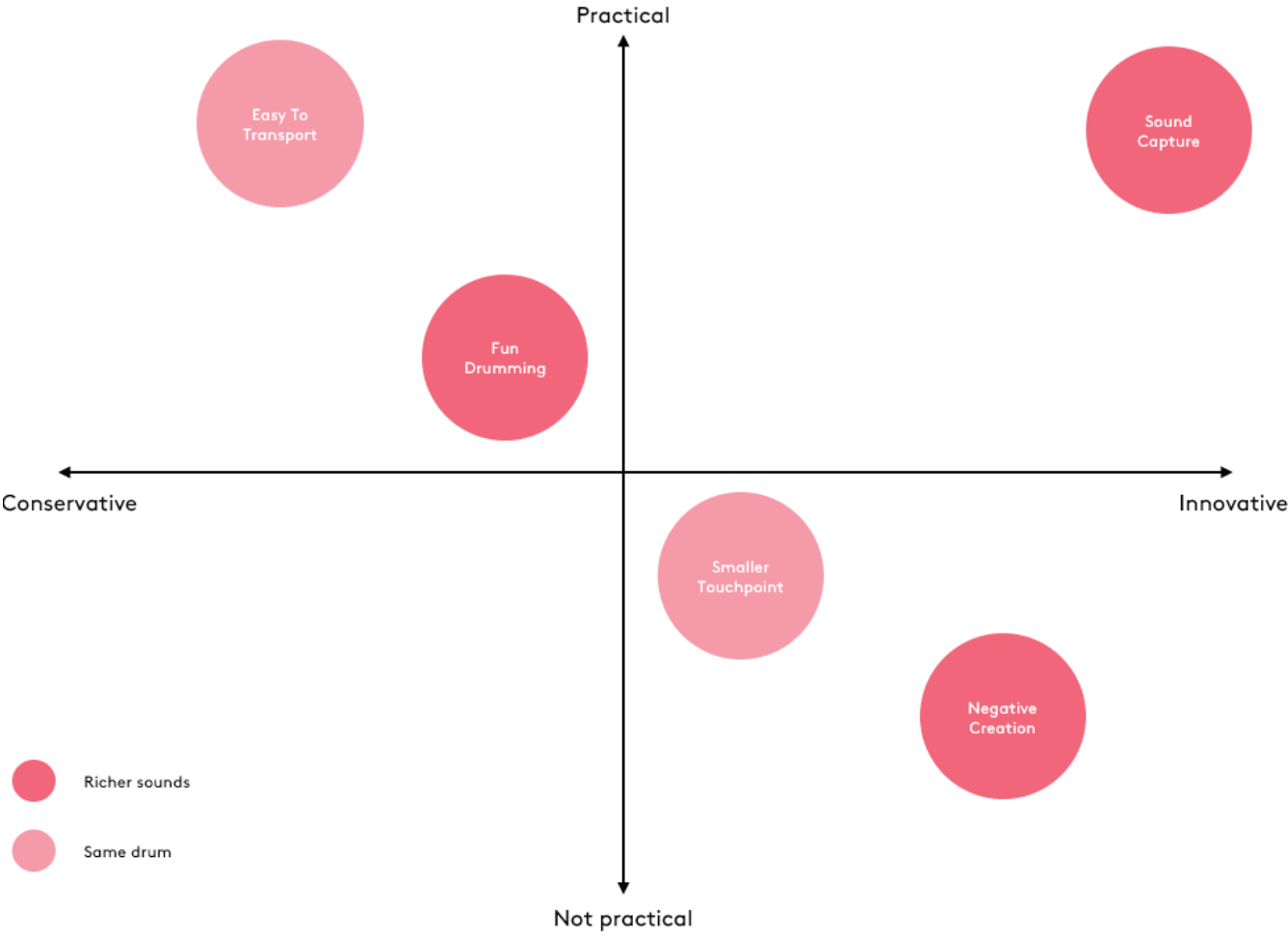


Figure 41 - Mapping of Ideas

Preparation

Quick Modelling

A cardboard prototype was built at the start of ideation (figure 42). The proportion of the prototype is 1:1. It consists of the elemental composition of the drum kit: one hi-hat, a snare drum, two toms, a floor tom, and a crash cymbal (from left to right). The purpose of building this prototype was to give a visual reference to the real drum kit and demonstrate the space for a real drum kit. The prototype helped a lot during the ideation process for many usages, e.g., quick ergonomic test, visual & three-dimensional thinking, photos as sketching template, etc.

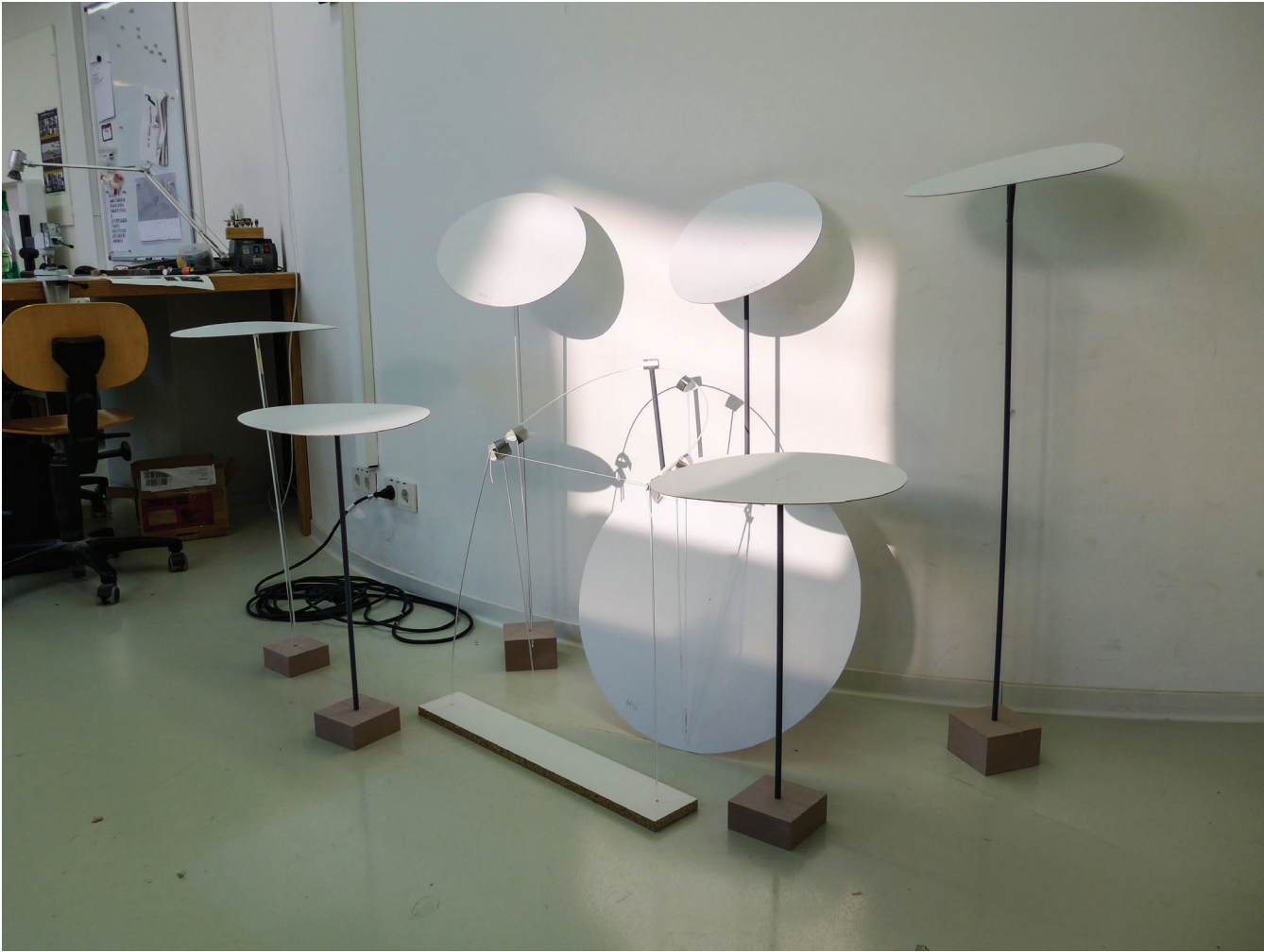


Figure 42 - Quick Modelling

Additional Interview

Before entering the design circle, an additional interview was conducted to clarify the user journey of the design idea of using the drumstick to collect sound. The idea was discussed with drummers, and several key questions were asked:

- How do drummers see the relationship between the outcome of the project and the current drum kit?
- What functions are required for a professional sound sampling process?
- What other concerns do drummers have?

Feedbacks were given, which helps to make the idea more concrete, and the key takeaways are shown as below.

The drummer perceives this future concept as a conceptual and experimental “percussion kit” instead of a new version of the “drum kit”. Since the drummer is the sound editor of his own kit, there may not be any difference between the drumhead and cymbal. In this way, there is also no need to try to keep the 100% original layout of the drum kit.

Drummers usually will not use the sound collected directly. For these professional drummers, they want to be able to configure the sound collected.

Drummers want to involve as less third-party software and hardware as possible. Collecting the sound and later turn to the laptop will make the whole idea less meaningful. The design itself should be able to create this closed user journey loop. For example, the current electric drum kits always come with a drum module that can configure each drumhead’s sound. This module could be a product for future reference. A complete initial user journey was created as the basis of design (Figure 43).

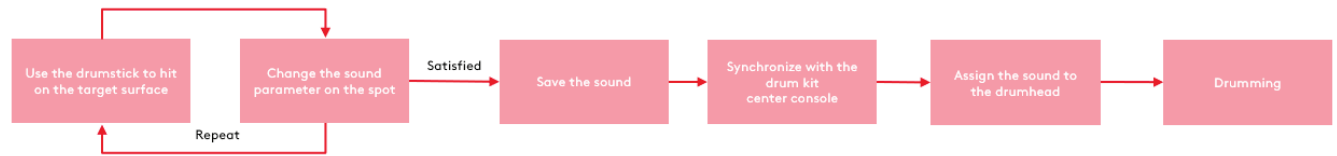


Figure 43 - User Journey

Design Circles

1st Design Circle

The focus of the first design circle was on the drum kit itself. The purpose is to solve the problem by redesigning the traditional archetype of the drum kit. Here, a metaphor-driven method was used.

Like the artist who uses the pen to dip the color pigment and draw on their canvas, drummers use their drumstick to collect sound and perform on their drum kit. For the drummer, the drum kit is the blank canvas for them to show their creativity. Under this metaphor, the drum kit can be perceived no longer as a stack-up of the circular elements but a large, continuous surface. Inspired by the BMW Gina (figure 44), which car body is covered with unique fabrics, the geometrical shape of the body is driven by the internal frame structure.

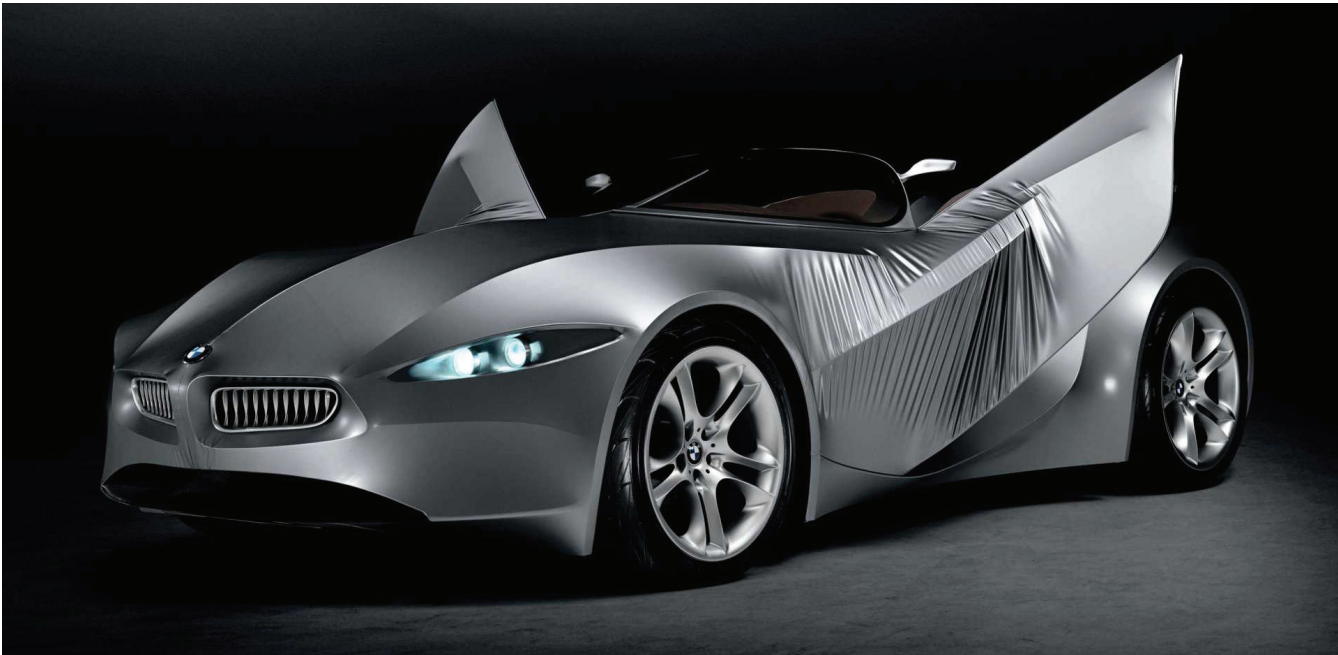


Figure 44 - BMW Gina (Car.info, 2020)

Compared to BMW Gina, it can be imagined that all drumheads are no longer separate circles but a surface as a whole. When it is not in use, it is just a surface, and when it is in use, the internal structure could pop up to form the drumhead (figure 45). Based on this idea of “surface”, two concepts were created.

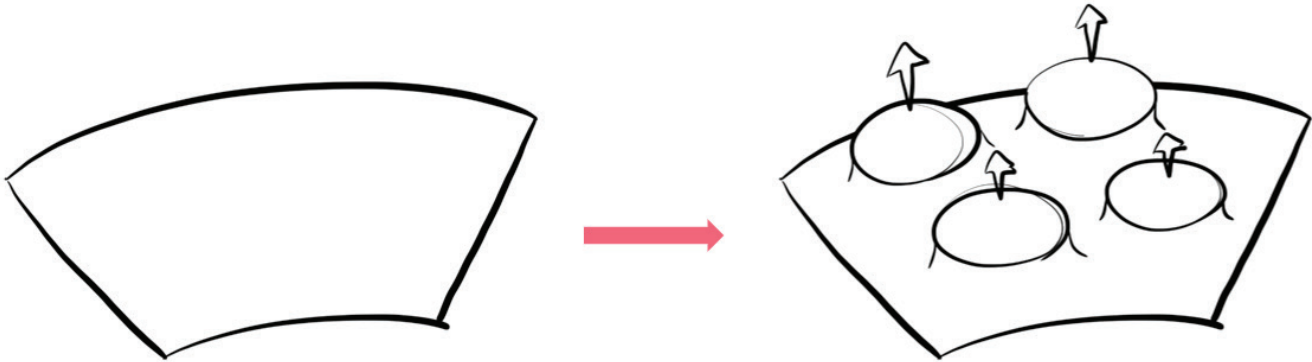


Figure 45 - Idea of Popping Up Surface

Concept 1 - Floating Canvas

The first concept (figure 46) tends to give a minimal feeling, as is shown in the mood board (figure 47). The new archetype consists of three layers: the top surface (drumming area), the legs, and the base (foot pedals). In this way, the drum kit contains fewer components and is easy to set up.

