Master Thesis

An Improved Design of IPL Hair Removal Device for Generation Z

Master of Science
Design for Interaction

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January 2021

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Executive Summary

This master thesis reports the research and design activities about designing a new Philips intense pulsed light (IPL) Lumea Prestige hair removal device for generation Z users. The project was supervised by TU Delft and Philips together as a graduation project of master study of design for interaction.

The project follows the double-diamond approach. Firstly, research was done about the current usability issues of the IPL hair removal device. Secondly, generation Z was selected as the target group because of the current market trend. Thus, user research was conducted about understanding the generation Z personal care characteristics. Contextmapping method was used here for deeper understanding of the users. Next, research was done about finding out how to match the current IPL device insights with the characteristics of the generation Z, and how the Philips IPL device can fit into the generation Z personal care routine. In the end, a design goal was discovered based on the research: **by designing an effective communication on the IPL device, a more comfortable IPL device with personal guidance will be created in order to reach a sense of achievement.**

Afterwards, co-creation and ideation were conducted for discovering ideas for the design. Moreover, an exploration on shapes was conducted as well. In the end, a new shape and a new design were created for the generation Z users. The key idea of the final design is about using a tracking sensor to personally guide users on conducting a correct IPL treatment on the lower legs. With a more comfortable shape and a personal guidance feature, the users will be able to conduct a correct IPL treatment, which can help them to have better end results. Therefore, the sense of achievement to reach their hair-free goal can be built up.

The final usability tests have been conducted with real generation Z participants, and the participants were tested to evaluate the effective communication of the device, the comfort of the shape, and the personal guidance feature and the confidence on reaching their hair-free goal. The results of the tests show that

- The communication of the new device is effective and clear to the participants.
- The new shape is comfortable for the users to use, which allows them more freedom to conduct treatments on different hand postures.
- The participants are very positive about the personal guidance and they strongly believe this function will help them to conduct a correct IPL treatment.
- With the personal guidance feature and more comfortable usage, the participants are more confident to reach their hair-free goal.

In conclusion, this master thesis discovered the main usability issues of the Philips IPL device, and how a new IPL can be adjusted to the generation Z users. Moreover, the final tests show that the personal guidance function with digital solutions will help generation Z users to conduct a correct IPL treatment. They will feel more confident to reach their hair-free goal and a sense of achievement can be built up.

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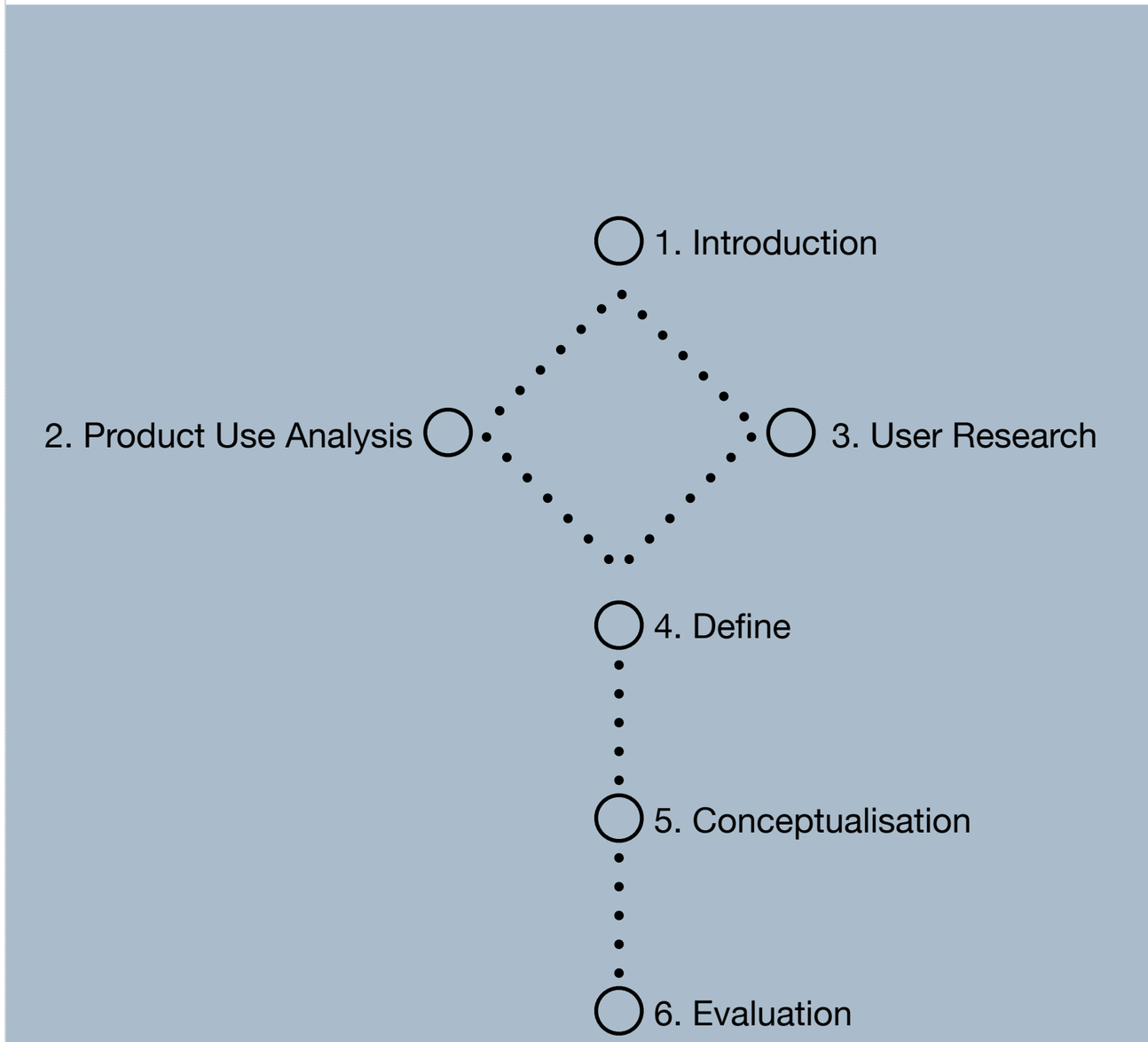
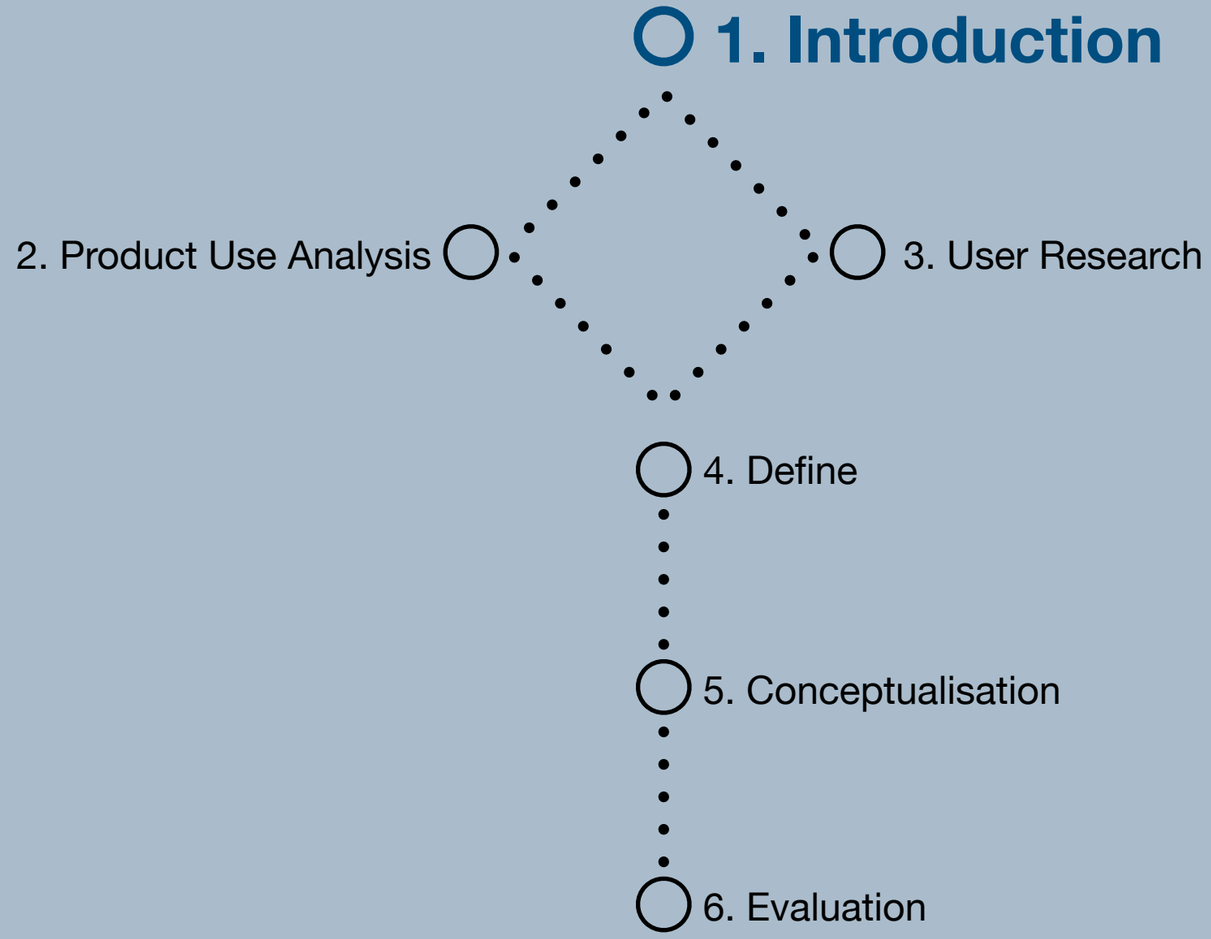


1. Introduction

- 1.1 Project background
- 1.2 Target Group
- 1.3 Current Main Problems
- 1.4 The Aim & Scope
- 1.5 The Approach

This chapter introduces the background of this project, the stakeholder, current main problems of the IPL hair removal device, research methods, generation Z characteristics and the approach.



1.1 Project Background

1.1.1 IPL Hair Removal Background

Hair removal is a popular topic nowadays and a lot of people do hair removal activities during their daily routines. People tend to remove their body hairs on their armpits, legs, arms, and genital areas. Most of them conduct hair removal activities because of cultural, aesthetic, hygienic, sexual or religious purposes. There are many ways of removing hairs which are varied in usage time, regions and cultures. The most common hair removal methods are blade shaving, epilation, waxing, electrical razor, trimmer, laser, and intense pulsed light. However, current hair removal methods are not always satisfactory and they do not provide optimal hair removal experience for the users. These methods are either too painful or they take too much time. Moreover, the results of these methods are not always effective, because the users need to apply these methods frequently in order to be hair-free for a long term.

Philips Beauty Eindhoven found out that consumers are dissatisfied with current hair removal methods. And Philips developed a household IPL hair removal device which can provide users with painless hair removal experience and long-term hair-free result. This household device uses the intense pulsed light (IPL) technology for hair removal. Users can apply intense pulsed light on their skin and their body hairs can be removed, if they follow scheduled treatments, they will have hair-free skin for a long period about 6 months (Philips, 2020).

What is IPL?

IPL stands for intense pulsed light, which is a non-laser high intensity light source. A high-output flashlamp in the device will produce a wide wavelength of noncoherent light, which is in the range between 500 to 1200nm. In dermatology, IPL usage relies on the basis of certain targets for energy absorption, which is from the wide spectrum of light wavelength (Goldberg, 2012). The light releases the energy on the skin surface, therefore, the melanin in hairs will absorb the light energy and then the hair roots will fall out after the treatment. However, this technology can not be used on dark skin which is harmful for the skin. And it is not effective on light hairs. More details can bee seen in chapter 2.

The IPL technology can remove body hairs, however, it can not remove all hairs at one time. This is due to the four different stages of hair growth. In theory, hair roots will absorb the light energy and they will fall out after treatment. However, not all hairs will fall out at the same time, because the hair growth cycle has 4 stages which are Anagen (growing phase for 3-5years), Catagen (regression phase for 10 days), Telogen (resting phase for 3 months) and Exogen (shedding phase). Anagen phase is the most suitable phase for IPL hair removal treatments, because the heat of IPL will be absorbed by the melanin of hairs strand and it will be transmitted to the papilla. Therefore, the root of the hairs will immediately goes into Telogen phase and the new hair growth will be prevented. The users are suggested to conduct the IPL treatment multiple times, in order to treat all hairs at different hair growth stages (Cutis Laser Clinics, 2016).

1.1.2 Philips IPL Hair Removal Device Overview

Philips has developed a household IPL hair removal device, which users can use whenever they want at home (figure 1). It offers consumers easy and painless hair removal treatments at home, which can enable consumers to have a prolonged smooth skin.

There are four attachments to fit and adapt human body figures such as armpits, bikini area, facial areas below cheekbones, and large body areas. Firstly, the users need to do a pre-treatment every time before using the device. This can prevent users from burning their hairs and harming their skin. The possible pre-treatments are shaving, waxing, and epilating. Moreover, users can use the skin tone sensor(STS) to detect their skin colour and the device will give a preferred light intensity setting for the users. After choosing the right setting, the user can start the IPL treatment. The recommended treatment schedule is that users use the device once every two weeks for 2 month, then they would see a significant hair reduction. After the first two months, users are recommended to use it every 4 to 8 weeks if they see hairs growing back (figure 2). However, this device can not be used on dark skin which can be harmful for the skin. And it will not be effective on red, light blond and grey hairs which have less melanin to absorb the light energy.

Figure 1 Philips IPL Lumea Prestige Device

Figure 2 IPL treatment regime (Philips, 2020)

1.1.3 Project Stakeholder

This graduation project is proposed by Royal Philips which is a health technology company. It focuses on improving people's health and delivering better healthy outcomes. Philips is switching its strategy from household consumer products to a healthy medical cycle. The health cycle is from health continuum, throughout healthy living, prevention, diagnosis, medical treatments and home care (Philips, 2020).

In order to provide consumers with better user experience and treatment results, Philips sees there is room for improvement of this device. Thus, this graduation project is created under this vision. Moreover, the new generation Z of consumers is coming to the market, and they are different from the current consumers. Philips sees that the current IPL device should be improved for the coming new consumers.

1.2 Target Group

Generation Z is becoming the new consumers which draws the attention from Philips. Philips would like to involve this group while offering customer solutions. Generation Z consumers are new to the market, who are born between 1997-2012 (Frey, 2020). In this project, the minimum age for user research is above 18 years old. In the current design, the generation Z users are not considered in mind with the design solutions and user experience. Philips would like to consider this group to be one of the future consumers for the IPL device.

However, generation Z users are different from the current main consumers. Generation Z consumers are embraced by new technologies and new adventures. With their open-minded thoughts, they are always eager to be creative and innovative. To better understand and design for the target group of generation Z, the main characteristics are discovered in chapter 1.2.1.

1.2.1 Main Characteristics of Generation Z

The figure 3 (based on MI&A Personal Health Philips, 2020) below summaries six main characteristics of generation Z, namely identity shaping, self expression, dialogue, analytical & pragmatic, inclusive and mobilise themselves.

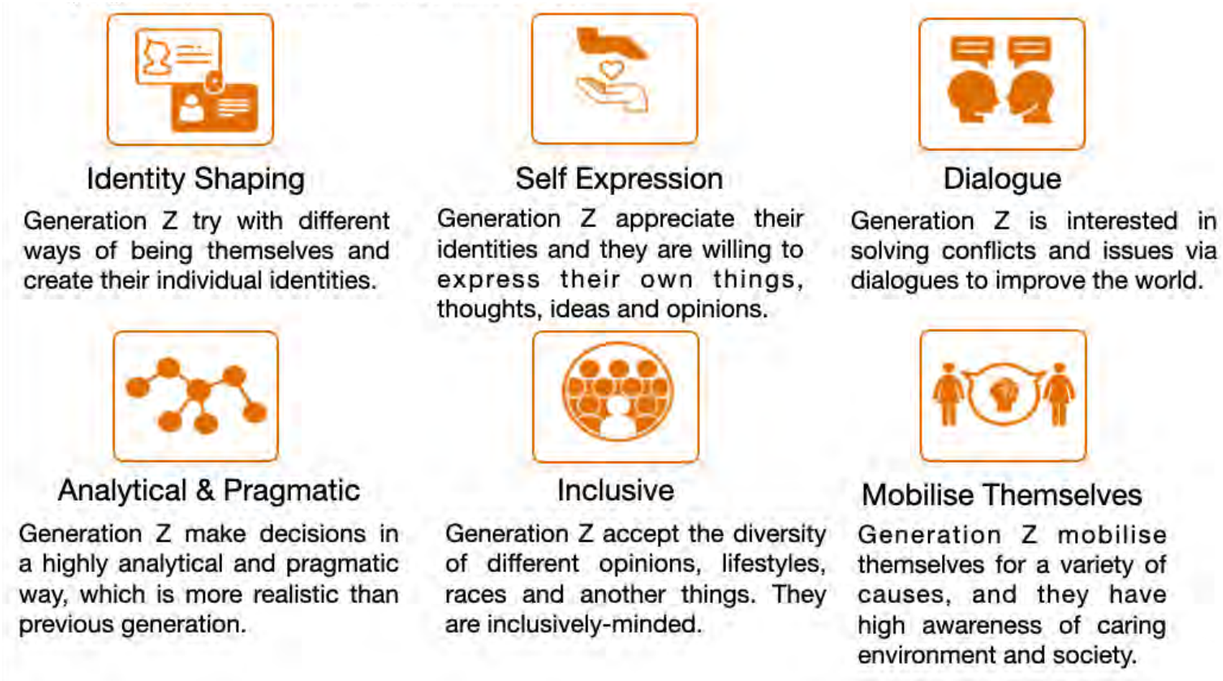


Figure 3 Characteristics of generation Z (MI&A Personal Health Philips, 2020)