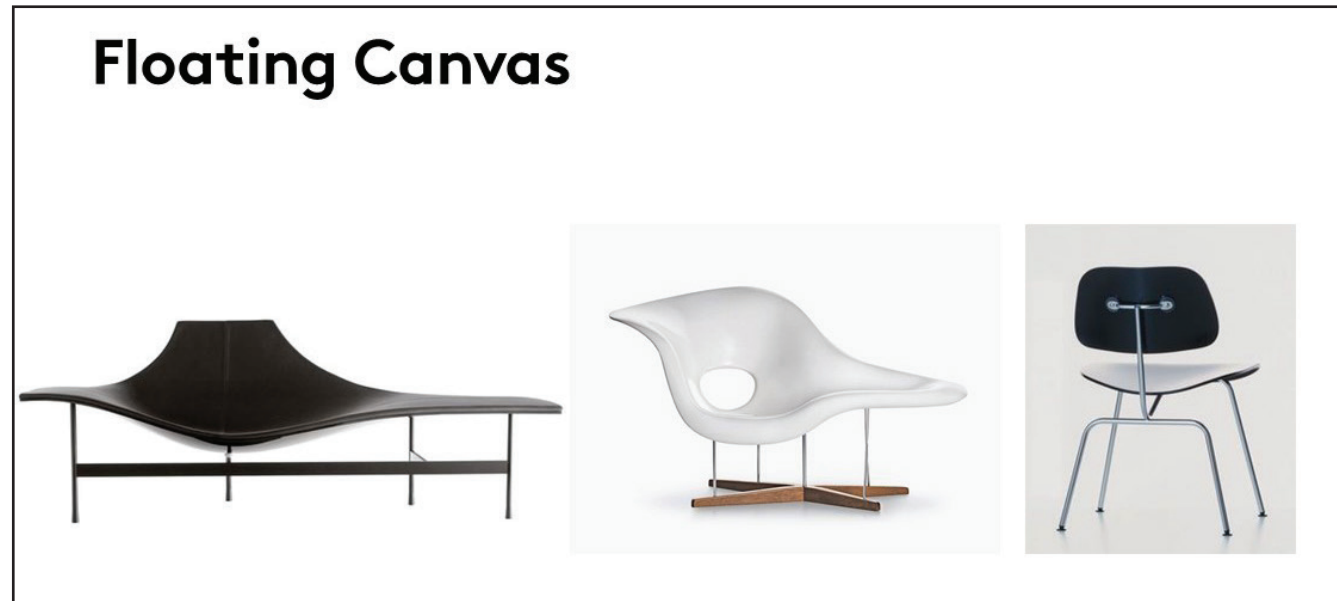


Figure 46 - Mood Board for Concept 1

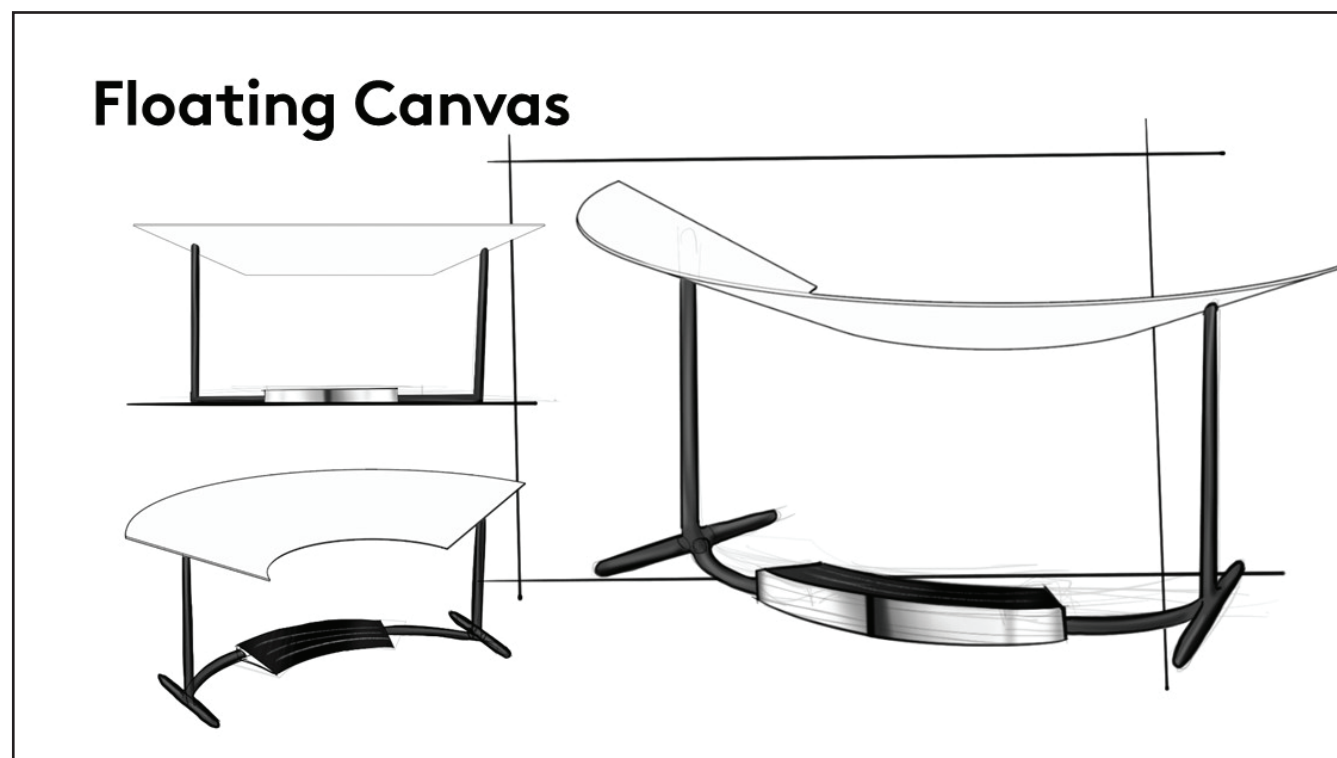


Figure 47 - Concept 1

Concept 2 - Iconic Circle

Based on the simple three-layer archetype, concept 2 (figure 49) wants to keep some original elements from the current drum kit. For a traditional acoustic drum kit, the most eye-catching element for the audience is the bass drum, which appears as a huge circle at the center. Here, this circle was added as a functional element – speaker, which tries to keep this iconic visual element while approaching with a new archetype. The circular element can have a powerful visual effect, as shown in the mood board below (figure 48).

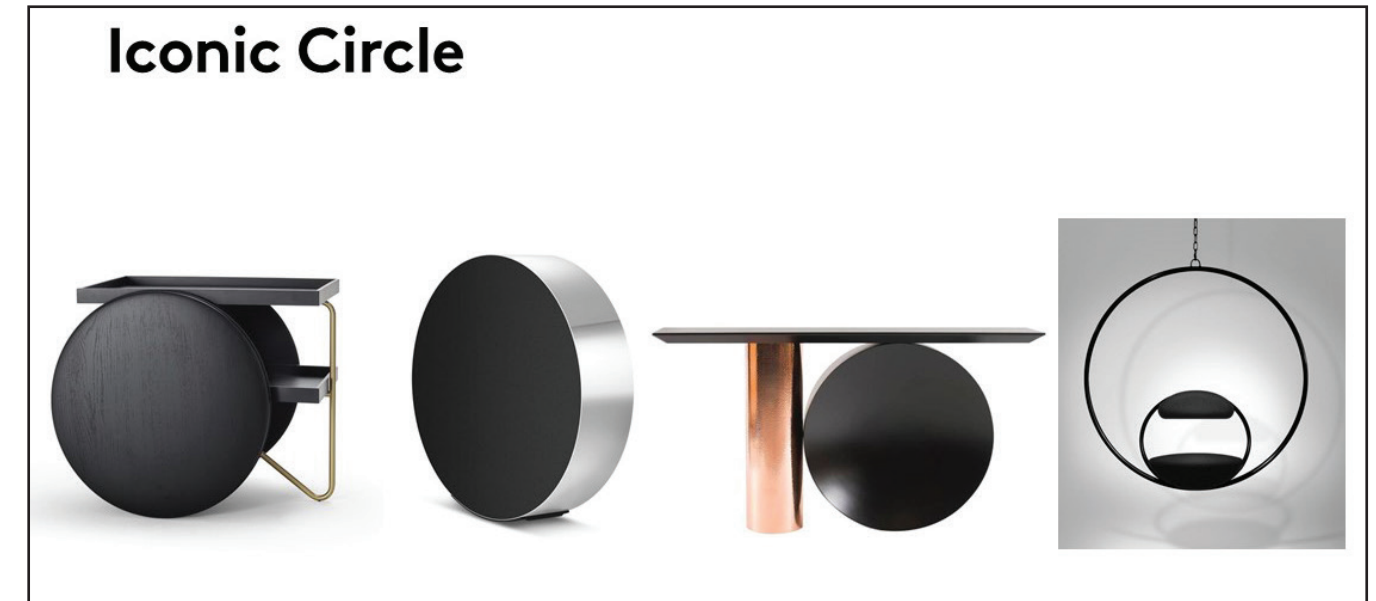


Figure 48 - Mood Board for Concept 2

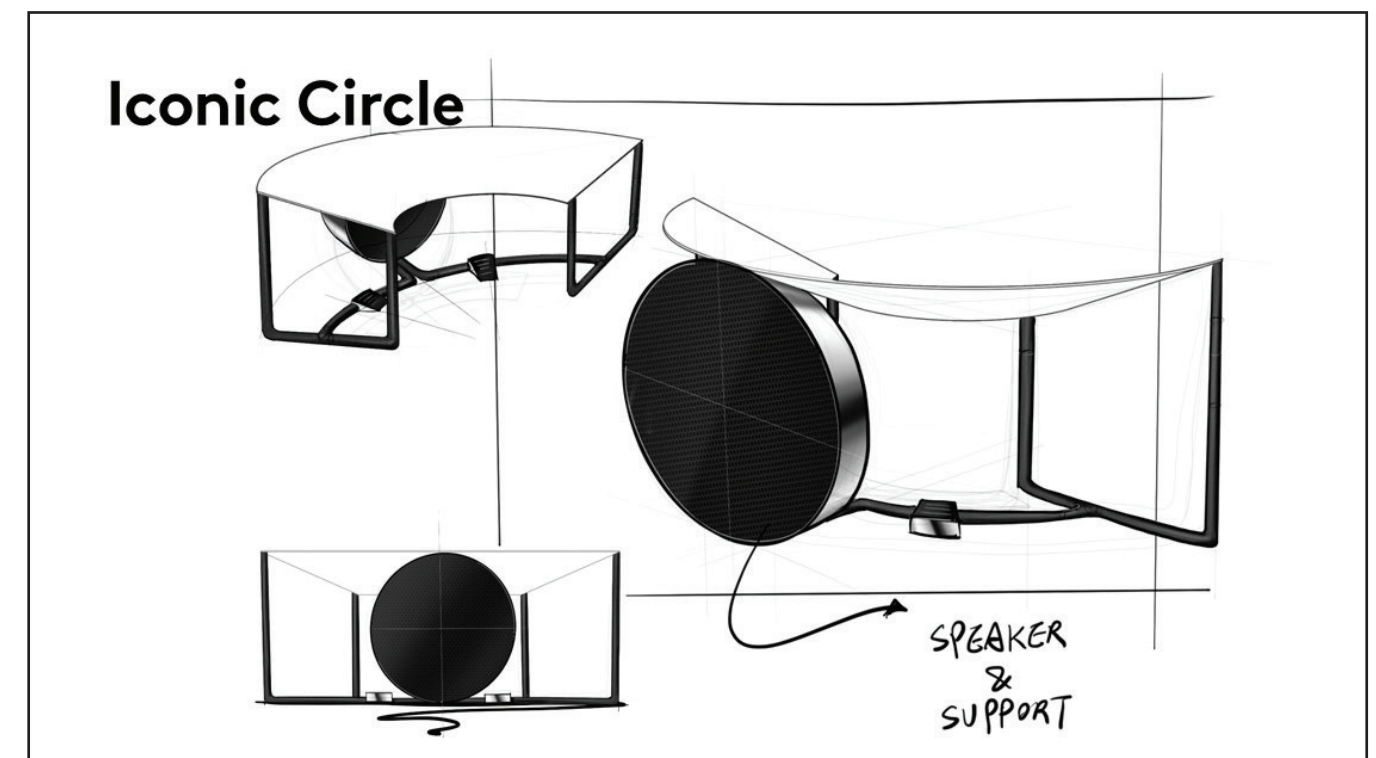


Figure 49 - Concept 2

Design Critics

During the first design critics, the result was far from satisfying. Many critic feedbacks were given, and the key takeaways are listed below:

- The diversity of the range of the concept is too limited. It seems that the designer was obsessed with this "floating surface" idea. More ideas and directions should have been explored.
- The technical or mechanism is not considered clearly for this idea. Both of the concepts are not convincing to work with such a thin surface on the top. It is not comparable using the same hydraulic motor mechanism as in BMW Gina. The technical stack-up does not have to be proved fully working but should be considered and presented convincingly.

2nd Design Circle

Based on the feedback of the first design circle, the ideation of the second round started with considering the technical practicality and exploring diverse directions. In this round, three concepts were created.

Concept 1 – Breathing Surface

The first concept followed the "canvas" idea presented in the first design circle. This time, the technical mechanism was considered trying to make the concept work. The concept still has the three-layer archetype and is easy to set up (figure 50).

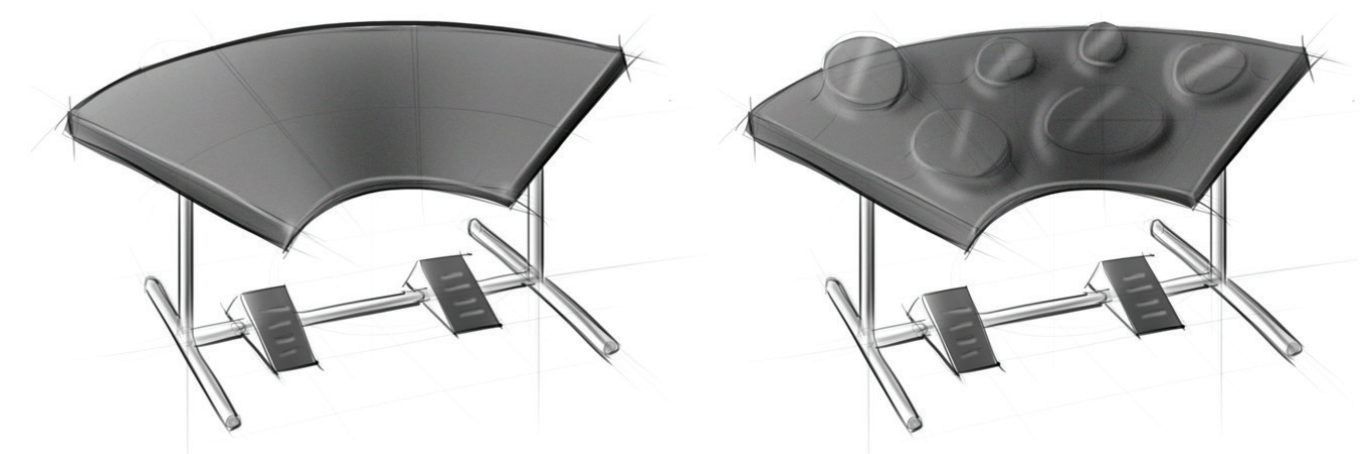


Figure 50 - Concept 1-1

The idea stays the same that the internal structure will pop up to form the drumhead when in use. Beneath the fabrics on the surface, the baseboards have a matrix of connection points where the detachable drumhead could be inserted. A small electric motor is embedded in each drumhead (figure 51).

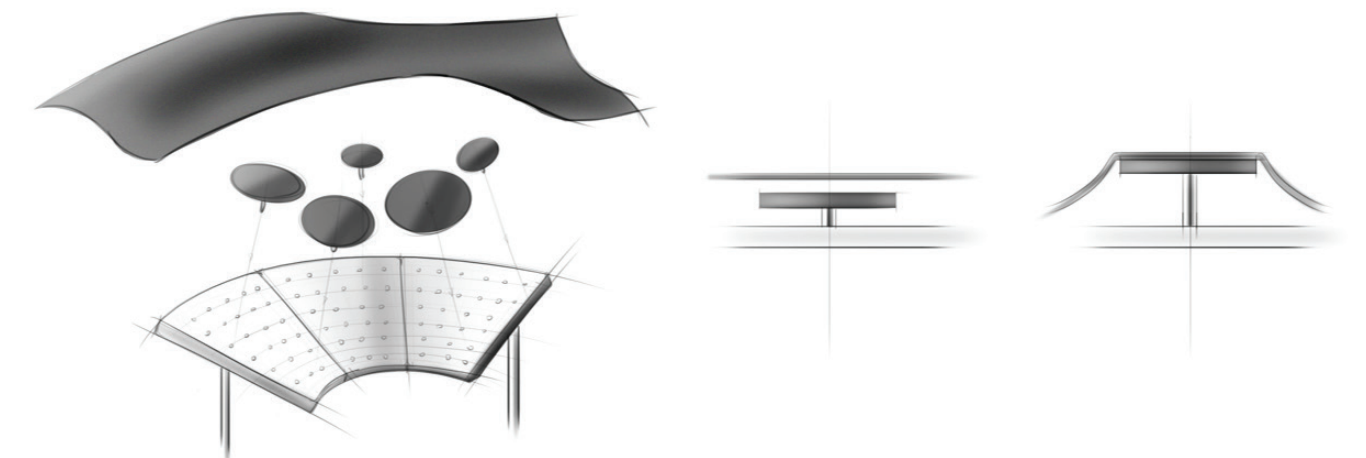


Figure 51 - Concept 1-2

The drummer can arrange their own layout of drumheads within the same area of the surface space by merely rearranging the detachable drumheads. They can choose drumheads with different sizes and also decide how many drumheads they need (figure 52).

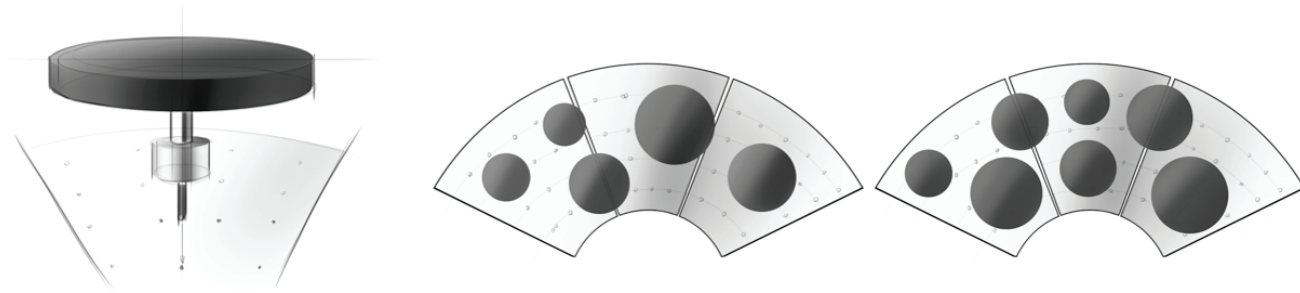


Figure 52 - Concept 1-3

Besides, the baseboards are modular. Drummers can expand their drum kit by adding modular baseboards. They can go up to a 360-degree drum kit if they want (figure 53).

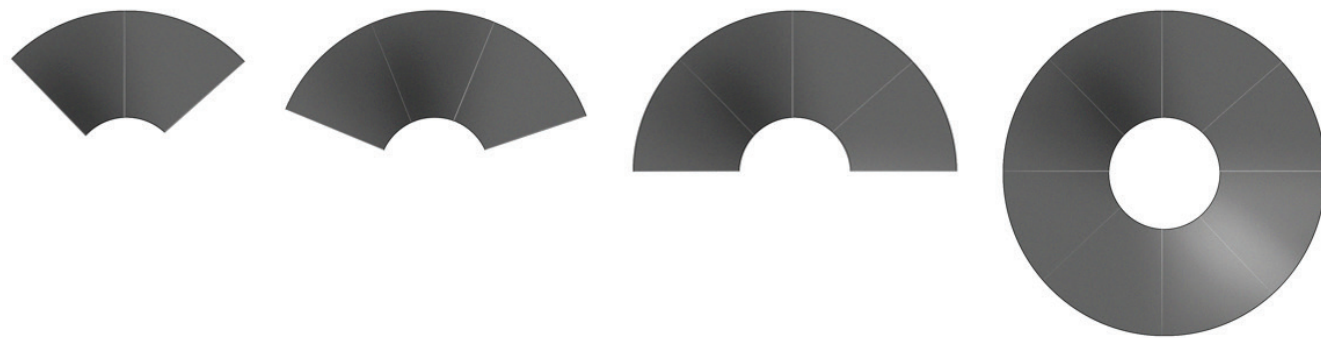


Figure 53 - Concept 1-4

Concept 2 - Tessellate

The second concept was inspired by the tessellated structure which is used in ISSEY MIYAKE bag, which is a combination of hard material with the flexibility (figure 54).