Social Media Orientated

Moreover, from Philips MI&A report (2020), generation Z is very social media orientated. For example, 20% of participants see bloggers / vloggers as trusted sources for beauty information. Most of the top-cited brand interactions take place on social media. 29% of Generation Z have watched a commercial video made by a brand and 26% of them have followed a brand on a social network, or visited a brand's social network page (23%). Moreover, 56% of generation Z use social media apps to express themselves creatively (MI&A Personal Health Philips, 2020). Moreover, Younger generations think that family and societal change are positive changes for them, they tend to share their life on social media (Parker and Igielnik, 2020).

Product Experience

Another input is that product experience is also very important for generation Z consumers (MI&A Personal Health Philips, 2020). From Philips product research centre, consumers perceive IPL household treatment as a "ME" time, they try to use this time to enjoy and be alone by themselves (Philips consumer knowledge consolidation, 2020). The consumers value the treatment experience more than which brand they purchased.

Identity and Personalisation

The third input is that Identity and Personalisation are more important for the generation Z consumers. From MI&A Personal Health Philips (2020), the majority of generation Z users agree that self-expression through appearance is connected with identity. If the product can help and satisfy their needs of self-expression and showing their identity, they would switch a brand easily. Moreover, more than 20% generation Z say they would rather spend money on the personalised experience rather than the brand.

Inclusive Generation Z

The fourth input is that generation Z is inclusive. They respect different races, gender, LGBT rights and equality. They are more likely to use gender neutral pronouns and man and woman are not the only gender options for them (Parker and Igielnik, 2020). Currently IPL appearance is designed for female users mainly, however, the new IPL device should also consider male users for a gender neutral style (MI&A Personal Health Philips, 2020).

Therefore, as being the future target users, the characteristics of the generation Z will be taken into consideration for the new design.

1.3 Current Main Problems

Philips would like to offer an optimal hair removal experience of the IPL device to the generation Z consumers. To come to an optimal experience, there are usability problems of the device which need to be overcome. From Philips product research centre (2020), the current device has main problems from current consumers:

1. Current users have no clue which skin area has been treated and which not. Thus, users lose track on their skin and they do not apply the right amount of flashes. On average only 1/3 of required flashes are applied during the treatment. Therefore, the efficacy of the device is lower than what consumers expected. It is like painting white colour on a white wall, which gives the users no clue about where they have painted where they have not painted.
2. Current users lose patience and trust during long treatment schedules and they misunderstand how often they should use the product.
3. Current users misunderstand the UI of the device when they choose settings for their treatments.
4. Using this product on lower legs is not easy for the current users to hold and operate, which has ergonomics issues.

1.4 The Aim & Scope

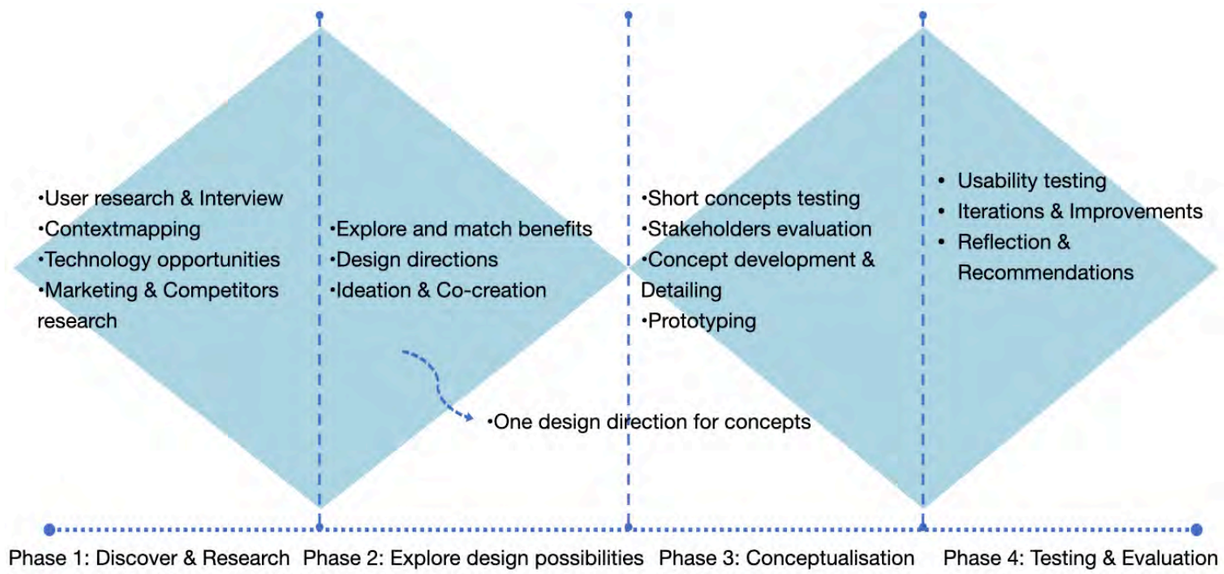
The aim of this project is to redesign the Philips IPL device for the future generation Z consumers. The scope of this project is to discover and analyse the usability issues of this product, and then find out what are the most relevant issues for the target group generation Z. Further analysis and research will be conducted to see how the needs of generation Z users can be included in the new design. At the moment, the most relevant usability issues of this product should be analysed and improved, which might lead to a better user experience. In the end, match the insights and redesign the IPL device for the generation Z users.

1.5 The Approach

This project has four phases, which will follow a double-diamond process. It includes the discover & research, exploring design possibilities, conceptualisation and testing & evaluation.

Firstly, current usability issues of this product will be analysed, from the first time use of the device until being committed to continuing to the end results. Secondly, user research will be conducted with the tool of contextmapping. This is to understand generation Z deeper and the differences between future generation Z users and current consumers of their hair removal behaviours. Afterwards, the relevant insights of product analysis and insights of generation Z user research will be matched, in order to find design opportunities. Then, ideation and direction selection will be done in combination with an expert evaluation.