Figure 54 - ISSEY MIYAKE Bags (EDELSCOPE.COM, 2020)

The use of tessellated structure offers the possibility to achieve a similar “canvas surface” idea in a geometrical way (figure 55). In this concept, when not in use, the drum kit can still be a flat surface. When it is in use, the legs can uprise, then the surface itself can form faceted geometry (figure 56). Each segment is a drumhead contains one sound.



Figure 55 - Concept 2-1

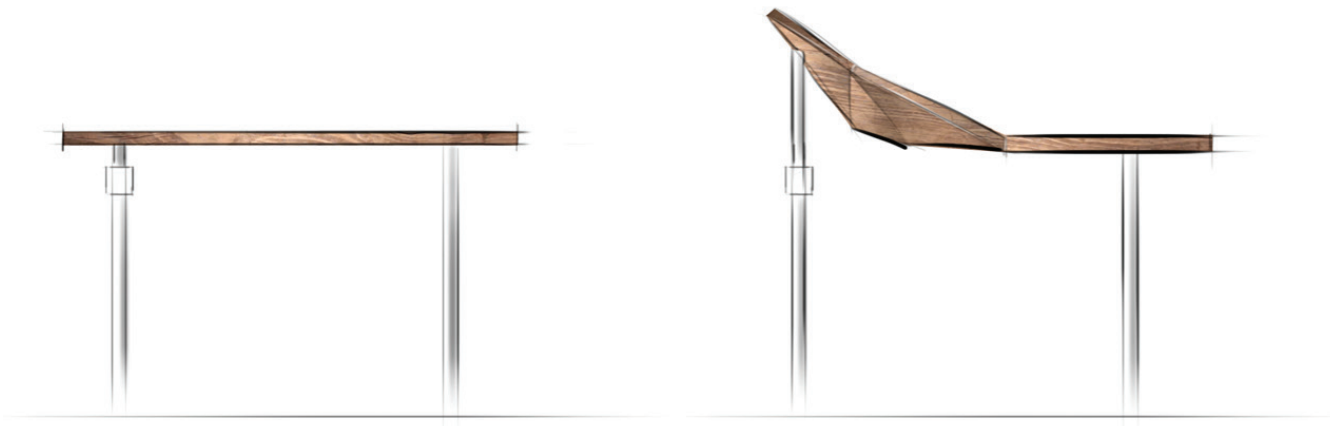


Figure 56 - Concept 2-2

For the technical structure, this tessellated plate consists of the drumming surface (rubber-like material with a sensor underneath, same as the electric drum kit) and the base material (figure 57). One feature of this design is that the base material can be customized. Drummers can choose the material which reflects on their taste. This material is a crucial visual impression for the audience.



Figure 57 - Concept 2-3

Concept 3 - Flowing Lines

The third concept was inspired by the frame-structured chair (see mood board, figure 58).

Flowing Lines



Figure 58 - Moodboard for Concept 3

Different from the other two concepts, the archetype of the concept 3 consists of the "skeleton" structure and the detachable drumheads.

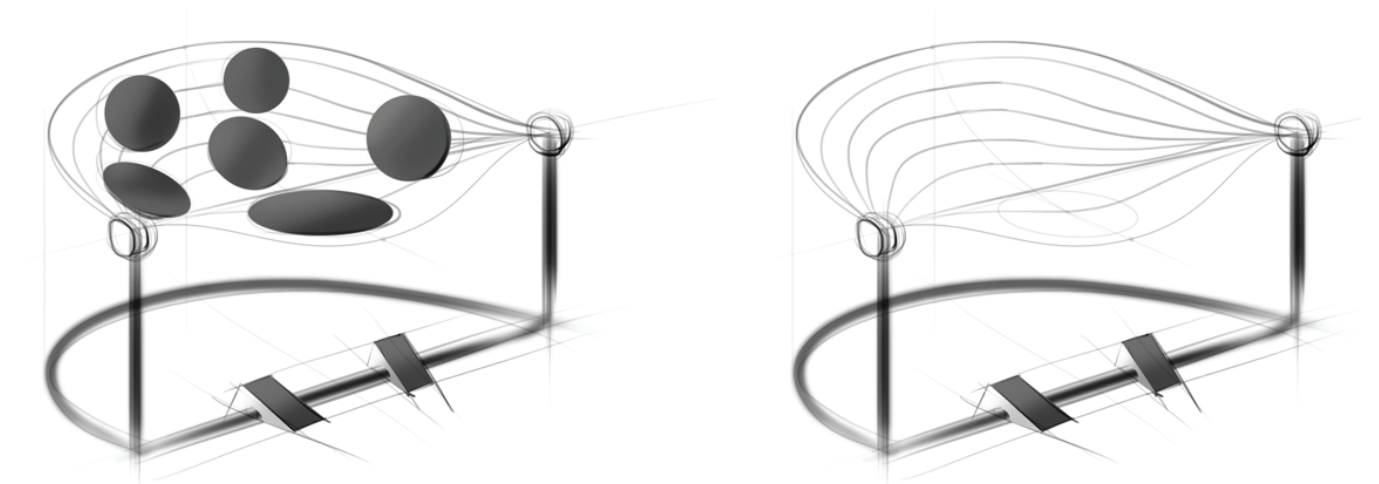


Figure 59 - Concept 3-1

The drum head is detachable and movable on the frame with a hinge to fix the position. Drummer can adjust the layout of the drumhead as they want.



Figure 60 - Concept 3-2

Design Critics

During the second design critics, the ideas are more diverse, with technical solutions considered. The overall result was improved compared to the first round. However, there are still many problems existing:

General Feedback

It is good that diverse ideas were explored this time.

Some sketches are lovely, but some of them are difficult to understand. Corresponding mood pictures could be used to demonstrate the idea if the sketch does not help or if some details are only placeholders.

Concept 1

- The idea of modular design and the configurability is convincing in this concept.
- The idea of keeping the fabrics here contains no functional value. The existence of the fabrics is only for the decorative purpose, which is not convincing.
- The small motor in each drumhead is to fulfill the uprising function. It is not worth the effort. Besides, the solution to having motors in every drumhead seems not considerate.

Concept 2

- The idea of having a different material as the base material to create customizability is good.
- This geometrical approach is new, but it is tough to convince the drummer it is a percussion instrument.
- This acutely angled and pointy visual impression is too strong, which is not convincing for the choice of the style.
- It is hard to imagine to adjust the leg to uprise to activate the drum. The interaction is not convincing.
- Drummers cannot change the configuration in this concept, which is not aligned with the design goal.

Concept 3

- This archetype is refreshing compared to the current drum kit (the skeleton with detachable drumheads).
- The freedom of configuration is high in this concept, which is convincing.
- This concept has not shown its full potential here. Different ways of the frame structure could be explored.

To sum up, concept 1 and concept 3 both have the potential to explore more, while concept 2 is off the direction. In the third round, ideas based on concept 1 and 3 will be further explored.

3rd Design Circle

Method

Based on the learnings from the second design circle, three concepts were created. In this round, metaphors were used to deepen the design story. The design logic is shown below (figure 61).

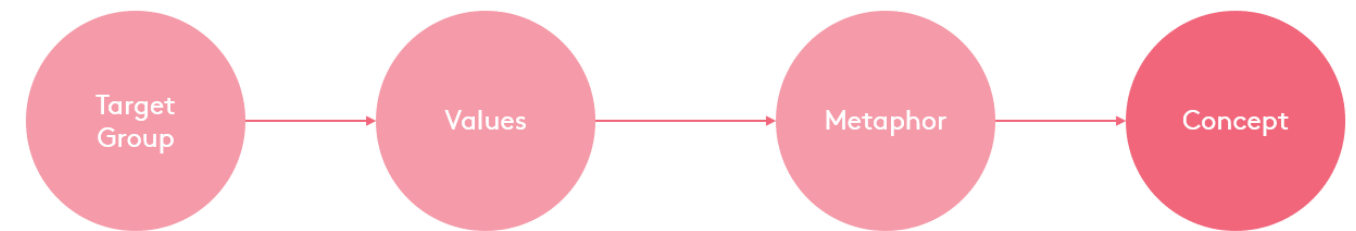


Figure 61 - Design Logic for the 3rd Design Circle

Three values were identified based on the target group:

Professional

For these professional drummers, drumming for them is not a hobby. It is also their job and life. They are professional and have lots of technical knowledge of drums and music. They are serious about drumming.

Passionate

Just like every musician, drummers are passionate about drumming. They love what they do. They are completely immersed in the world of sound while drumming. They are full of emotion and eager to communicate with the audience.

Explorative

Drummers are curious and explorative. They have the inner drive to continuously look for new percussion gig, new sound to enrich their sound library.

Based on these three values, three metaphors were created, with each one emphasizing one value. The concept follows the metaphor.

Concept 1 - “Professional Scientist”

The first metaphor is “scientist”. The same characteristic shared by the scientist and the drummer is that they are both professional. They are the expert of what they are doing. In this way, drummers could be perceived as the scientist of the percussion.

The first concept consists of two plates acting as the drumming surface and foot pedal area, respectively. The shape is bold and straightforward with a precise metal frame to emphasize the professional value.



Figure 62 - Concept 1-1

The top plate is a hybrid of interactive display and drumming surfaces (figure 63). The idea is that the user could change the layout (the amount and the position of the drums) through physical interaction, e.g., long press on display to locate the center of the drumhead and then drag and drop it, pinch and un-pinch to change the size of the drumhead. The user could easily change their configuration.



Figure 63 - Concept 1-2

When not in use, the top plate can be rotated to the vertical position to save the space and indicate a “not-in-use” state (figure 64).



Figure 64 - Concept 1-3

The control hub of the drum kit acts as a remote control and attached to the frame through magnetics.

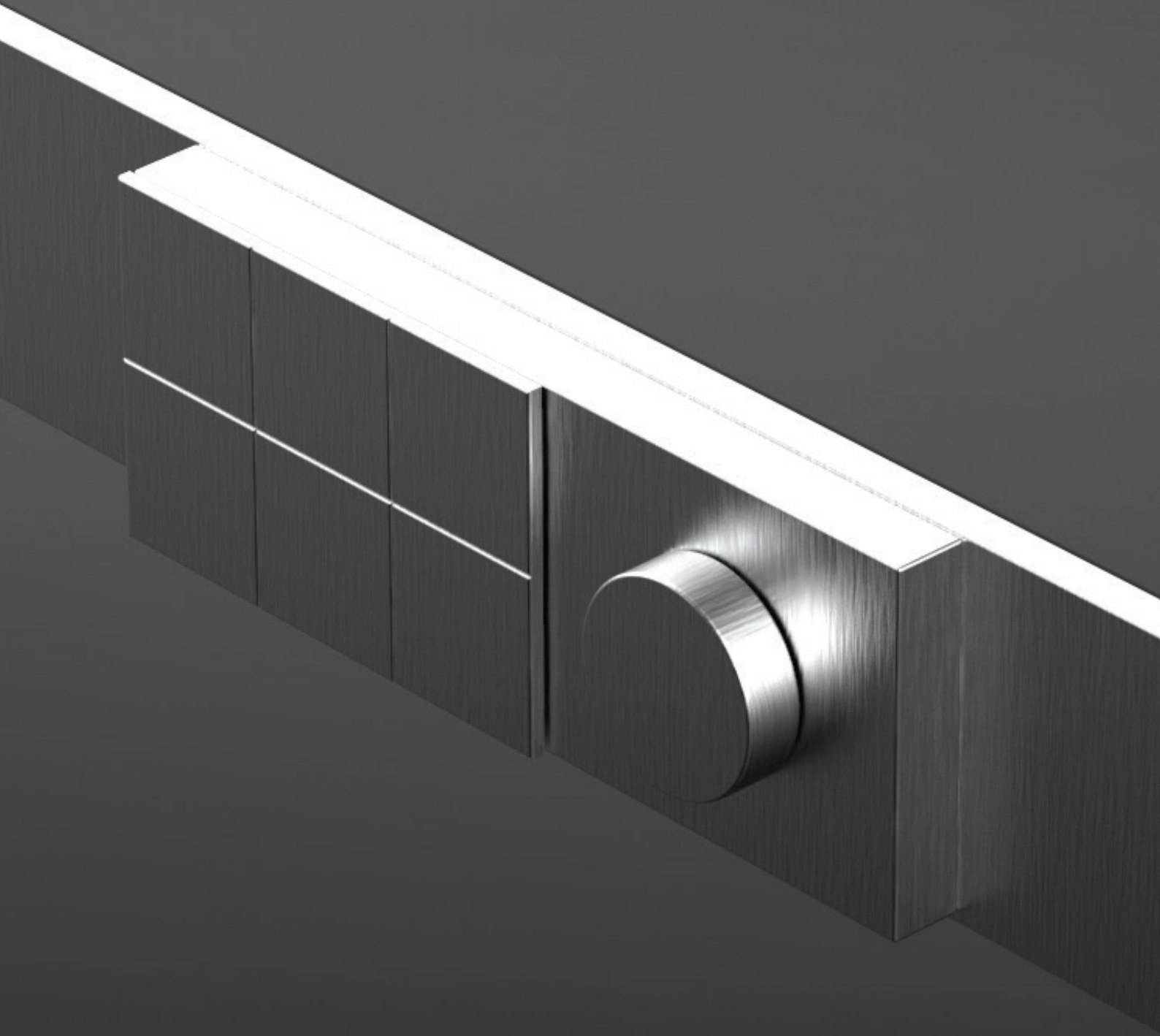


Figure 65 - Concept 1-4

Concept 2 - “Passionate Boxer”

The second metaphor is “boxer”, which emphasizes the value – passionate. Like the boxer, drummers are full of passion and have this dynamic characteristic during their performance. The shape was inspired by the martial art training station. Similar to a tree, drums are like the branches all come from the main stem. The base plate acts as both the foot pedal and weight to stabilize the whole drum kit.

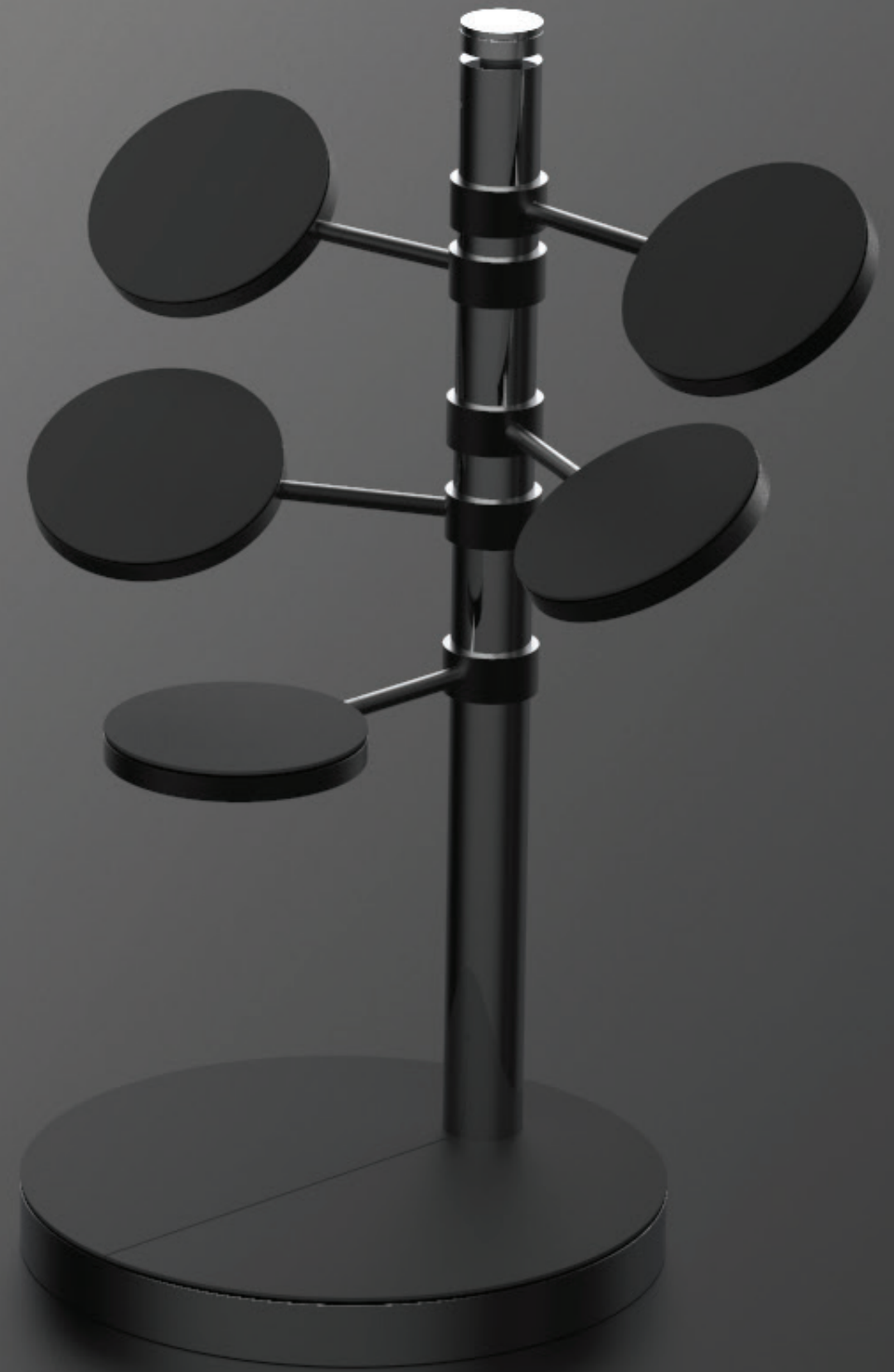


Figure 66 - Concept 2-1

With the 3-dimensional structure, drummers could move and rotate the drum along the stem and rotate the branch to adjust the position.



Figure 67 - Concept 2-2

The stem also acts as a central speaker with the remote control hub resting on the top.