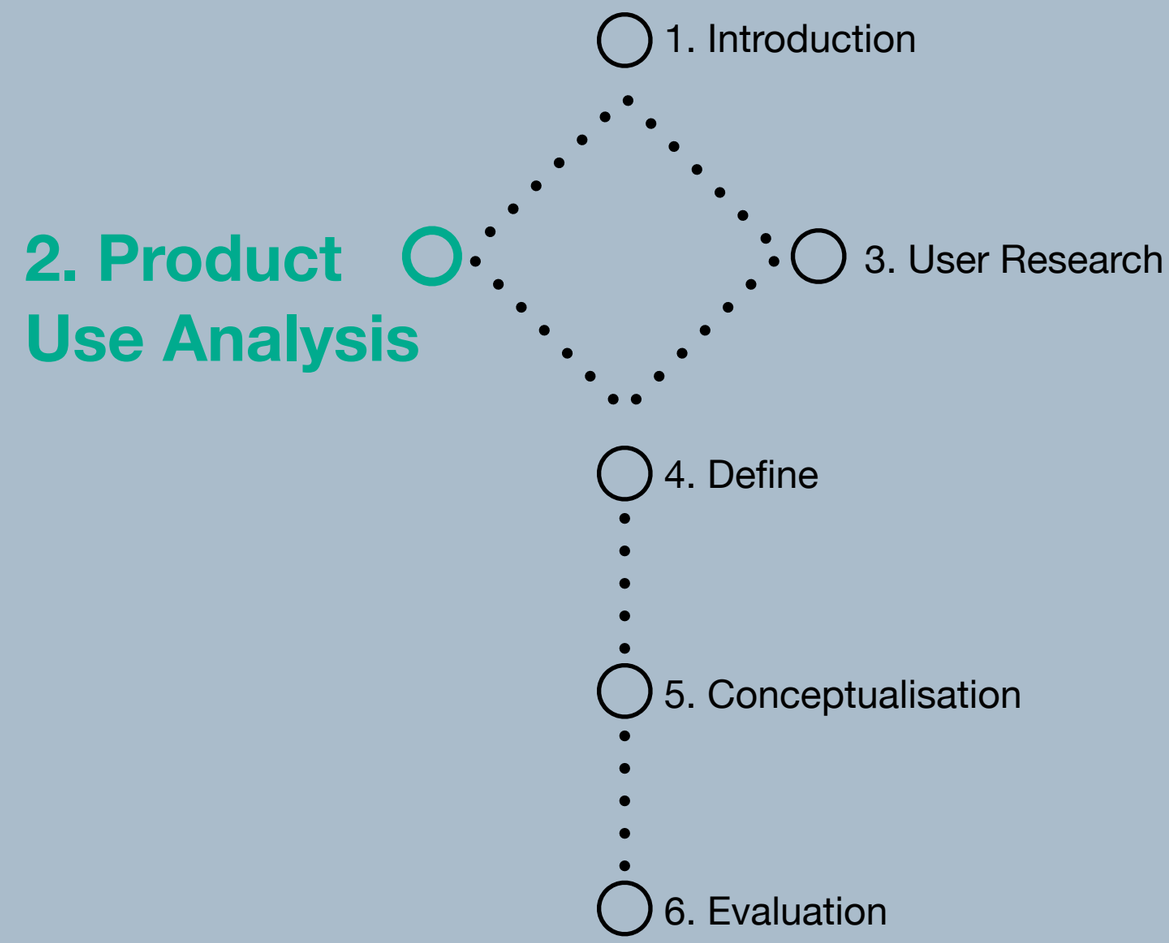
In the end, one design direction will be selected to further develop into design concepts. These concepts will be created based on the selected design direction and agile prototypes will be made for usability testing. Later on, an improved final concept will be presented, and also recommendations and reflections will be provided.



2. Product Use Analysis

- 2.1 Product Usage and Specifications
- 2.2 Current Usability Issues of IPL Device
- 2.3 Conclusion

This chapter is the usability analysis of the current Philips IPL device. In this section, a cognitive walkthrough has been done in order to better understand the usability issues of the IPL Lumea Prestige device. This includes the interface, the user manual, and physical interaction of holding the device. In the end, the main problems of this product are discovered. However, the most relevant problems for generation Z users are still not known yet, more research about Generation Z will be done in chapter 3 in order to address and match the usability issues of IPL device in this chapter.



2.1 Product Usage and Specifications

Philips Lumea Prestige IPL hair removal device uses IPL technology to reduce body hair growth and help consumers to have hair-free end result. The main product specifications are listed below.

Figure 4 Philips IPL Lumea Prestige. From "*Philips consumer knowledge consolidation,*" by Philips research centre, 2020.

Product Specifications (Philips Research Centre, 2020)

Power intensity range: 2.5 to 6.5 J/cm².

The body flash lamp window:3.5 cm x 1.5 cm = 4.1 cm².

Product dimension: 20 x 10.5 x 17.5cm,

The length of handle: 11.6cm,

The diameter of cylinder handle: 3.8cm

The weight: 1.02 kg.

The device has 5 light energy settings which are linked to different skin tones. From figure 5 and 6, it shows which skin tones are safe to use and which hair colours are effective in the IPL. However, in order to protect consumers, Philips IPL device has a skin tone sensor and skin detection sensor. The skin sensor recommends the setting which is comfortable for most women with a similar skin tone and the skin detection sensor detects if there is skin and it prevents unintentional flashing without skin contact. Additionally, all users have to do a pre-treatment which is to remove their body hairs before they use the Philips IPL. The users can do their pre-treatment such as shaving, waxing, and epilating. Beside the device itself, the IPL Lumea also has an App(figure 7), which helps the users to plan the treatments, receive tips, ask questions and get guidance.

Figure 5 suitable skin tones (Philips Research Centre, 2020)

Figure 6 suitable body hair colours (Philips Research Centre, 2020)

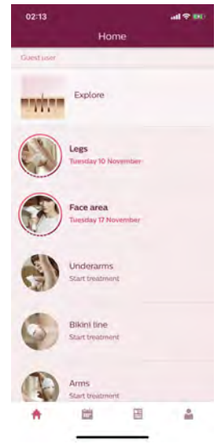


Figure 7 IPL Lumea App

Main product features

The main features of this IPL device which are shown to the consumers are listed below.

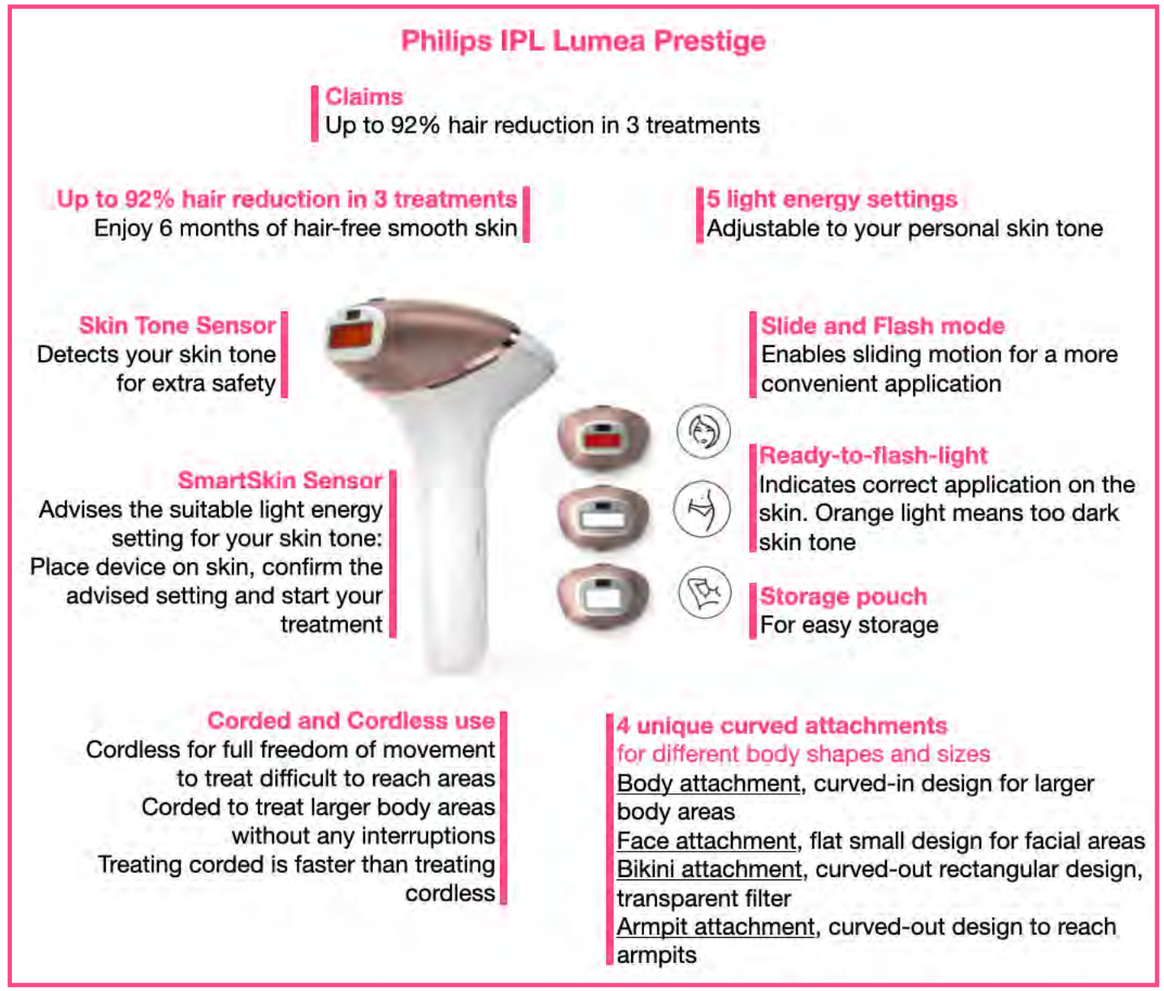


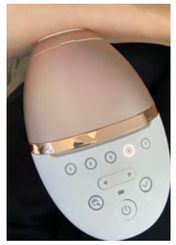
Figure 8 Philips IPL Lumea Overview. From "*Philips consumer knowledge consolidation,*" by Philips research centre, 2020.