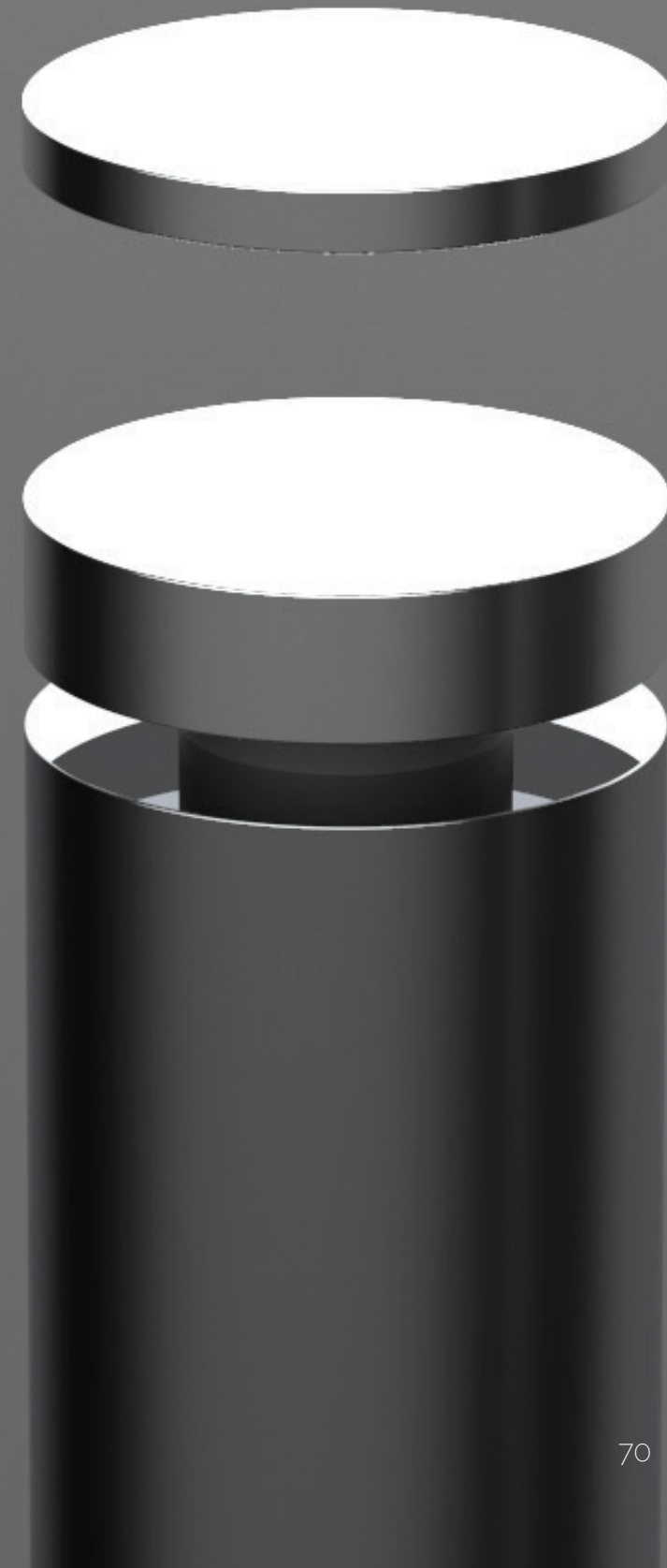


Figure 68 - Concept 2-3

Concept 3 - “Explorative Collector”

The third metaphor is “collector”, which emphasizes the value – explorative. In this story, the drummer is not only the performer but also the collector of the sound. With their intrinsic explorative characteristic, they are eager to go out to collect sounds. Following this logic, for drummers, the drum kit is more than an instrument. It is their showcase of the sound. The form was inspired by the bookshelf.

The drumheads, control hub, and foot pedal are all hung on the frame. The drummer can adjust the position themselves.

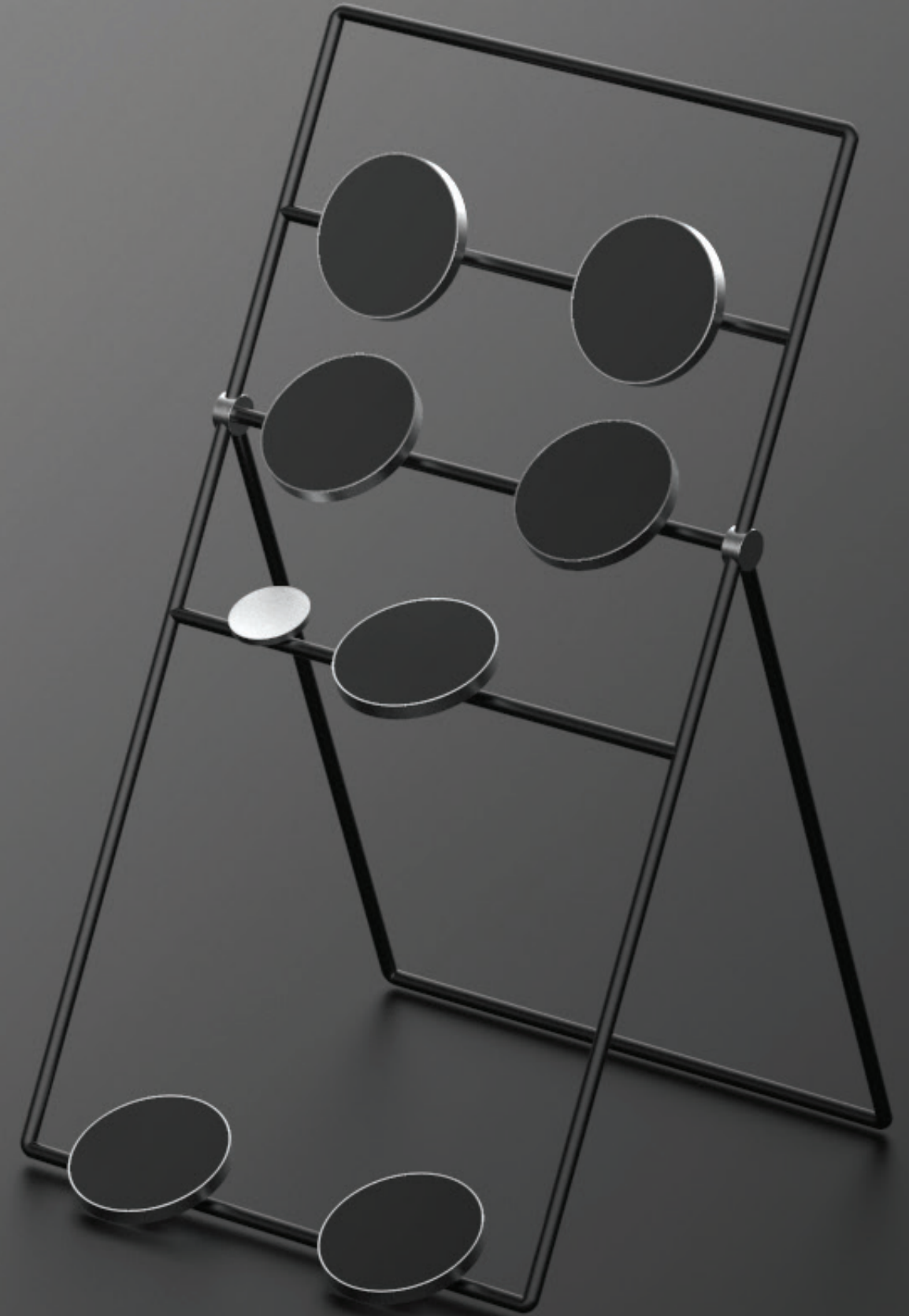


Figure 69 - Concept 3-1

With a similar mechanism of the ladder, the drum kit could be folded when not in use to save space and for transport.

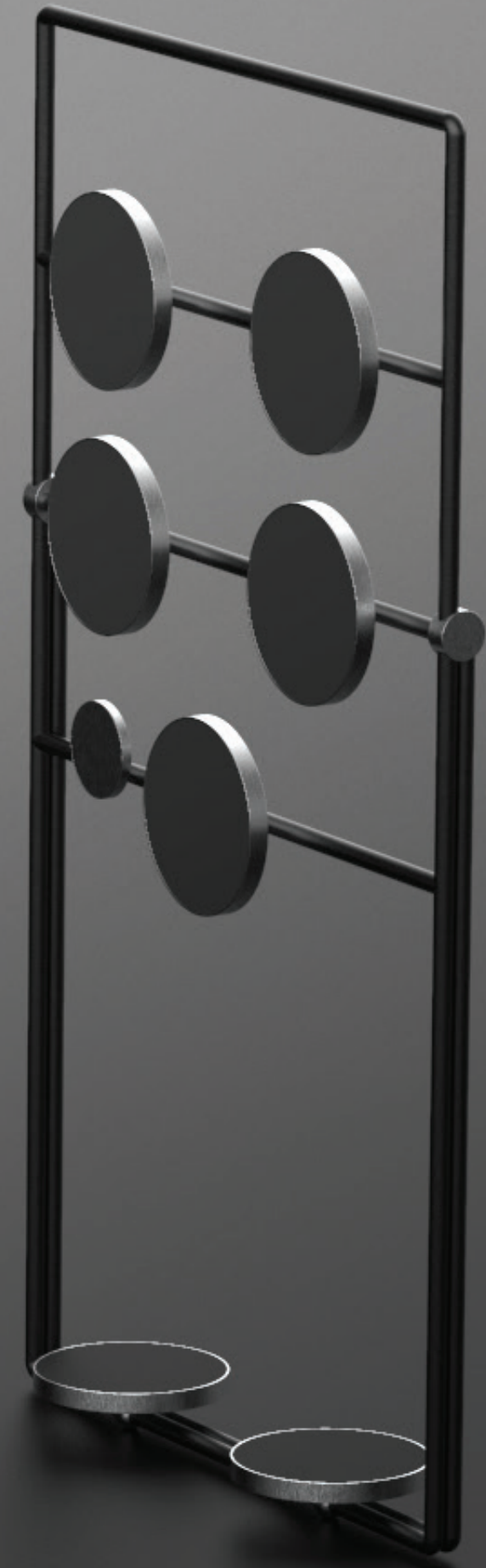


Figure 70 - Concept 3-2

Morphological Approach

The concept was divided into five design elements: the frame structure, drumheads, the smart module (together with drumsticks), and the foot pedal. For each element, sketches were done to explore ideas first. Then the promising ones were created in Solidworks and rendered in Keyshot to compare and evaluate based on aesthetics and practicality. Following the same process for each design element, the final design was created. Examples of sketch explorations are shown in figure 73, and the whole morphological development process is visualized in figure 74.



Figure 73 - Examples of Sketch Exploration

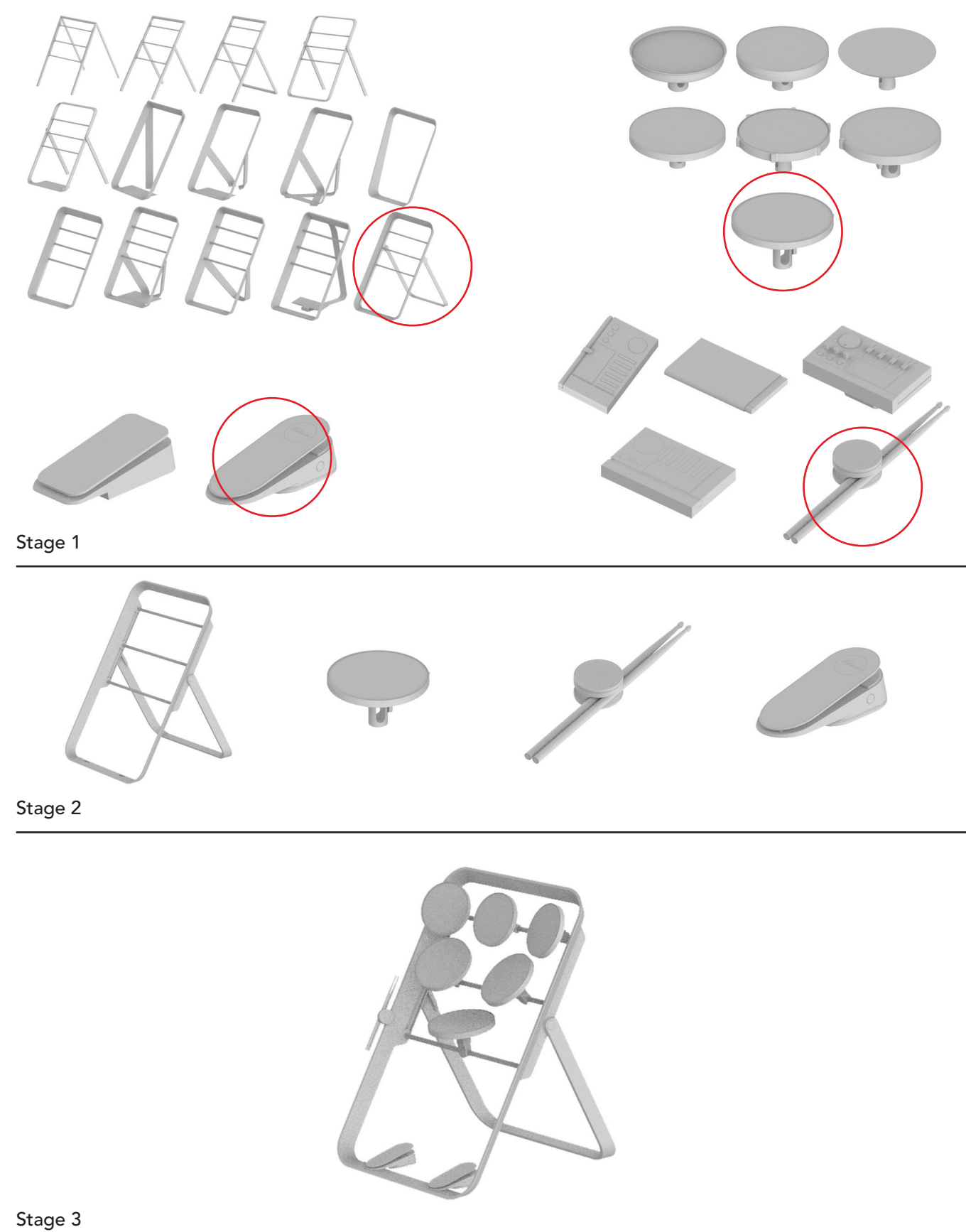


Figure 74 - Morphological Process

User Journey

As is shown in figure 75, the user journey of the design concept consists of 4 key scenarios: collecting sounds, configuring, transporting, and drumming. For the traditional acoustic and electronic drum kits, the user journey starts with configuring and extends to transporting and drumming. As for the design concept, the user journey is extended to collecting sound so drummers could collect sound samples and build their own sound library.

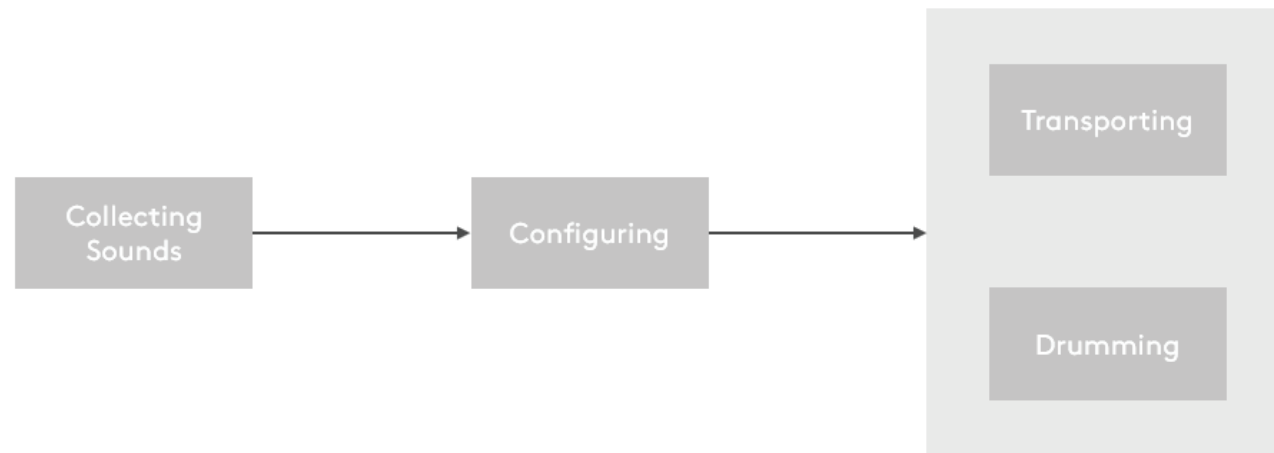


Figure 75 - User Journey

Collecting Sounds

When collecting sounds, the drummer detaches the smart module from the frame and clip it on the belt or pocket. When he goes out and wants to try the drumming sounds on the surrounding objects, he can take the drumsticks out, switch it to the exploration mode and begin exploring. He can also apply the sound effect and configure the sound's technical parameters in real-time by interacting on the smart module. He can switch to collecting mode when he is satisfied with certain sounds and save it into the library (figure 76).

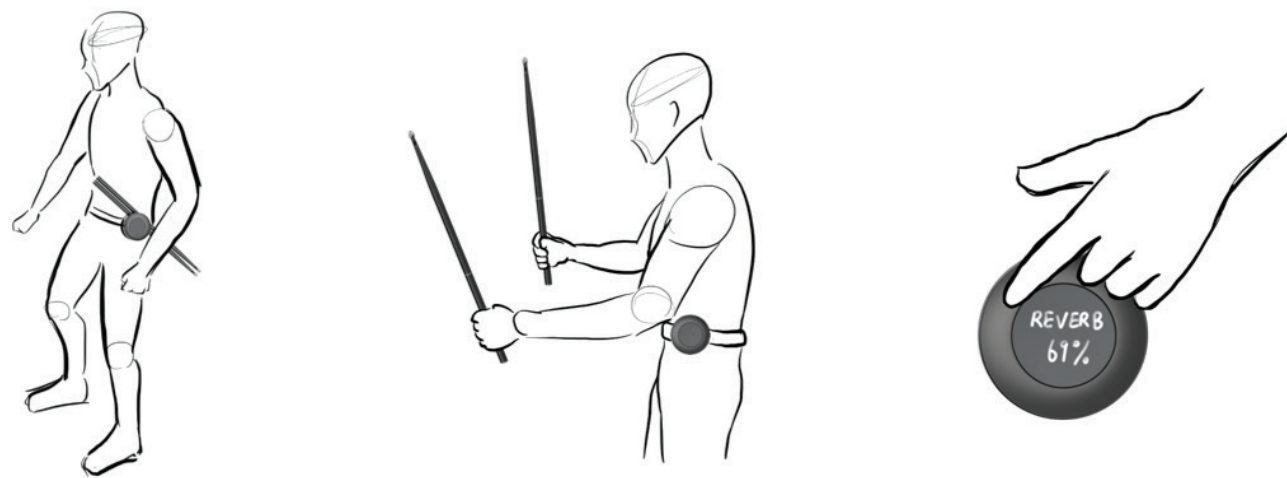


Figure 76 - Collecting Sounds

Configuring

The whole drum kit is automatically set in the performing mode when the power is on. Drummers can press the button on the side of the individual drumhead to activate the configuration mode and connect the drumhead with the smart module. Then the drummer can configure the drumhead's sound parameter or apply a different sound to that drumhead.

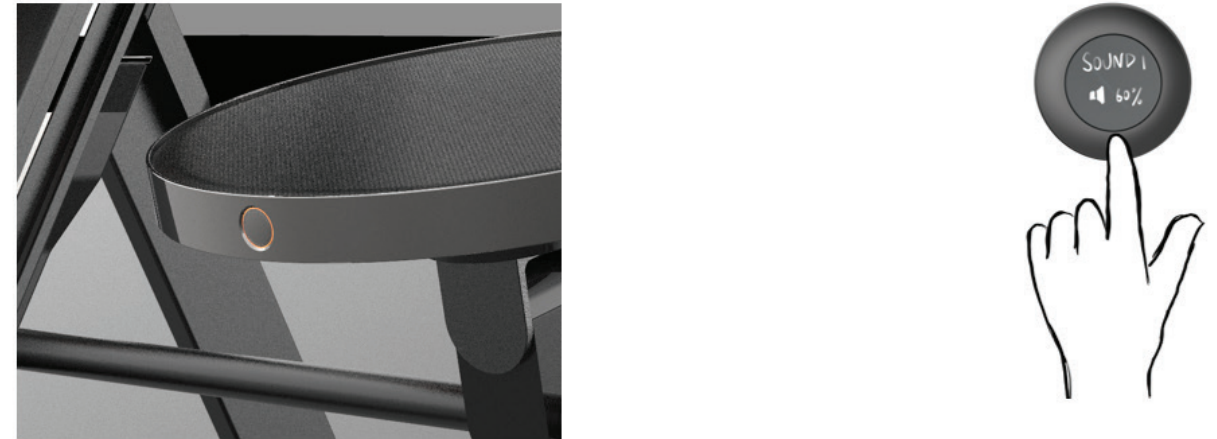


Figure 77 - Configuring

Transporting

To transport the drum kit, the drummer needs to detach the pedal first and then fold it. They can then move the drum kit or take it into the van. The smart module, drumstick, and foot pedals should be transported separately.



Figure 78 - Transporting

Drumming

As for the drumming, the drummer can drum in a similar way to the regular drum kit, sitting on a drum stool.

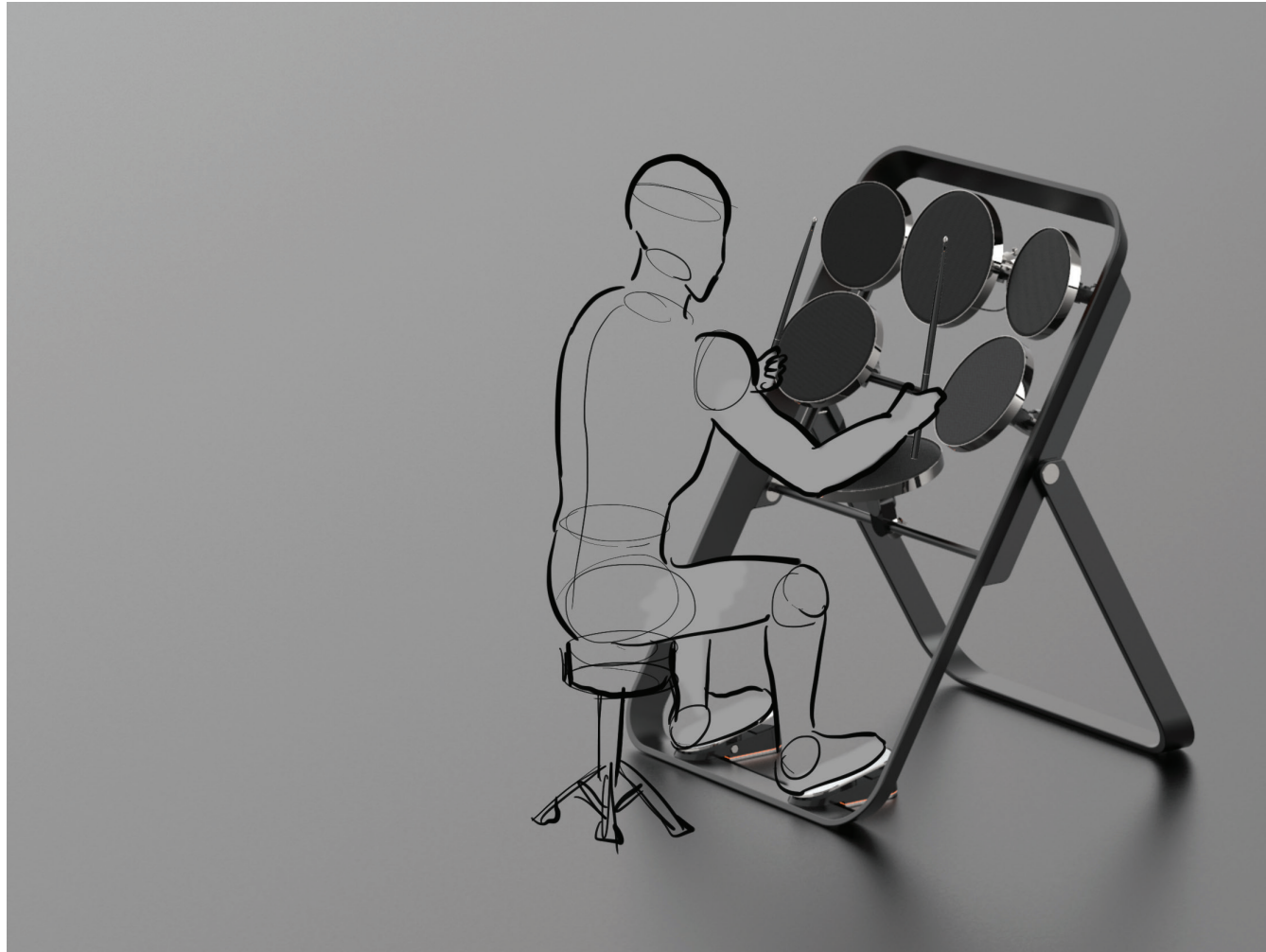


Figure 79 - Drumming

Detailing

In the detailing part, all the details regarding technical solutions and ergonomics were validated to ensure the design is feasible at the product level.

Overall Dimension & Inclination

To determine the suitable dimension, and the inclination for the majority of the drummers, three prototypes with different dimensions were constructed in 1:1 scale to test on. As is shown in figure 80, the dimension of the frame is 1.5m*0.9m, 1.6*0.9m, 1.6*1m, respectively. Three people were invited to test the dimension with a different height (1.65m, 1.75m, 1.85m, respectively). After the test, the frame size of 1.5m*0.9m with an inclination angle of 60 degrees provided the most comfortable drumming experience (figure 81). Therefore, the overall dimension of the frame and the angle of inclination are determined.



Figure 80 - Proportional Prototypes



Figure 81 - Angle of Inclination

Drumhead Dimension

For an acoustic drum kit, different drumheads are with different diameters. Based on this feature, three different diameters were determined after trying in on the cardboard prototype (figure 82). In this way, it provides a relatively familiar experience for the drummers and makes the product visually more attractive. The diameter of the large, medium, and small drumhead is 32cm, 29cm, and 26cm, respectively.



Figure 82 - Drumhead Cardboard Prototypes

Frame Hinge

The hinge between the front frame and the back frame is expected to fix the drum kit in the defined inclination and withstand the force exerted during drumming. The design of the mechanical structure of the hinge based on the reference of similar products.

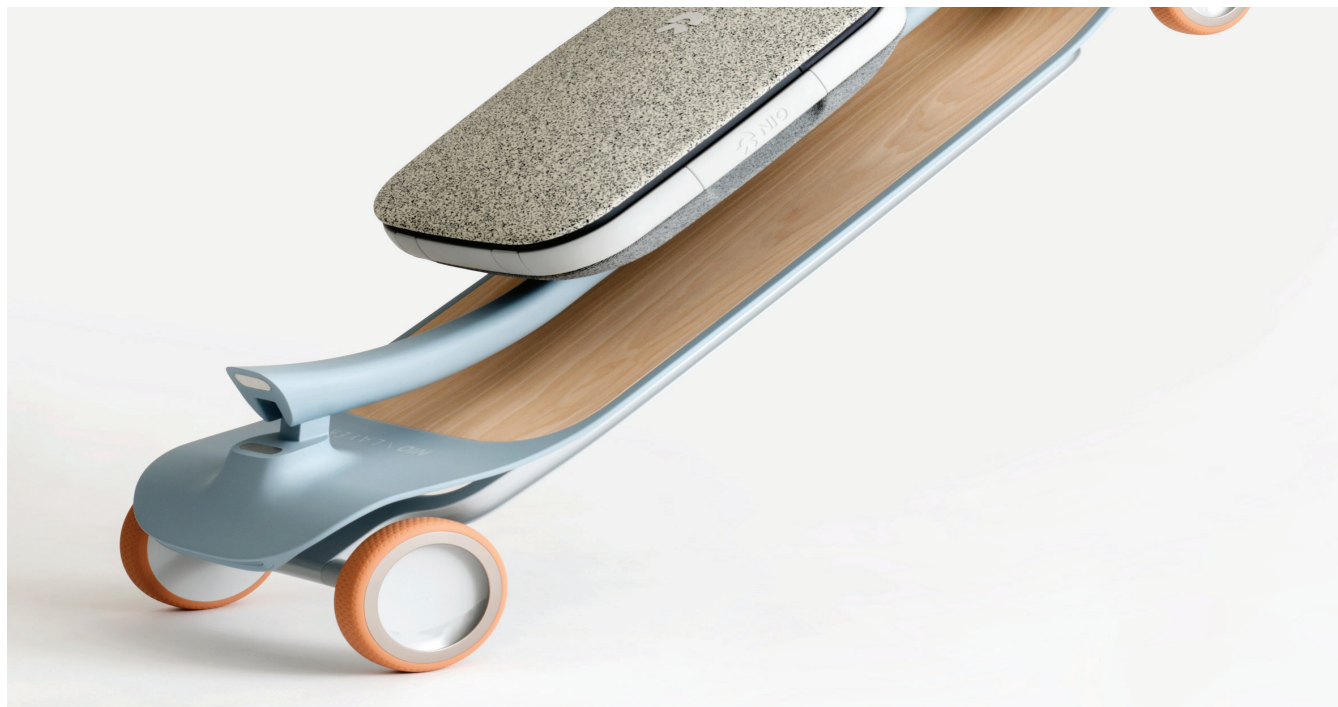


Figure 83 - Scooter Designed by LAYER (dezeen, 2019)

As is shown in the figure 83, for the scooter, the pressure is supported by the contact area of two surfaces. This mechanism is applied in the design to ensure the stability.



Figure 84 - Push Hinge for Strollers (BabyGearLab, 2020)

Since the folding mechanism is involved, the back frame should not be loose when folded since it will bring inconvenience for transport. Here, the mechanism from the scooter hinge was referenced (figure 84). The hinge only works when the user presses the button, and the hinge only has two fixed positions: folded and unfolded. The design of the frame hinge is shown in figure 85, where an extra surface was added to ensure the stability.



Figure 85 - Frame Hinge Design

Drumhead Hinge

One of the design requirements is that the drummer should be able to adjust the drumhead position freely. The flexibility is controlled by the hinge on the back of the drumhead. Here, the current hinge of the drum kit is referenced because it proves the stability of the mechanism (figure 86).



Figure 86 - Existing Drum Kit Clamp Hinge (LONG STAR PERCUSSION, 2020)

Shown in figure 87, the drumhead can move and rotate along the metal bar, the drumhead itself can also swing from left to right in a range. This control of the drumhead position allows the drummer to play in an ergonomic-friendly way since they can adjust the drumhead to fit their own ergonomic dimension.

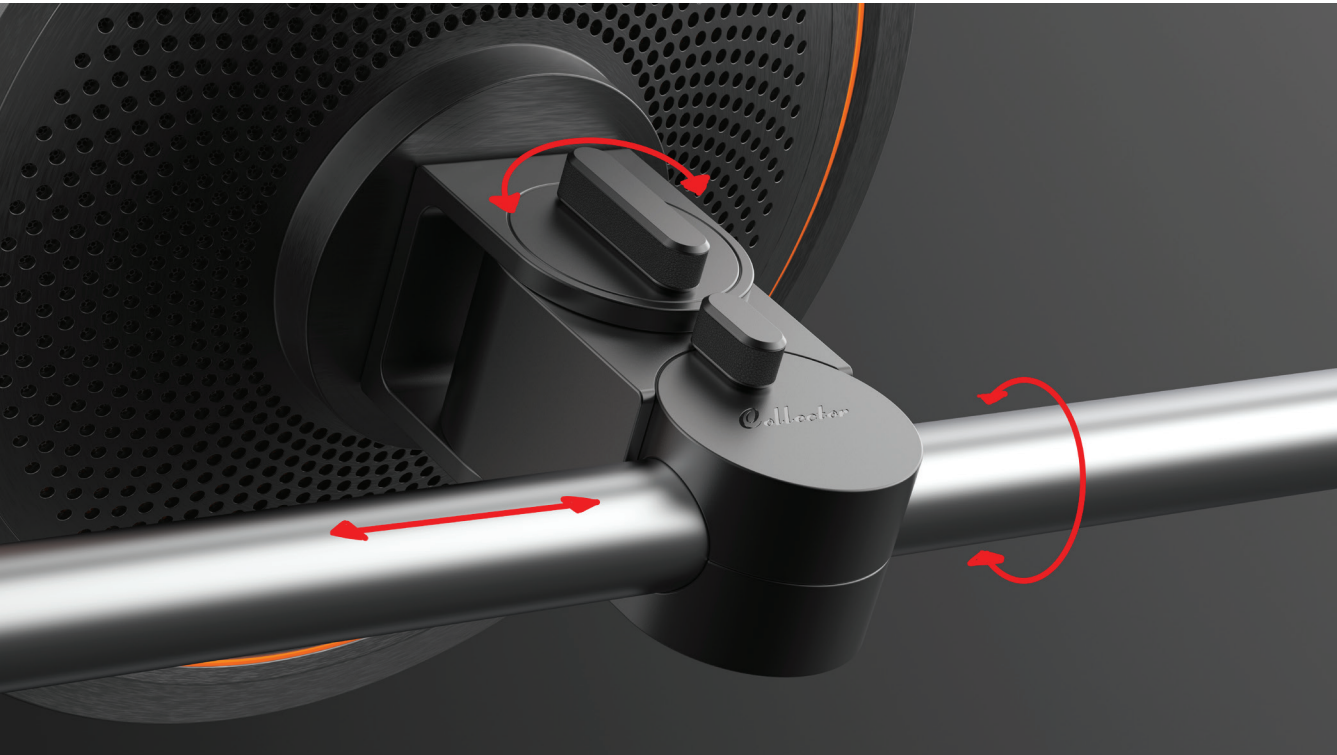


Figure 87 - Freedom of Drumhead Hinge Movement

Besides, by untightening the screw, the drumhead can be disassembled effortlessly from the frame (figure 88).

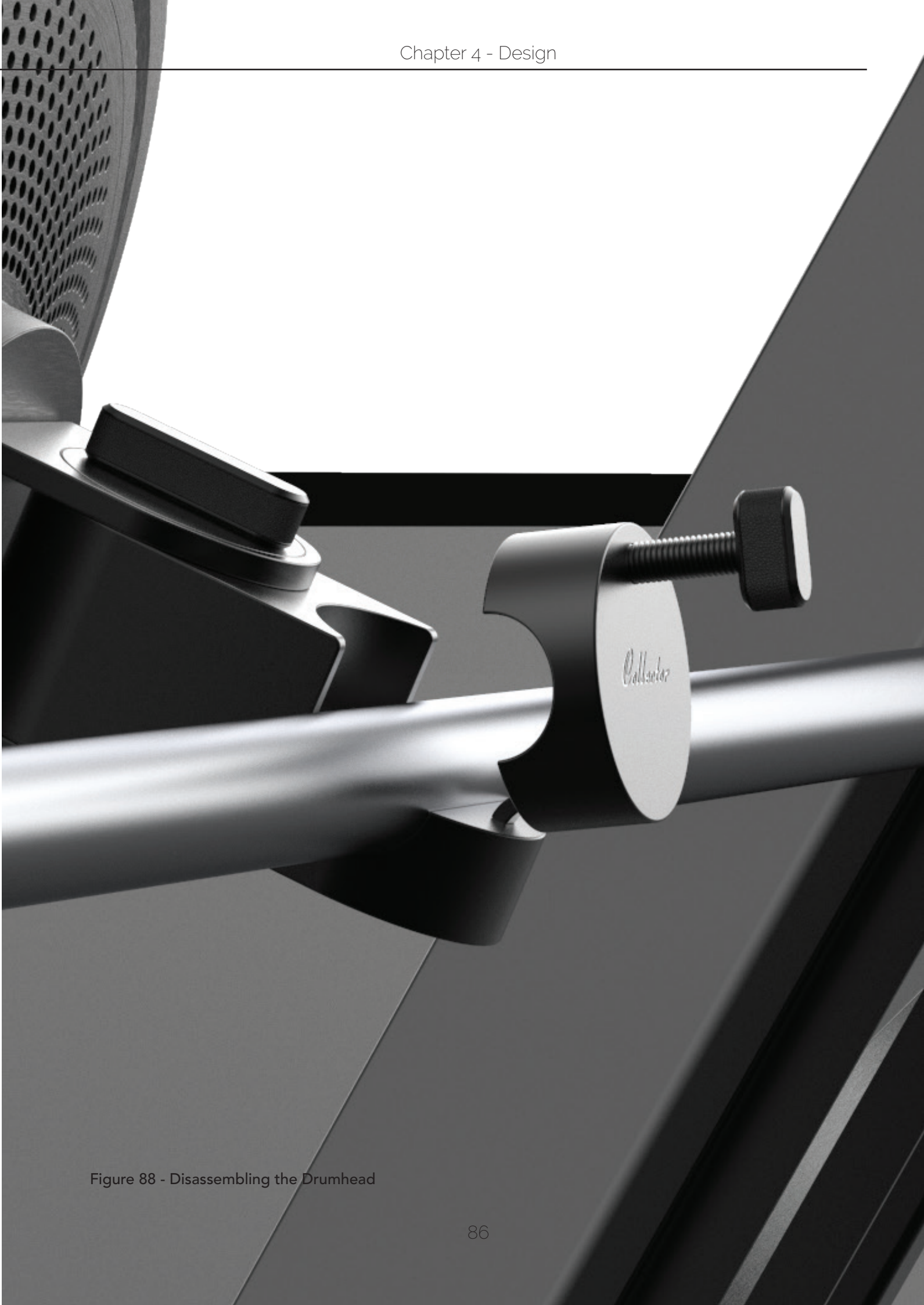


Figure 88 - Disassembling the Drumhead

Power Supply

The design aims to have as few cables as possible since cables are hard to organize and make the place messy. The overview of the power supply is shown in figure 89 (key power transfer points 1 - 5 are explained below).