How to use the product

The general way of using the device is explained below. This includes the basic steps of operating the Philips IPL Lumea device. The user can follow the steps below for one time treatment.

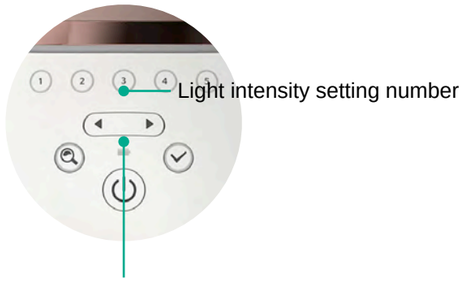
1. Open the box, read the user manual and choose the correct attachment for your treatment area.

2. Switch on the device and press the SmartSkin button to detect skin tone.

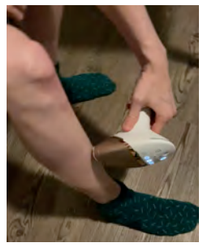


3. Scanning your skin tone for a suitable setting. The device will recommend a setting for you.

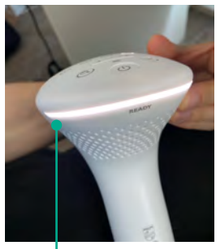
4. Confirm the recommended light intensity setting by clicking this button. The white-blue light indicate you are having setting 4.



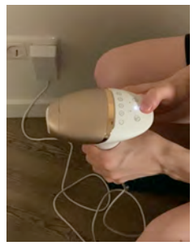
5. If you feel the setting is too painful, you can adjust the light intensity setting by pressing this button.



6. Start the treatment by pressing the flash button on the handle.



7. You can only flash when “ready to flash” light is on, it means you have a good skin contact.



8. You can use the device corded and cordless.

9. After using it, you can clean it and store your device in the pouch.

2.2 Current Usability Issues of IPL Device

In order to deeper understand what are the main usability issues of the Philips IPL device, the cognitive walkthrough method was used here. The cognitive walkthrough is used to analyse the usability of a product. A new user will be asked to conduct tasks on a given product, which is a usability task-specific method. Rapid insights can be seen during the cognitive walkthrough process, which can be beneficial to see how the user understands the product and how the user uses the product with or without the user manual(Jones, 2020).

Task Flow

In this session, a voluntary male user from target group Generation Z participated in the first-time-use of Philips IPL device and completed the user journey from unpacking to finishing the first treatment. This user had no experience with using any IPL device but is interested in hair removal offers. The volunteer was asked to use the Philips IPL device on lower legs, armpits and upper lip, because current consumers show usability issues mostly on these three body parts.

Without interruption, this user had to finish all IPL treatments including the pre-treatment(such as shaving before using the IPL device). There was only one participant in this session, thus, the outcome might not be objective in large scale.

Observation was used and key insights were written down for analysing the results. Therefore, there are usability issues discovered and relevant insights are collected. The steps of how the usability cognitive walkthrough is conducted can be found below (figure 9).

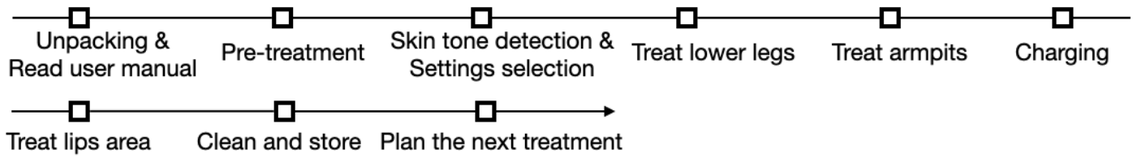


Figure 9 cognitive walkthrough tasks

After the usability cognitive walkthrough session, the main usability issues and insights are discovered and collected.

- The detailed process of the whole cognitive walkthrough session including tasks details, photos, and extra explanation can be seen in the appendix B.

2.2.1 User Interface

During the tasks, the participant showed difficulty understanding the user interface.

- 1. The light intensity settings(from 1-5) are confusing for the participant, which he thought it was for his skin tone, not the light intensity(figure 10). For example, the user misunderstood that number 5 is his skin tone type 5, which should be the light intensity setting 5.
+ 2. The user liked the light indication of the settings, it is intuitive for him to understand the device is detecting his skin and he needs to confirm it.
- 3. The icons on the interface and attachments are not clear for the user. The participant did not recognise the armpits and facial attachment icons at the first time, and he checked the user manual for clarification. Moreover, the icon of the skin tone scanning button is not clear. The participant thought it was for a searching function.
- 4. The steps of confirming the light intensity setting is confusing. User clicked number 5 to confirm the setting, because the setting number looks like a button (which is not a button). And the user can only click ✅ button to confirm the setting(figure 10).
- 5. After changing the setting, the user intended to confirm setting by clicking ✅ button, but the system does not require the user to confirm it again. There is a confusion from the user that if the change of setting is confirmed or not.

Figure 10 Confirm button

Figure 11 Cleaning and Storage

2.2.2 Cleaning & Storage

- Cleaning methods are not well explained in the user manual, the user did not know where and how to clean the device. And it was not possible for the user to store the device, because the user can not put all parts of the device into the pouch (figure 11).

2.2.3 User Manual

- The user manual does not effectively communicate with the user. The user said: “I don’t want to read a book to learn how to use the product.”, thus, the user stopped reading the user manual but started to search videos on Youtube. Because it was so much text and he prefers video instructions(figure 12). However, there was only one participant in this testing, thus, the opinion of user manual might be subjective.

Figure 12 Search IPL information on Youtube

2.2.4 Communication

The device does not well communicate with the users in certain parts of treatments, for example:

- 1. The user can not see the interface while detecting his skin tone on the lower legs (figure 13). Thus, the user does not know when the skin tone scanning is done.
- 2. The user mentioned that he has no clue about where has been flashed and where has not been flashed. Therefore, some parts of the skin are not treated, which may lead to inefficient end results. Moreover, the user can not keep being motivated to use the device, because the user can not see results immediately. This issue makes the user lack encouragement and does not have a sense of achievement after the treatments.
+ 3. It is easy for the user to see the”ready to flash” light while treating his lower legs.

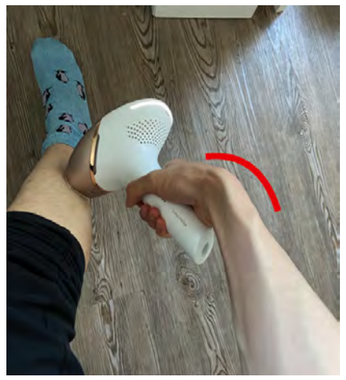


Figure 13 Treating Lower Leg

2.2.5 Ergonomic Issues of IPL Device

During the cognitive walkthrough session, the user operated the device on the treatment areas. Although the walkthrough session is mainly for usability of interfaces, the participant experienced significant discomfort while using the device on the lower leg. Thus, the significant ergonomic issues of using this device are discovered, because of the skin contact, the weight and the handling.

However, from Philips Research Centre(2020), most users did not experience discomfort while using the device on their upper lips, arms, bikini area and armpits. The reasons are that the shorter treatment time (5-10minutes) and keeping good skin contact on these body parts is easier than lower legs. Therefore, literature study has been conducted to analyse the ergonomics of the Philips IPL Lumea device and the insights from the study will be shown in the following sections.

Skin Contact

It is not easy and uncomfortable for the user to have good skin contact with the device on the shin bone of the leg. The user took a very long time to keep the device in a good position on lower legs (figure 14), because there is less fat on the bone area and the skin surface is not flat.

Handle of Philips IPL Device

From literature study, Lindqvist (1998) recommends a suggested range of length of a handle for women and men. For women, it is approximately from 90 to 110 mm, but not less than 80 mm. For men, it is approximately from 100 to 130 mm, but not less than 90 mm. Moreover, the diameter of a handle is one of the key parameters that influence how the user can apply force. As a cylinder handle, if the user uses the power grip (figure 15), which is also the holding posture of Philips IPL device. The recommended diameter for women is 34mm and for men is 38mm. The recommended diameter range is from 34mm to 45mm (Lindqvist, 1998). The length of Philips IPL device handle is 11.6cm and the diameter of cylinder handle is 3.8cm. This is within the recommendation range of a handle which provides the user with a comfortable power grip posture.

Therefore, the user stated that the handle is easy to hold and operate when the treatment time is short. However, he experienced discomfort when he conduct lower leg treatment for 30 minutes, because of the weight and centre of mass are not ideal.