- 1. The main power inlet lies at the bottom back of the front frame. The frame is made of a hollow metal frame, and the cables and other necessary components will be installed inside.
- 2. The Drumhead is powered through a short cable. One side is connected to the drumhead, and the other side is connected to the frame where there is a slot underneath.
- 3. The frame powers the smart module through wireless charging, similar to Apple Pencil 2 and iPad Pro.
- 4. The smart module powers the drumsticks through wireless charging, similar to Apple Pencil 2 and iPad Pro.
- 5. The frame powered the drum pedal. The metal pin under the drum pedal and metal surface inside the slot on the frame allows the electricity to flow from the frame to the pedal.

Drum Pedal

Besides providing the power to the drum pedal, the pin and slot allow the drummer to move the drum pedal within a degree of freedom. The drum pedal can slide along the frame and rotate around the pin axis to match the natural opening angle of human feet while sitting (figure 90).

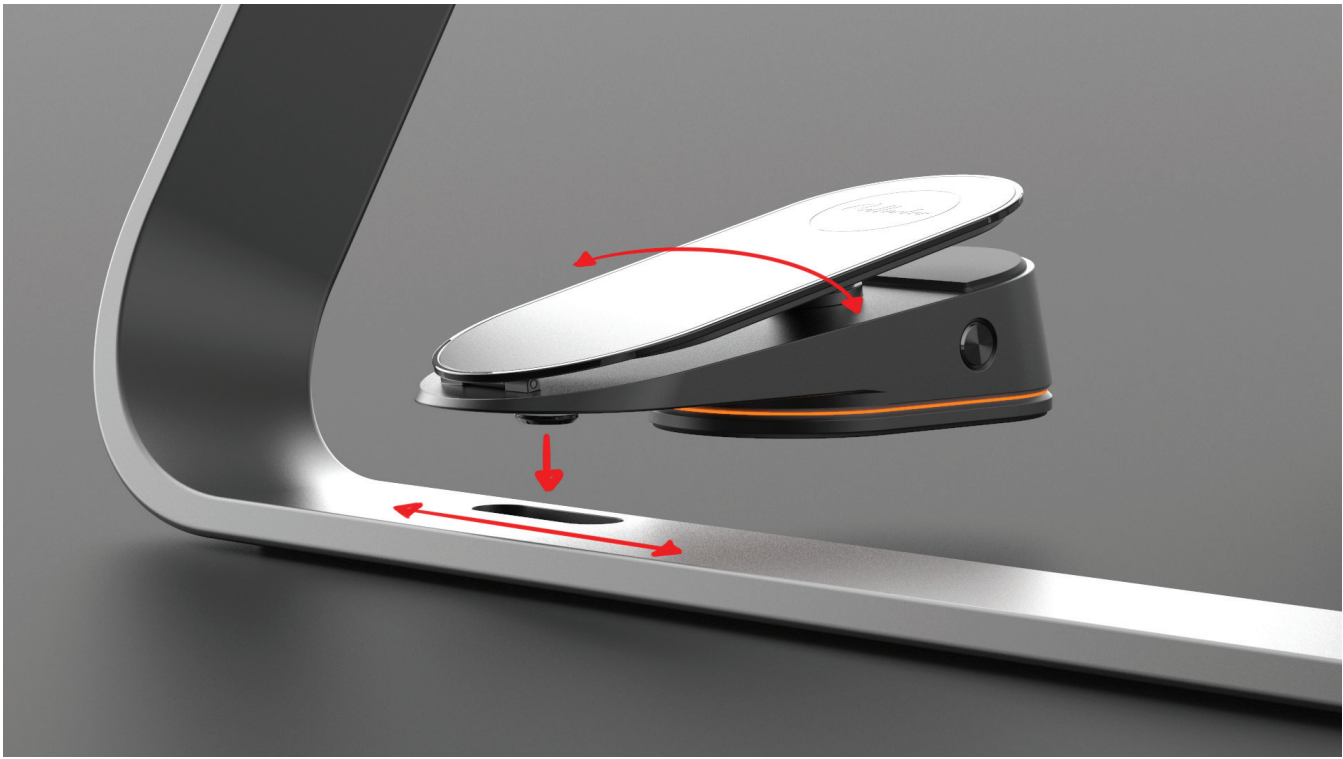


Figure 90 - Pedal Design

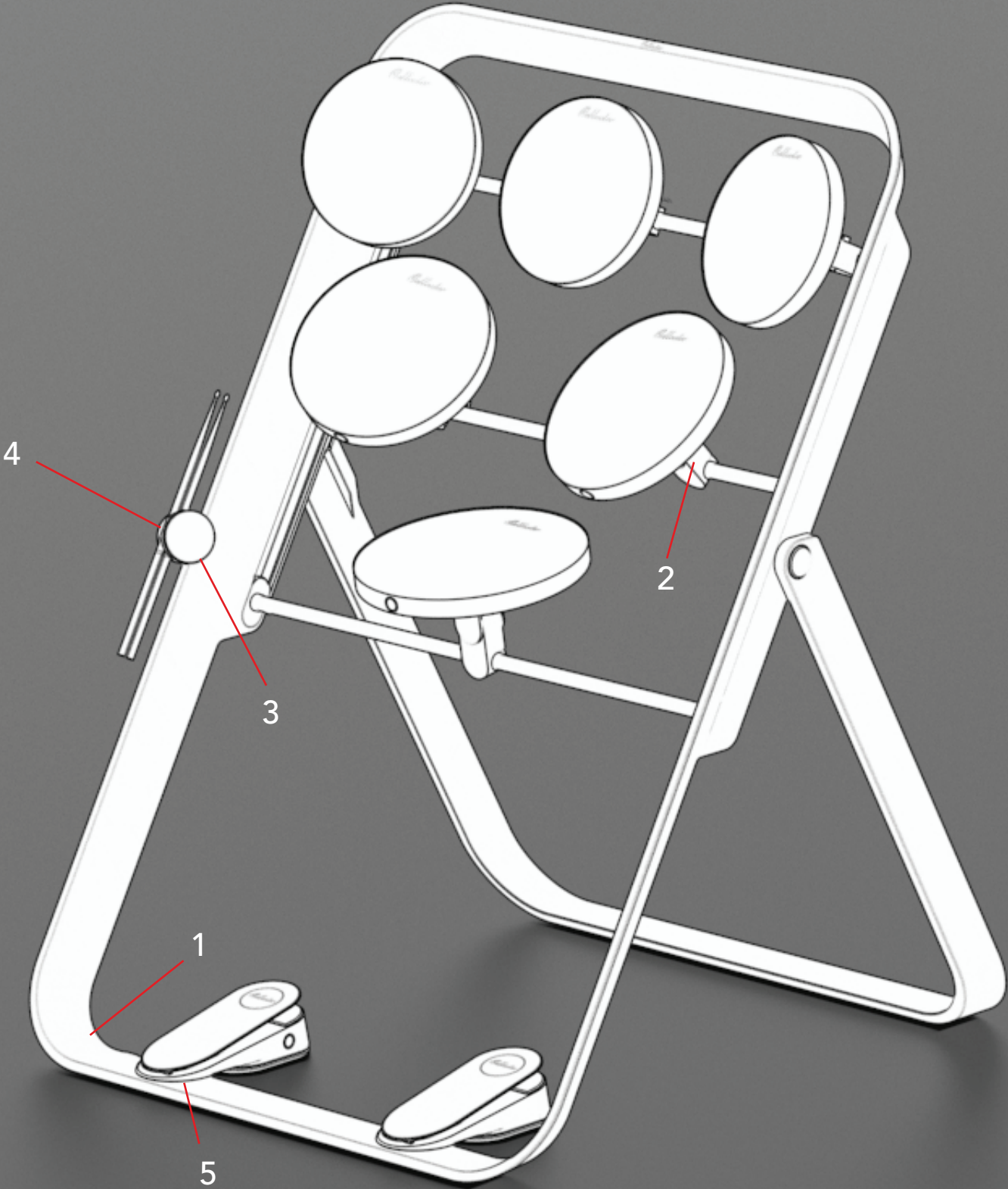


Figure 89 - Power Supply Overview

Weight

Another critical factor that affects the flexibility of transport is the weight of the whole drum kit. In Solidworks simulation, with materials applied, the weight of the frame is around 7kg, and a medium-sized drumhead is around 1.5kg. Assume the drummer chooses to have six drumheads on this drum kit, then the total weight will be 16kg. The weight is affordable for a normal adult man. For drummers with smaller strength, they can choose to detach the drumhead and transport them separately. However, the weight is only an estimation, and with the real components and internal structure applied, the result would be different.

Name

“Collector” is the metaphor that inspires the design in the later process. Here, the drummers are referred to as the “Collector of Sounds” since they share the same values. Collectors are obsessed with the objects they are collecting. They are passionate about it and always exploring the outside world to try to find new objects to add to their collection. Likely, drummers are also passionate about the sound of percussion and always curious about the surroundings to explore new sounds to add to their own drum kit.



Figure 91 - Mood Picture for Collector (Pexels, 2020)

Final Design

The final design consists of 3 essential products: the drum kit, the smart module, the intelligent drumstick.

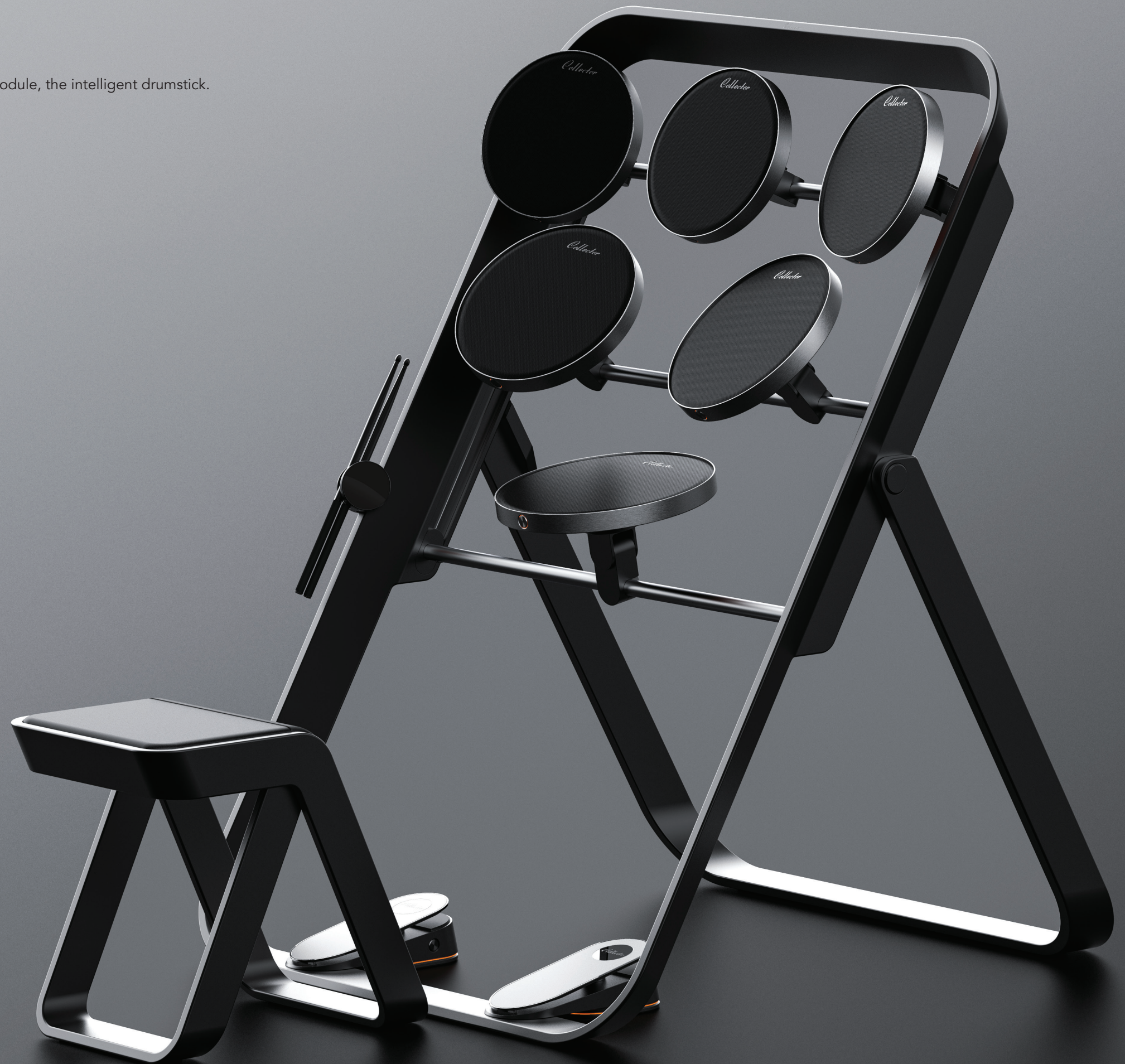


Figure 92 - Final Design "Collector"

The smart module and smart drumsticks are clipped on the frame for charging.



Figure 93 - Module on the Frame

The smart module and smart drumsticks are detachable for drummers to explore new sounds.



Figure 94 - Smart Module & Smart Drumsticks



Drummers can adjust the drumhead position by adjusting the hinge to fit their own ergonomic dimension and drumming habit.

Figure 95 - Drumhead Hinge

Drummer can change the layout of the drumheads as they want.

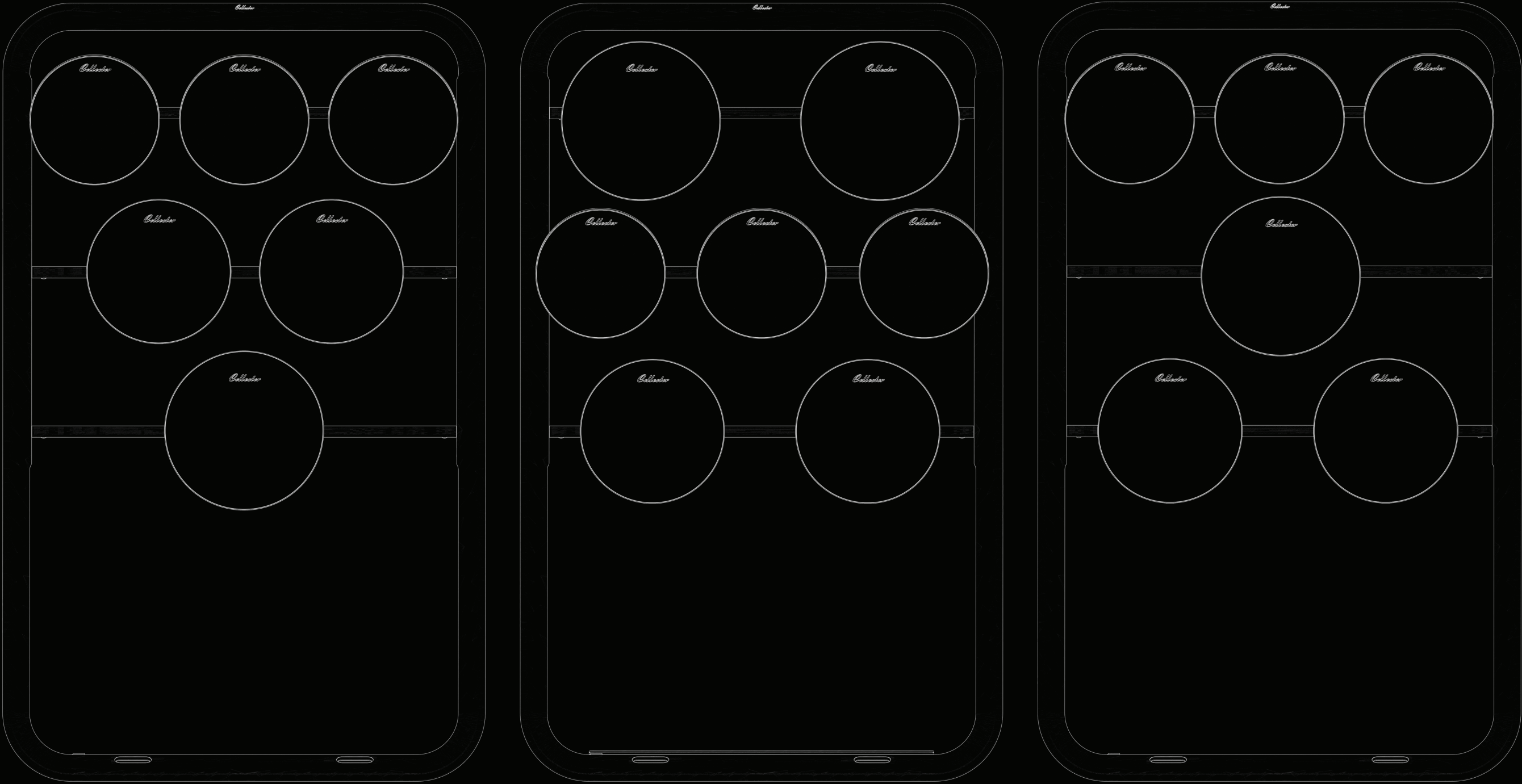


Figure 96 - Different Layouts

When folded, the drum kit takes little space and can act as a decorative piece and is easy to carry.



Figure 97 - Folded Position

Some design details are shown in the following pages.

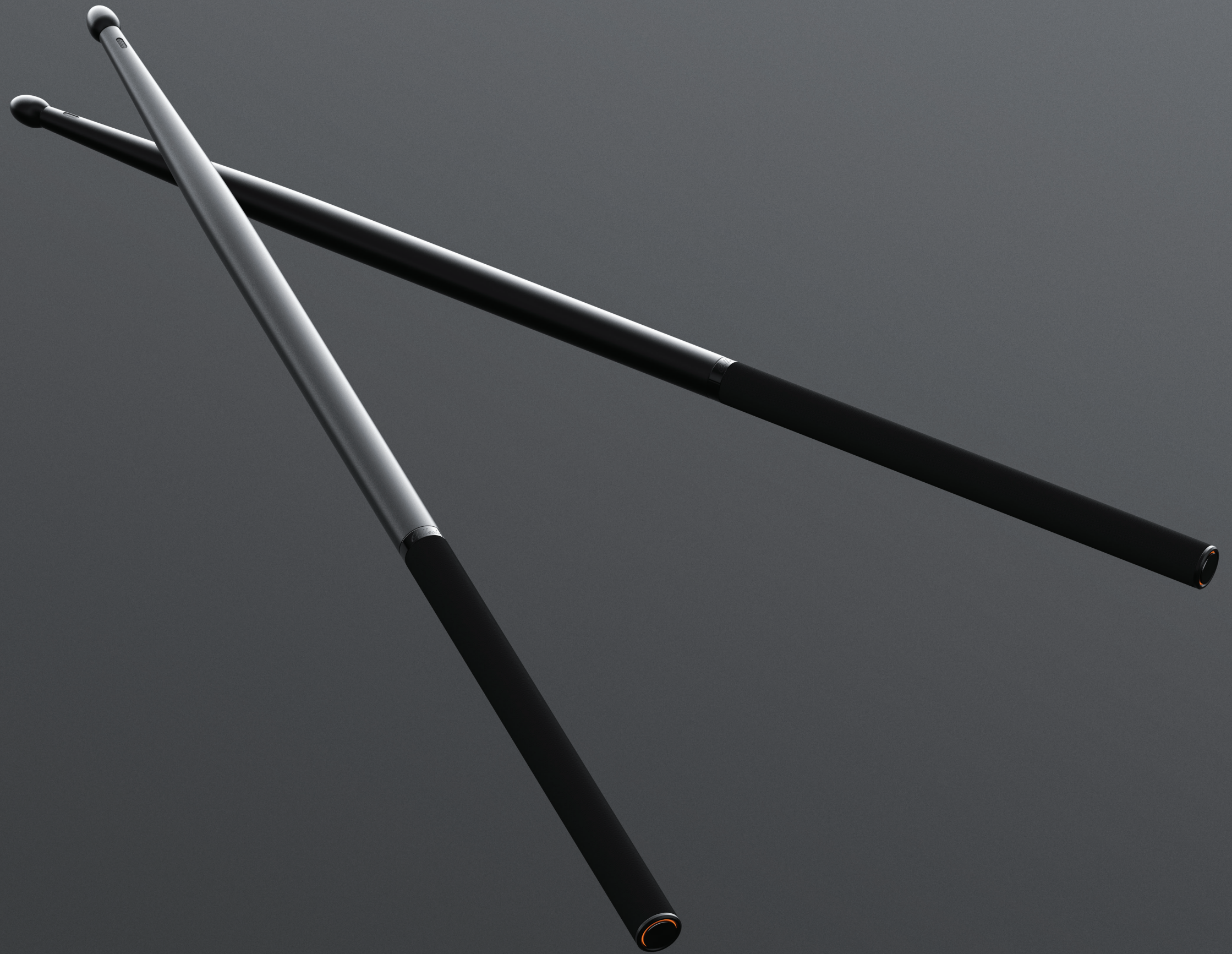


Figure 98 - Intelligent Drumsticks

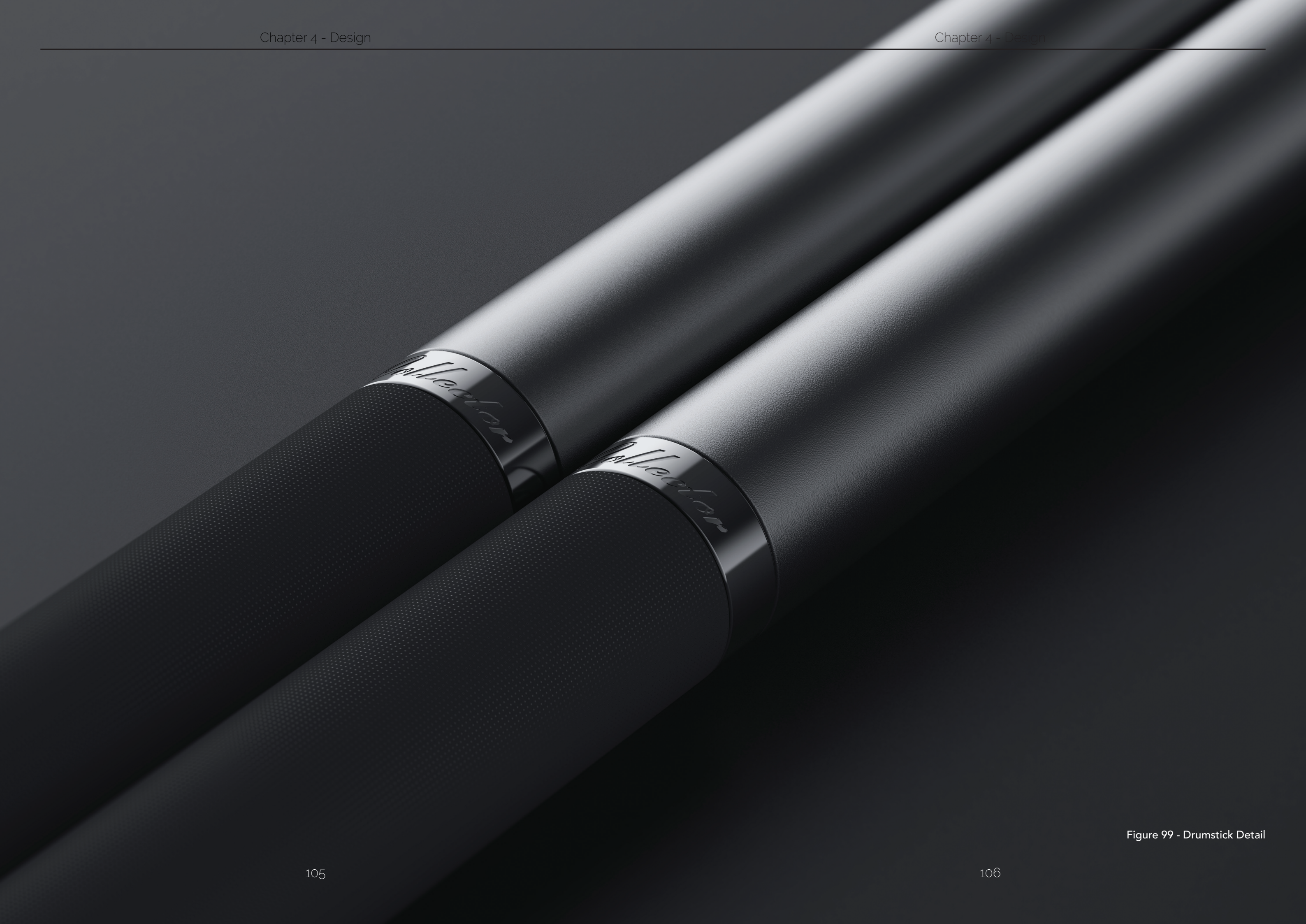


Figure 99 - Drumstick Detail



Figure 100 - Drumstick Detail



Figure 101 - Pedal



Figure 102 - Pedal

- CHAPTER 5 - EVALUATION

Overview

After the design is finished, the designer must look back at the project brief and evaluate the concept. In this project, a user test was conducted after the development phase to see how well the design reaches the initial target. For the user test, a functional prototype was built with the function of collecting sound, and a questionnaire was created. The result was analyzed in this chapter.

Functional Prototype

Only talking about the idea of collecting sound for the drum kit is abstract and can be interpreted in different ways. A functional prototype was built to demonstrate how the user will interact with the product to explain the idea(figure 103). The prototype consists of a drumstick, a microphone (attached on the drumstick), a pair of earphones, a sound signal adapter, the control unit (sliders, buttons), and laptop programming software for music (PureData, figure 104). There are three modes: exploration mode, record mode, and playback mode.

When in the exploration mode, the user can drum on any object they want. The sound collected through the microphone will go through the software, and the drummer can hear the pre-processed sound from the earphone. In this way, drummers can control the sound parameter (reverb, delay, etc.) through the slider, which enables them to edit the sound sample in real-time. When the drummer found an exciting sound, they can switch the prototype into the collection mode and collect that specific sound sample. In the end, to simulate the scenario where the drummer is drumming on the drum kit with the customized sound, they can switch to the playback mode, in this mode, whatever the object/material they drum on, the sound will be that sound sample they collected.

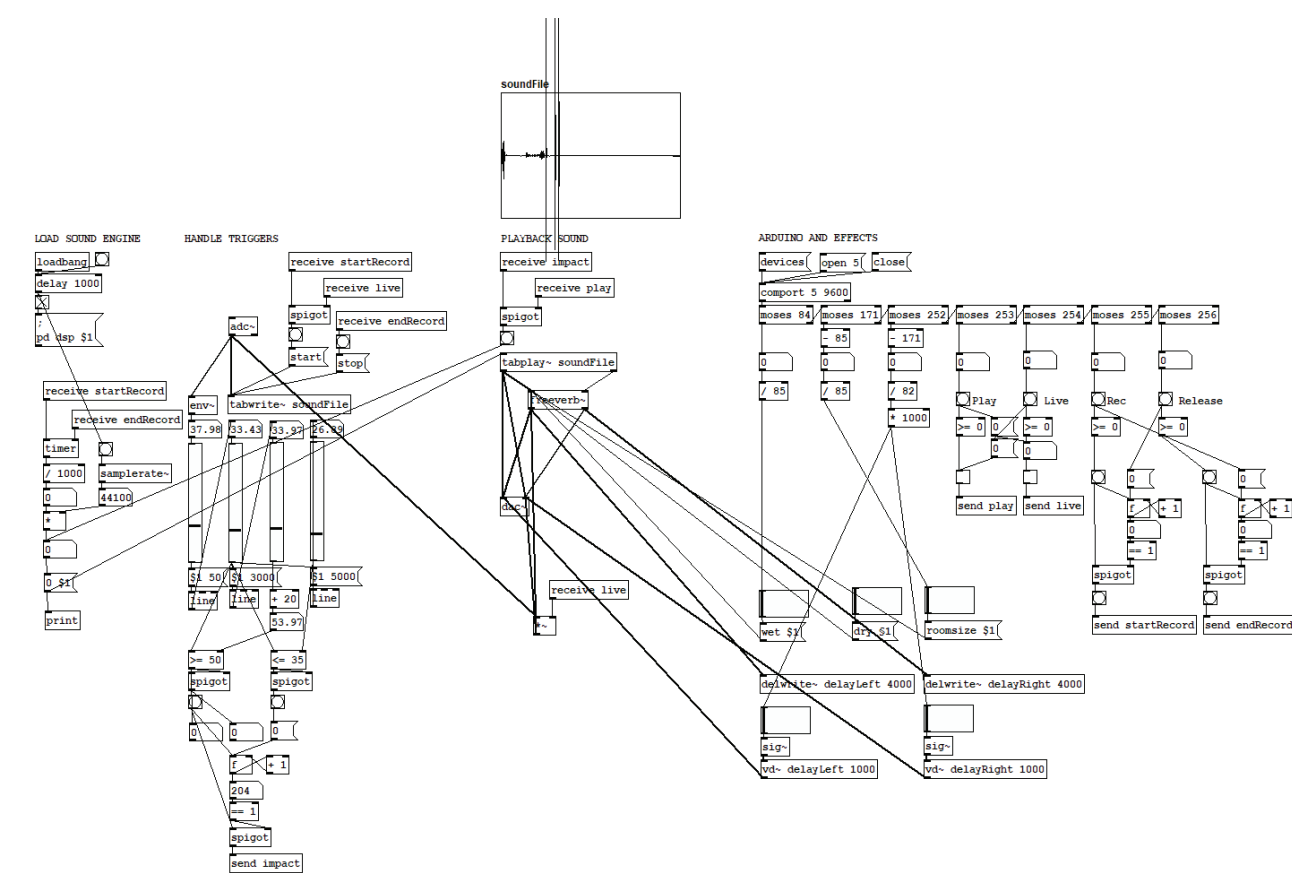


Figure 104 - PureData Programming

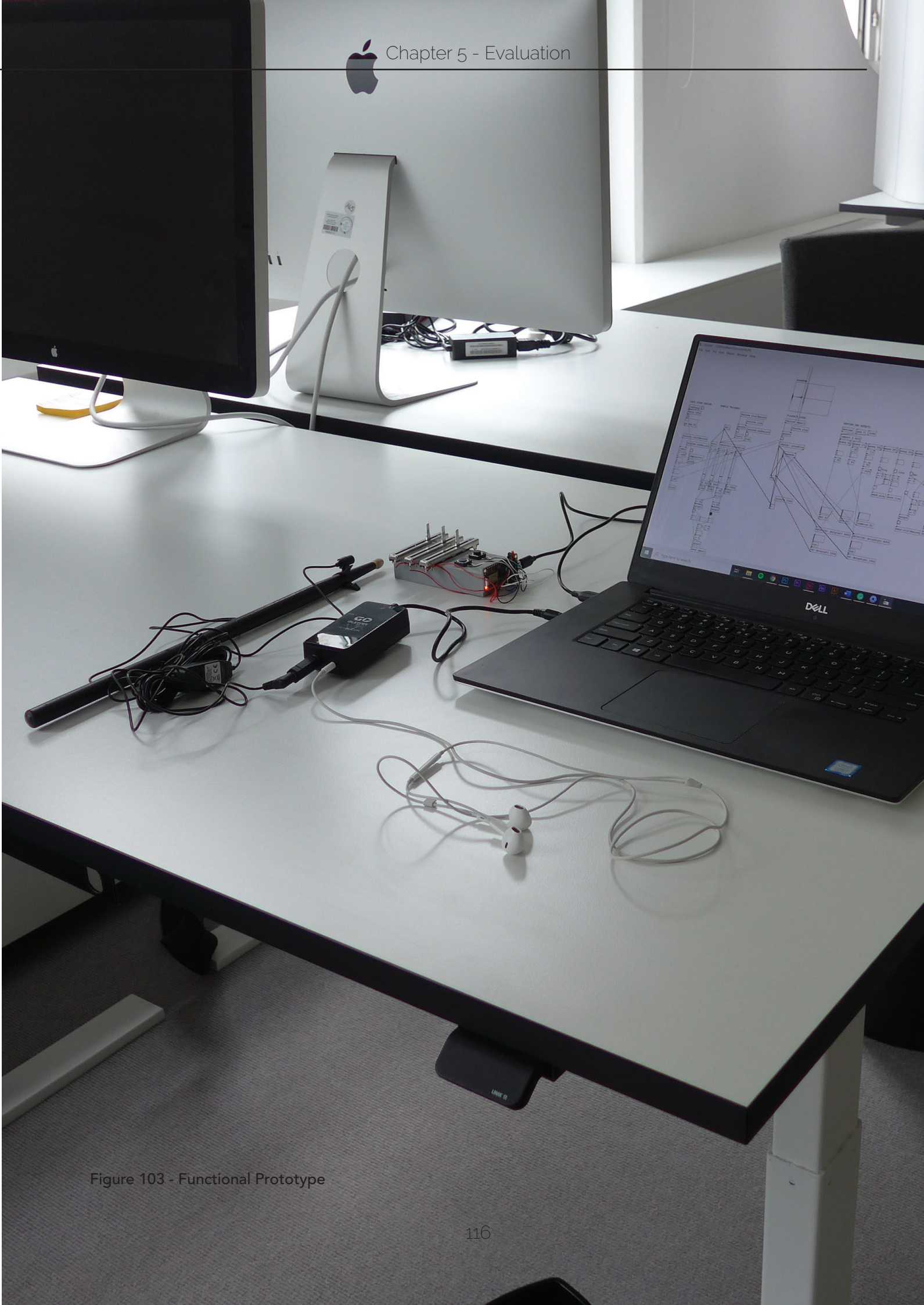


Figure 103 - Functional Prototype

User Test

Seven participants were recruited for the user test (four drummers and three people with musical background). The user test aims to answer three key questions (for the full content of the questionnaire, see appendix 8): What emotions were triggered by the concept, both in the level of user experience (idea) and the product itself (aesthetics)? Does the design fulfill the functional needs defined? What is the participants' opinion? What other feedback/advice do participants have?

Results

After the test, the results are summarized and analyzed below.

Emotions

The tool called PrEmo (figure 105) was used to evaluate the emotion. The participant can identify their emotion based on the types of emotions provided. The emotions of participants triggered by the idea and the product are visualized below, respectively: (each circle represents that this emotion is mentioned once by one participant).