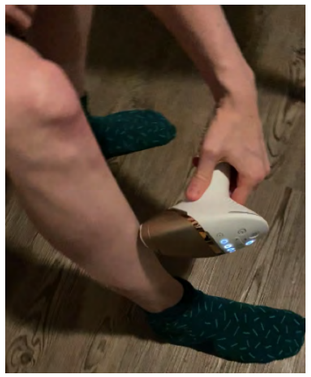


Figure 14 Skin Contact

Figure 15 power grip postures (Elam, 2017)

Centre of mass

One of the complaints from Philips reviews is that consumers think the weight of the IPL device is too heavy. It is 1.02kg which would be heavy if the user uses it on the lower leg for more than 20 minutes. Elam (2017) had insights gathered from user studies about a handheld vacuum cleaner. In this case study, participants were asked to hold the handheld vacuum cleaner with the weight from 1kg to 2.2kg (figure 16).

In this study, for handheld devices, the centre of mass position in relation to the wrist position should be considered. For example, the user will feel more comfortable if the distance between the centre of mass and the wrist joint can be shorter, which can decrease the load on the wrist.

Figure 16 Centre of mass testing (Elam, 2017)

Figure 17 Estimated centre of mass of Philips IPL device

For the Philips IPL device, the battery is located on the top of the device instead of in the handle. Thus, the centre of mass is not on the handle but it lays on the top of the device. The estimated centred of mass is shown from figure 17. Therefore, for the Philips IPL Lumea device, the centre of mass can be adjusted for a better handling experience, which the user will feel it less heavy.

Hand postures of Philips IPL device is not ideal

In the session, the user's wrist is uncomfortable because of the strains on the wrist. The user needs to keep 90° perpendicular on the skin, in order to have good skin contact with the device. These actions cause discomfort on the user's front arms during the treatments, especially on lower legs treatment. Moore et al. (2011) identified several hand postures for handheld devices.

There is one neutral posture and four awkward postures (figure 18). From overview of observed hand postures, Philips IPL device has the hand postures of Ulnar Deviation and Flexion. These two postures are not comfortable for users to keep for the treatments on legs for about 20 minutes. There is an analysis of hand muscle activity done by Moore et al. (2011), which is about measuring the front arm muscle activities in six hand postures while using a handheld device (figure 19). The postures of the IPL device (Ulna Deviation & Flexion) have high levels of muscle activity, which can cause muscle pain and soreness.

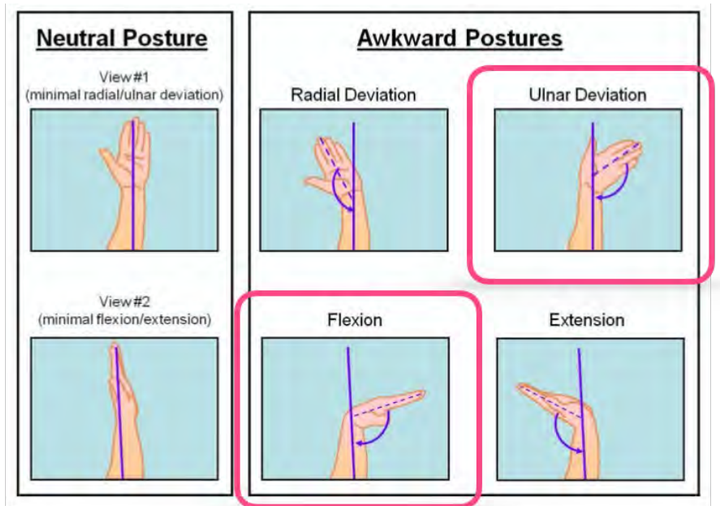


Figure 18 Hand postures (Moore et al., 2011)

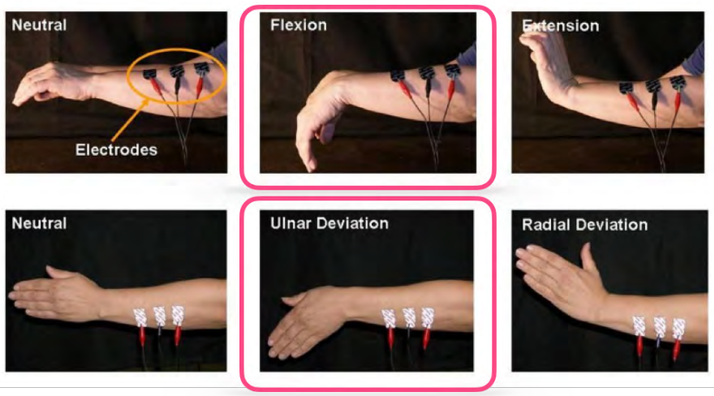


Figure 19 Hand muscle activity (Moore et al., 2011)

User has discomfort on the back and waist

In order to keep neutral posture in the wrist, users sometimes tend to bend their back to reach the ideal posture. It provides comfort for the wrist, however, it raises discomfort in their back. From figure 20, Moore et al. (2011) also stated two neutral postures and awkward postures for back postures. Thus, the participant experienced the back sore and pain after treating his lower legs, which were caused by back flexion, twisting waist and lateral bending.

Furthermore, to understand what could be a comfortable holding posture, In figure 21, Moore et al. (2011) used a handheld drill to perform a screwing task. Four examples of situations show that a pistol grip and inline grip can be a useful way for keeping the user's wrist in a neutral posture. When the user uses Philips IPL device, it is easy to keep a neutral posture while treating their armpits, bikini lines, belly and arms. However, it is not in a neutral posture when the user treats their lower legs, which is actually a large part of the treatment process.

Therefore, for the Philips IPL device, if the shape needs to be changed in the later stage, it would be suggested to design a new shape which allows the user to keep a neutral posture at 90° at most of the time.

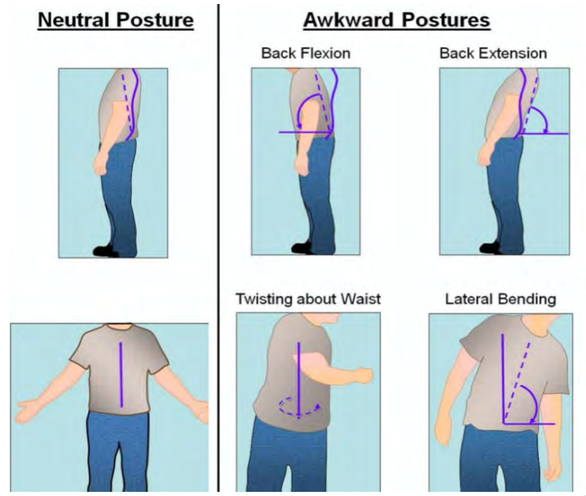
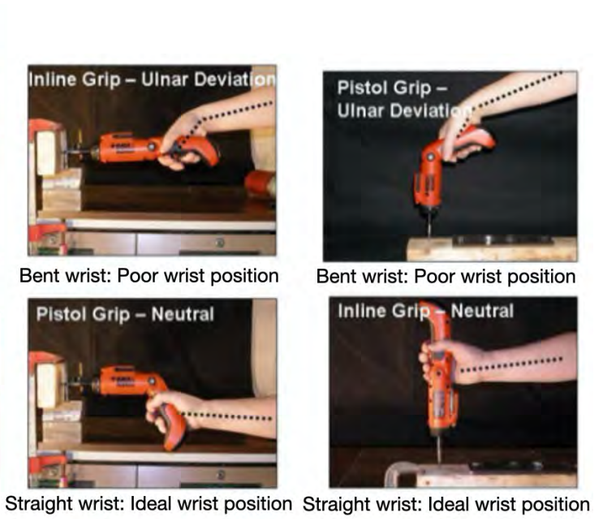


Figure 20 Back Postures (Moore et al., 2011)



Bent wrist: Poor wrist position

Bent wrist: Poor wrist position

Straight wrist: Ideal wrist position

Straight wrist: Ideal wrist position

Figure 21 Hand postures of holding a drill (Moore et al., 2011)

Aesthetics appealing will provide comfort

From Philips research centre (2020), current consumers complain the weight of the IPL device but they think it is acceptable to use it. Most of they think it looks easy to hold in their hands and they can perform the most of tasks. From the research of Kuijt-Evers (2007), aesthetics are vital for users in expecting comfort in products. It has a major impact on user's opinions of comfort and purchase decisions. Aesthetic appealing products may give the user a feeling of using it comfortably, however, this comfort only exists in a short time. If the product has significant ergonomics issues and the time of performing tasks is long, then the discomfort will show up in the end. The Philips IPL device can perform most of the treatment tasks in a comfortable way, however, the discomfort comes from the treatment on lower legs which is the longest treatment time for about 30 minutes.