From figure 106 and 107, it can be seen that the emotions triggered are mostly positive. Participants are fascinated by the idea of collecting their own sound and excited about the potential of what they can do with this function. As for the product, they are amazed that the drum kit's unique design language, which shows a significant difference from the current existing product and the clean and minimalistic design style, triggered their desire to try it.

In a word, reflecting on the design vision, the design does trigger participants' curiosity, which means the design reached the design vision from an emotional aspect.

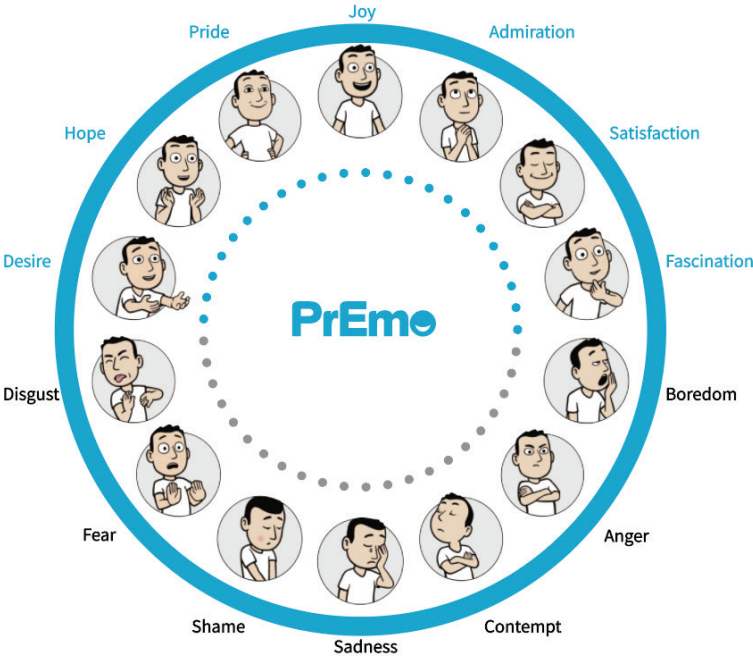


Figure 105 - PrEmo (Laurans, G. & Desmet, P.M.A., 2017)

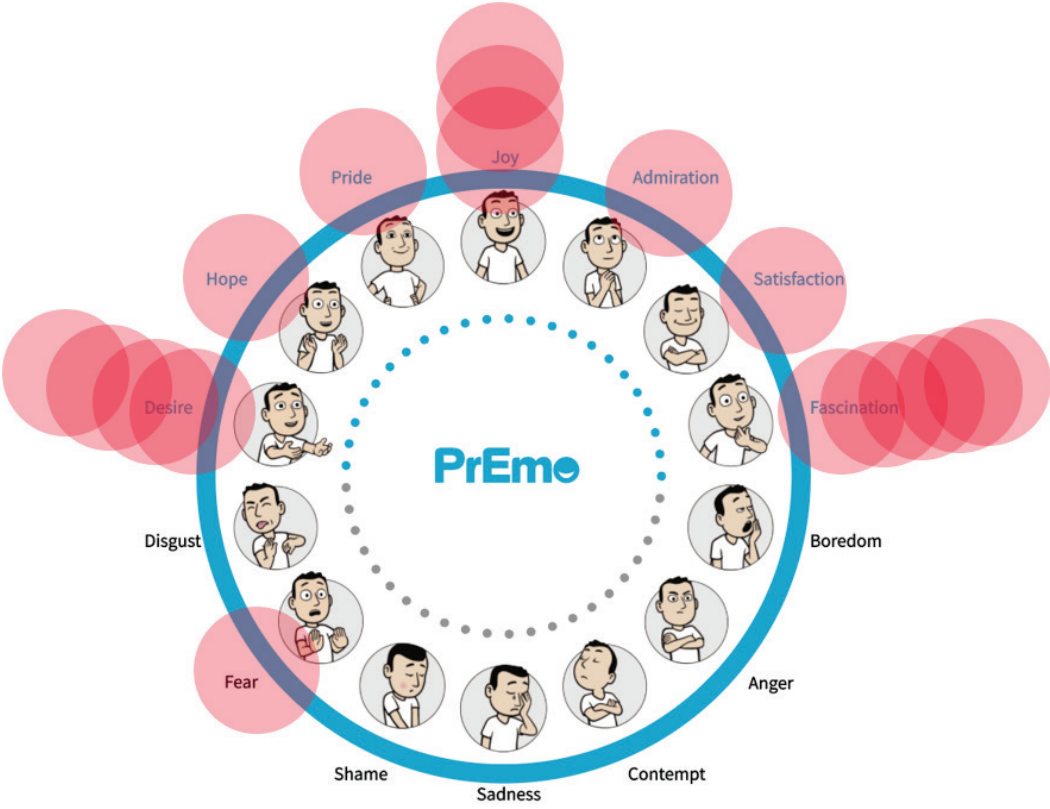


Figure 106 - Emotions Triggered by the Concept UX (Idea)

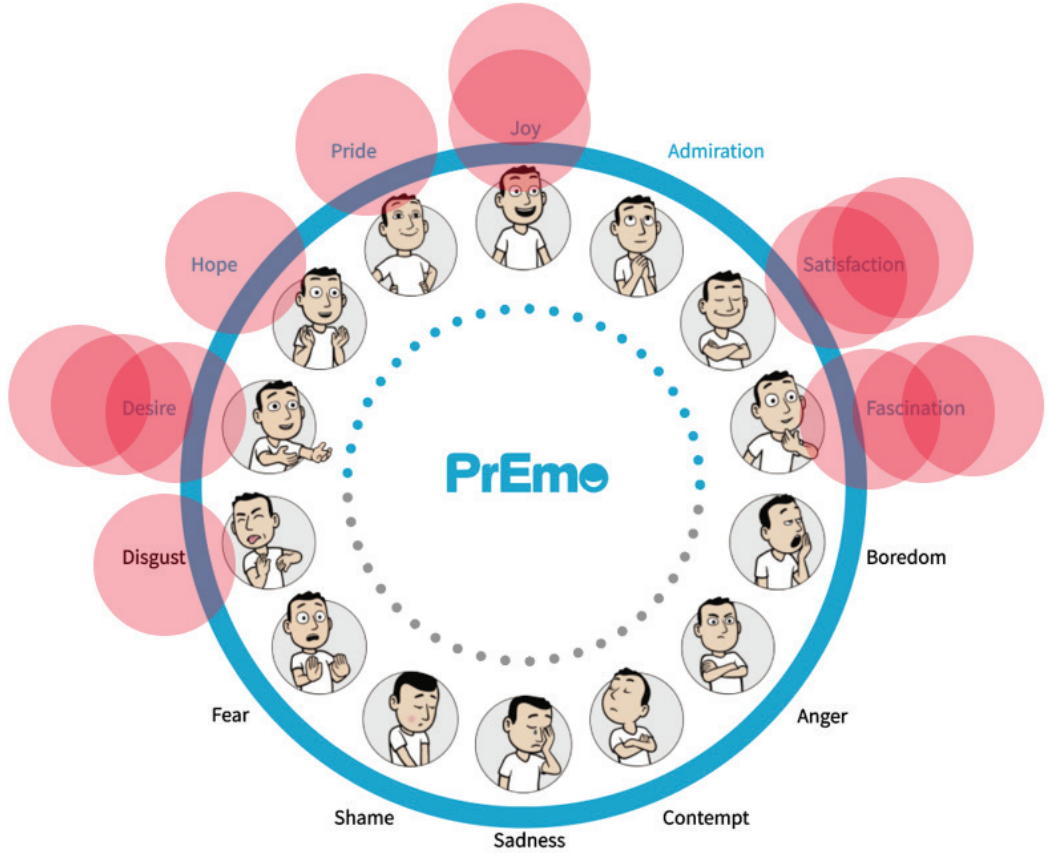


Figure 107 - Emotions Triggered by the Product Design (Aesthetics)

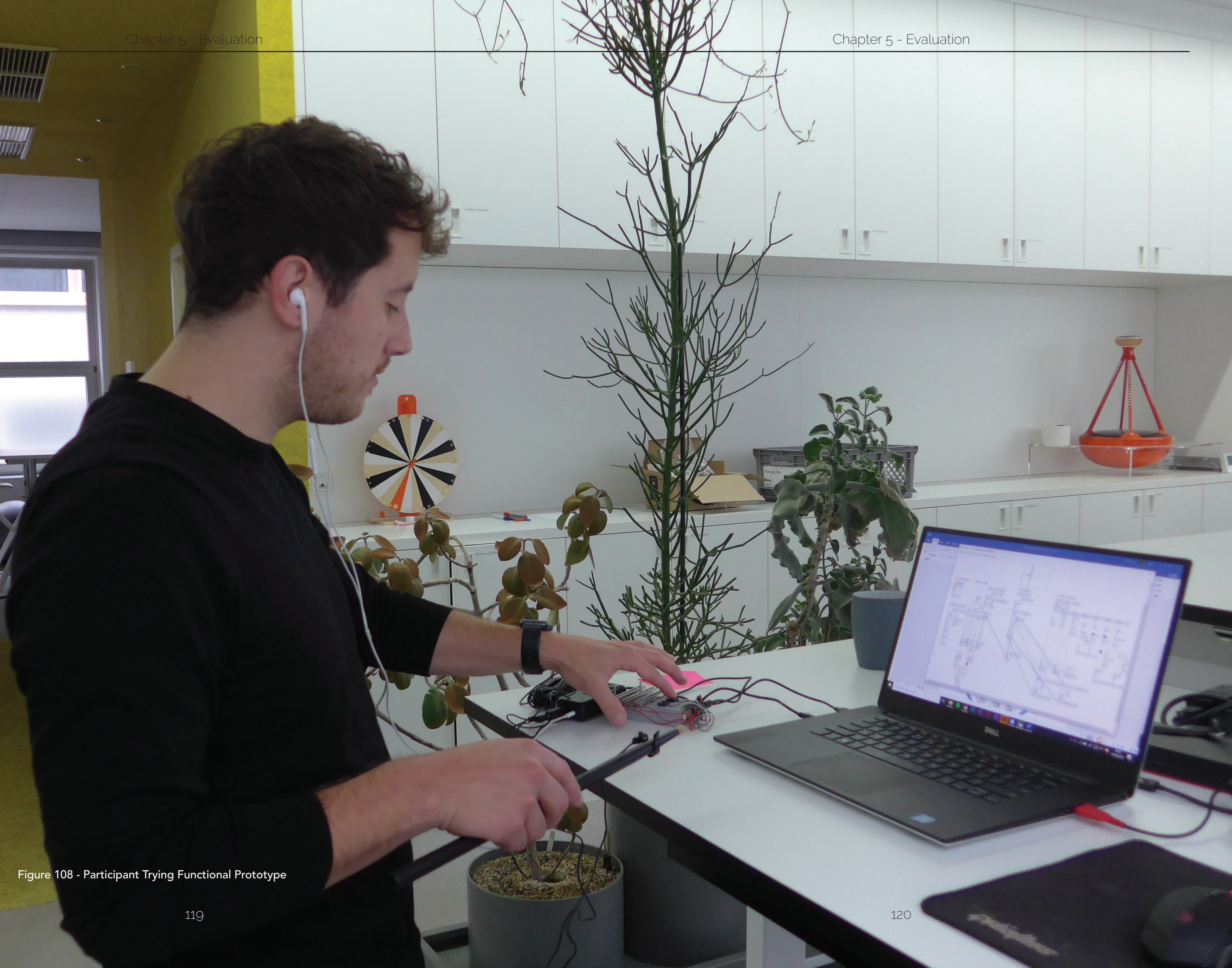


Figure 108 - Participant Trying Functional Prototype

Functional Needs

There were four functional needs defined for this project:

- 1. Richer sounds: The design allows the drummer to produce richer sounds.
- 2. Easy set-up: The design is easy to set up as a drum kit.
- 3. Flexible transport: The design requires less effort transport, which means it takes less space, contains fewer components, etc.
- 4. Customized configuration: The design allows the drummer to modify the drumhead layout with less effort (adjust the position of each drumhead, change the number of drumheads, etc.)

The participants were asked to rate how well the design fulfills these four functional needs using the scale below (figure 109).

1	2	3	4	5
Not fulfilled at all	Barely fulfilled	Fulfilled	Well Fulfilled	Perfectly Fulfilled

Figure 109 - Rating Scale

The average score of each functional need was calculated, and the results are shown below (figure 110). The average scores of the four functional needs are 4.3, 4.2, 4.5, 4.1, respectively, which means the design fulfilled all the functional needs defined.

Participant	1	2	3	4	5	6	7	Avg. Score
Richer Sounds	5	4	2.5	5	5	4.5	4	4.3
Easy Set-up	4	5	4	3	5	3.5	5	4.2
Flexible Transport	5	5	3.5	5	3	5	5	4.5
Customizable Configuration	2	3	4.5	5	4	5	5	4.1

Figure 110 - Rating by Participants

Feedbacks

Other key feedbacks are summarized as below:

- Participants like the wireless approach of the design compared to existing drum kits (especially electronic drum kit), which require a lot of cable management.
- The durability of the drumstick remains a significant concern since drummers are worried that the electronics inside may be broken during drumming.
- Drummers do like the design when viewing it not as a replacement of the current drum kit but a new approach of the percussion instrument. However, they are worried that they may not be able to adapt to this product’s new drumming way. The reason is that the drumming habit is tough to change, especially when they already played the traditional drum kit for a long time.
- Some of the drummers are excited about the sound exploration idea. They see the potential for the establishment of a new platform where drummers can share their sound samples online.
- The design looks different with a new “ladder archetype”, this brings a new design language to make the drum kit look lightweight, compact, and flexible. However, in the meantime, it lost the astonishing visual impact that the traditional drum kit brings. The ladder also gives a feeling of limitation to the drummers.

- CHAPTER 6 -

DISCUSSION

Recommendation for Future Validation and Development

Due to the limitation of time and resources, the final design remains on a conceptual level. However, many parts need to be validated and developed in the future to bring the concept into a real product. Here, the points that need to be validated further or have the potential for further development are discussed.

- The durability of the drumstick needs to be validated in the future. In the ideal design story, the drummers are expected to use the same drumstick to collect sounds and perform. However, the drumsticks themselves are consumables, and drummers have to replace them regularly when they are broken. With the electronics inside, the drumsticks are becoming even more fragile. Most of the current drumsticks are made of wood. It remains questionable whether using different materials like high-quality metal (for example, titanium) will make a difference in durability and sound.
- The stability of the frame structure and the drumhead fixture needs to be validated. Although on the current design, the design of the hinge and fixture structure is based on the existing product and the design is tested visually stable from the perspective of real drummers, the further test has to be done to ensure the stability using software simulation or real testable prototype with real material applied.
- The weight of the drum kit needs to be validated. One of the critical factors that determine the flexibility of transport is weight. In this project, the weight of the product was roughly simulated using Solidworks. The weight will change when the real internal structure and components are applied later and requires serious consideration. Preferably an accurate simulation should be conducted on the production-ready CAD model in the future.
- The wireless charging technique is implemented inside the smart module, frame, and the drumstick, which needs to be validated in the future. In the concept, the wireless charging technology is implemented with enough pre-reserved internal dimensions in the components, but how to implement and install all the components remains untested due to the design scope.
- There is only one style of CMF (color, material, and finish) for the concept right now. However, there is enormous potential to develop a more CMF strategy to satisfy drummers' needs of different music styles. For example, brass and wood may be applied for the design concept to fit a drummer who plays jazz music. Packaging (cases) could be a potential related product for the design concept in the future. There are already drum cases or bags for the transport of the drum kit in the market. Packaging could be an opportunity for this project in the future as well to provide better protection during the transport while showing the unified design language extended to a packaging level.
- Although the design of the physical product is the main focus of this project, the digital experience also plays a significant role regarding the function of sound collection and configuration embedded in the concept. Related digital user interfaces should be designed in the future. The concept also shows a great potential to build up a platform where drummers can share the sound they collected. It will be a promising idea as the physical product extending to the digital experience and even form an online ecosystem for the drummers.

Reflection

After the design was finished, self-reflection was based on two parts: reflecting the project learning goals and personal experience.

Project learning goals

Four learning goals were set in the project brief. A reflection was done on these goals at the end of the project.

Project Management

Conducting the project aboard in two different countries (China and Germany) with almost all the communication done remotely, it is a challenge. Although the project was delayed at the end for several weeks, the project management worked relatively well from the author's perspective, and many obstacles were overcome considering the real-life situation (time difference, detailed planning, etc.).

Communication & Determination

Much effort was put in for communication since it is one of the biggest challenges for the whole project. The author spent much extra time to make sure that all the meetings are well-prepared with excellent visuals and logical structures. The author always kept the determination to deliver the design with the best quality throughout the process.

User Experience

The user experience was deeply dug into the research phase with an in-depth interview of the real drummers. The author gained a good understanding of the user while creating the concept. The methods of user research were applied and practiced during the project.

Visualization Skills

The author did not meet the expected level of use of visualization in this project. Sometimes the explanation of the concept and the idea relied too much on mood pictures and verbal presentation. The author should be more confident and not afraid of showing the sketches. It is a lesson that the purpose of sketching for the designer is not showing off but to communicate the ideas better. Although, indeed, the designer with excellent sketching skills always look cooler. The author will keep pursuing that as a personal goal.

Personal Experience

It is a unique experience for me to accomplish this project, considering how special this period is, not only for myself but for the whole world. There is a lot of blood and tears happening along the way. A lot of questioning about the design happened all along the process. It is a great lesson that I learned that one of the inherited characteristics of the job as a designer is that people will judge your work. To be a good designer, you have to be open to all different voices, and most importantly, you have to stand up for your design with substantial augmentation. A good design is not something that looks fancy, but it makes sense to be there and will be needed by somebody with desire.

To sum up, this project is a unique and unforgettable experience, and it taught me so much. A lot of discouragement happened along the process, but the way to becoming a good designer, even a great designer, must require even greater courage. I would like to end the project with my favorite lines from the movie Whiplash.

“There are no two words in the English language more harmful than ‘Good Job’.”

“But is there a line that maybe you go too far and discourage the next Charlie Parker from ever becoming the next Charlie Parker?”

“No, because the next Charlie Parker would never be discouraged.”

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