2.3 Conclusion

After the volunteer performing all the tasks and the literature study of ergonomics, the main usability issues are concluded.

Product ergonomics & Aesthetics: If the appearance of the product looks comfortable to use, it can provide short term comfort feeling for the user. However, the hand posture of using this IPL device needs to be improved, which is an issue for users to use the device. The weight, the shape and centre of mass can be reconsidered.

User Interface: The user interface is not easy to understand, thus, an easier and intuitive interface should be provided. For generation Z users, digital solutions can be considered.

Skin contact: It is not easy for the users to keep having good skin contact while treating the lower legs. Easier skin contact solutions can be considered.

Communication: The device does not give any feedback about whether you are doing it right or effectively, therefore, users have missing spots on their skin during treatments which lead to an inefficient end result. Moreover, users do not read the user manual carefully which is not interesting to read the large amount of texts. Effective and fast communication should be considered in the IPL device.

Discussion

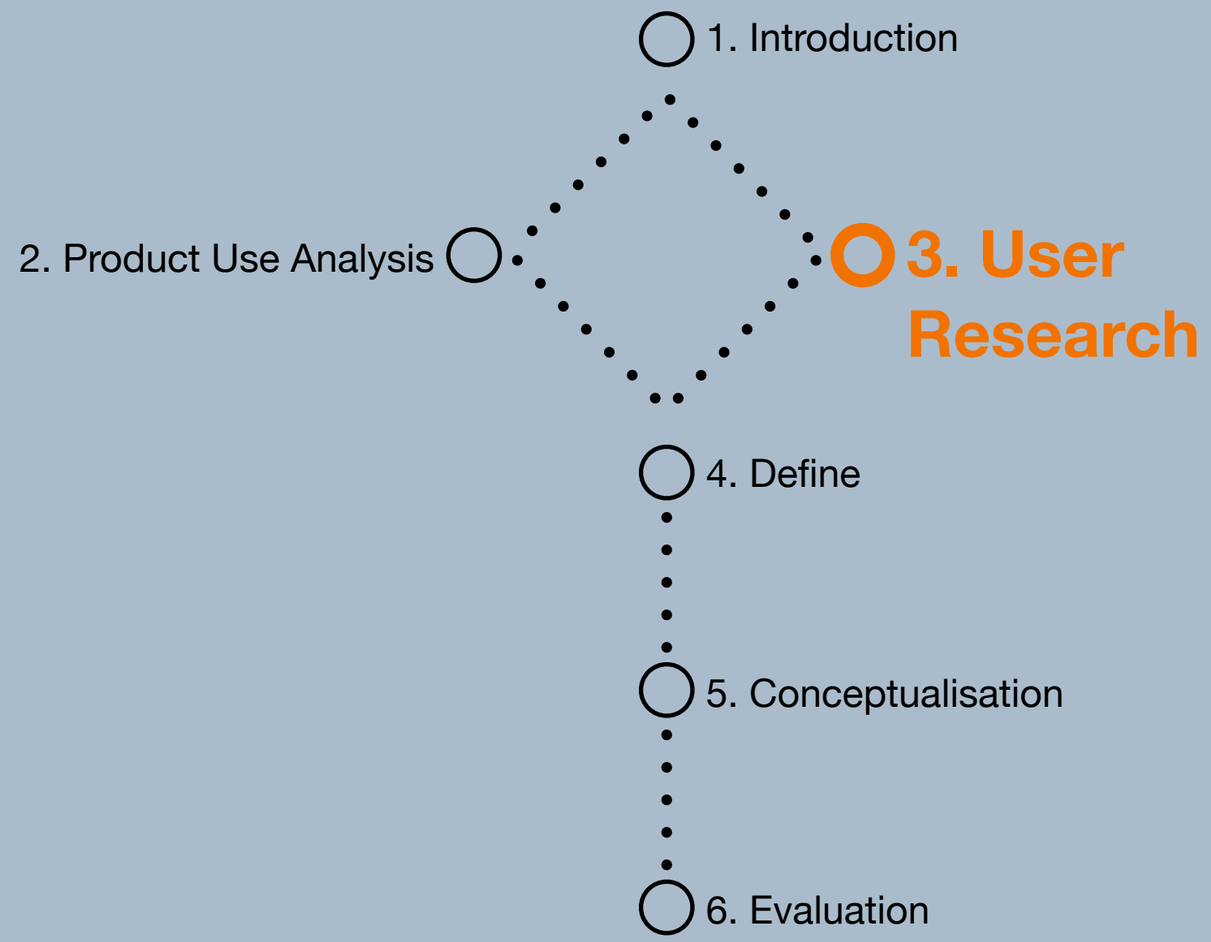
There was only one participant joined in this session (due to the Covid-19 lockdown), the outcomes of this session might be subjective. Moreover, the participant conducted tasks on upper lip, lower legs and armpits, which are the most common treatment areas. But users might also use this device on other body parts, such as arms and bikini lines. Therefore, there might be more usability issues on other body parts.

Further more, the generation Z target group might have specific needs related to usability of the IPL device because of their different lifestyles. This will be further researched in chapter 3 in the aspects of generation Z hair removal habits, easy usage of products, self-understanding of using the product, new ways of using the user manual, and social media channels.

3. User Research

- 3.1 Research Goal and Questions
- 3.2 Research Methods: Contextmapping
- 3.3 Target Group
- 3.4 Procedure
- 3.5 Insights of Interviews
- 3.6 Personas
- 3.7 Design Directions
- 3.8 Conclusion of User Research

After the analysis of the current IPL product, another important aspect is the user. Understanding the target user can acquire insights about how to improve the current IPL device for the generation Z users. This chapter is about conducting the user research of the generation Z consumers, in order to find relevant insights to match the usability insights from chapter 2. In this section, the user research method of contextmapping has been used for deeper understanding of generation Z personal care behaviours and hair removal habits. Moreover, relevant insights from generation Z users are collected, in order to seek the opportunities to adjust Philips IPL device for generation Z consumers. Design opportunities are concluded after main research topics In the end, target group personas are concluded and possible design opportunities are proposed.



3.1 Research Goal and Questions

Research Goal

The objective of this research is to understand generation Z personal care routines/rituals and their grooming experience. To find out the issues of generation Z grooming journey and how Philips IPL device can fit in it. Furthermore, to explore the future possibilities of Philips IPL device for generation Z users.

Research Questions

The research questions for this research are:

- What are the general behaviours of generation Z when they do personal care?
- Why do generation Z do personal care?
- How do generation Z do their grooming?
- How is the experience and what are the issues of grooming for generation Z?
- What are the similar things and differences of grooming between male and female of Generation Z?
- What are the possibilities for the Philips IPL device to solve issues of grooming for generation Z?

3.2 Research Method: Contextmapping

In this user research, contextmapping(Sanders and Stappers, 2012) has been used for a better understanding of the generation Z users. Because the contextmapping can allow users to be involved in the design process, where users can be the “experts of their experience”. In this approach, the users can express more about what they say, what they do and how they feel or dream(figure 22).

This contextmapping approach followed with a sensitising session and an interview session. Participants were asked to fill in a sensitising booklet one week before the real interview, this can trigger and understand the generation Z users deeper(Sanders and Stappers, 2012). In order to help participants to feel easier with dreaming about future ideas, the structure and set-up of interviews will follow the path of expression(figure 23) from Sanders and Stappers (2012).

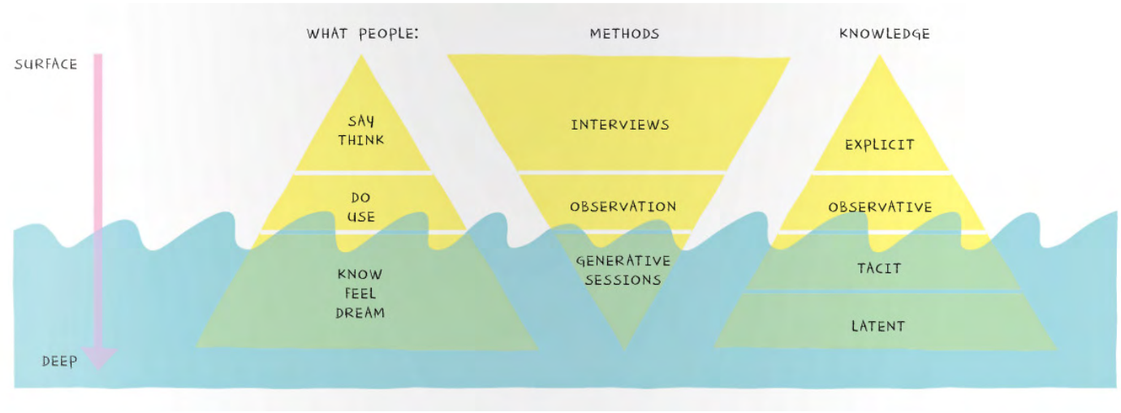


Figure 22 How people do, say and make in different levels of knowledge. (Sanders & Stappers, 2012)

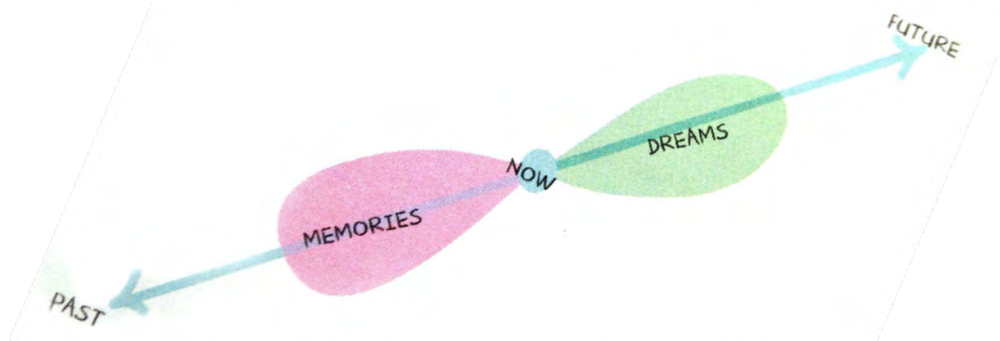


Figure 23 Path of expression (Sanders & Stappers, 2012)

3.3 Target Users

11 participants were invited for the interview, including 8 females and 3 males who are aged from 18 to 27 years old. There are two participants who are older than 25, which is not within the age range of generation Z. However, these two participants are still in University and having similar social groups with generation Z users.

Participants are all students, and their ethical backgrounds are Dutch, German, Chinese, Italian, Spanish and mixed Asian Dutch. All participants have signed up for a privacy notice consent form before the interviews, see in appendix C. Moreover, another key criteria is that they would be interested in investing money on personal care products when they have an available budget.

3.4 Procedure

In the research, the first step is about sensitising booklet and the second step is about interview. There are explained as below.

3.4.1 Sensitising Booklet

The booklet is to ask participants to stimulate their daily personal care experience before the interview. Preparing sensitising questions before the interview can evoke deeper experiences and insights for the interview, and participants would have more time to recall their previous memories and dream about their future experiences (Sanders and Stappers, 2012). The booklet includes the topics of personal care activities, personal care products, personal care routines and ideal personal care environment (figure 24). The details of this booklet can be seen in appendix D.

Participants received the booklet one week before the interview. They will need to spend around 15 minutes on answering the questions, and they need to track and write down their personal care activities for one week before the interview.

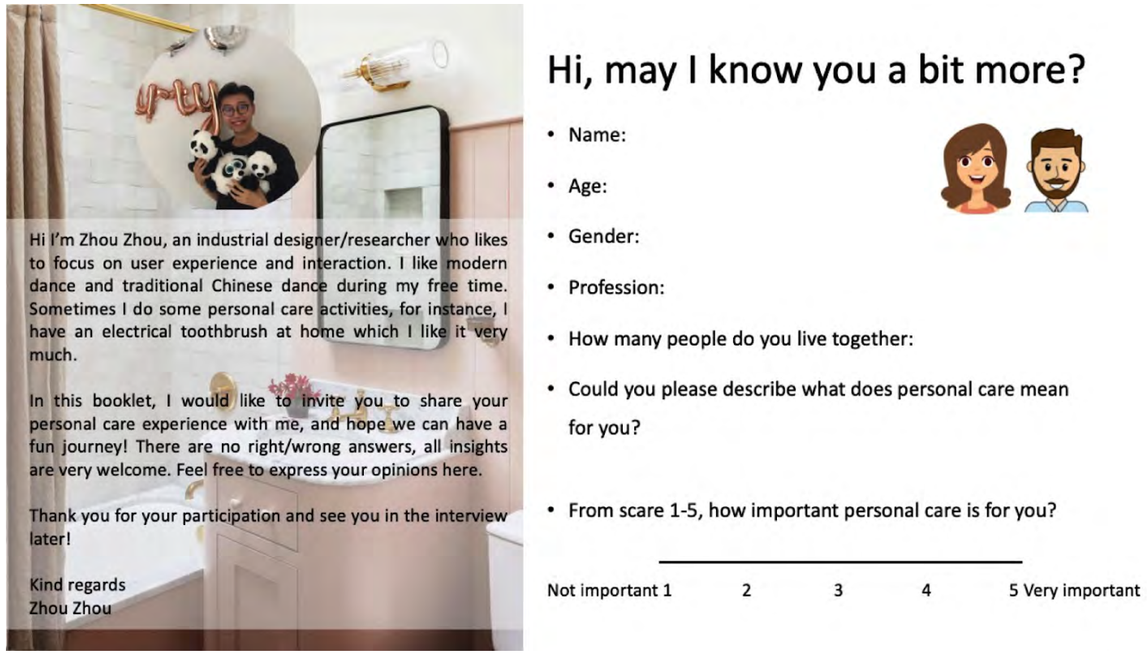


Figure 24 Sensitising booklet

3.4.2 User Interviews

The user interview is set up in order to understand the behaviours of generation Z when they do personal care, specifically towards their grooming experience.

After filling in the sensitising booklet, the interview will follow up. The user interview takes 45 minutes for each participant. Participants will be asked questions firstly about their sensitising booklet, which is about their personal care behaviours. Then some questions about grooming will be followed during the interview. When it comes to private topics such as hair removal parts, participants can remotely place blue dots on the figure to indicate their answers instead of talking about it directly (figure 25). If the participant showed interest in IPL, extra questions about the IPL device will be asked as well and answers are collected anonymously. Interview questions can be seen in appendix E.

There was one participant who joined the interview as a pilot interview, in order to check if participants could understand the materials of the interview, if the structure of the interview is logical, and if participants understood the questions. The pilot interview went very well, thus, the result of the pilot interview can be included into user research. All interviews were conducted via Teams online, due to Covid-19 situation (figure 26).

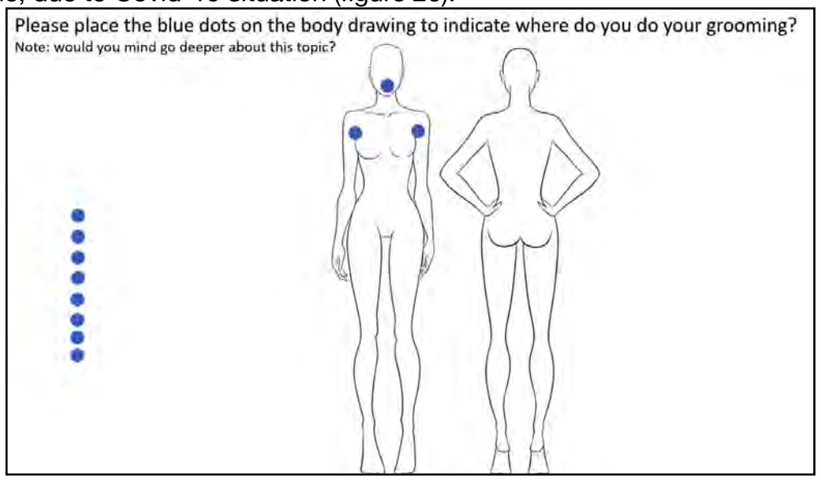


Figure 25 Place dots on human figure for private hair removal topic

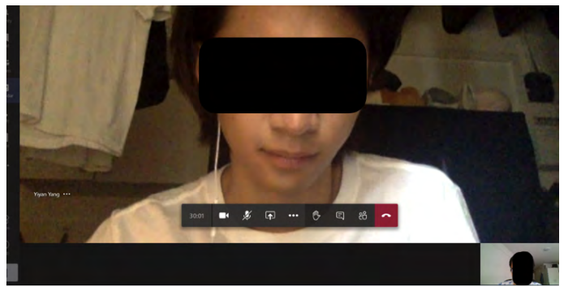


Figure 26 Online user interview via Teams

3.4.3 Data Collection & Analysis

After the interview, data and results were collected. The interview quotes which are linked to research questions(orange stickers) are placed together. Then the answers to research questions are collected(figure 27).

Next, in order to understand the link between different participants and create user personas, the quotes which have similar topics are placed together with pink stickers(figure 28). Therefore, main insights of interviews, the answers to research questions, and possible personas are concluded from this session.

Figure 27 Answers related to research questions

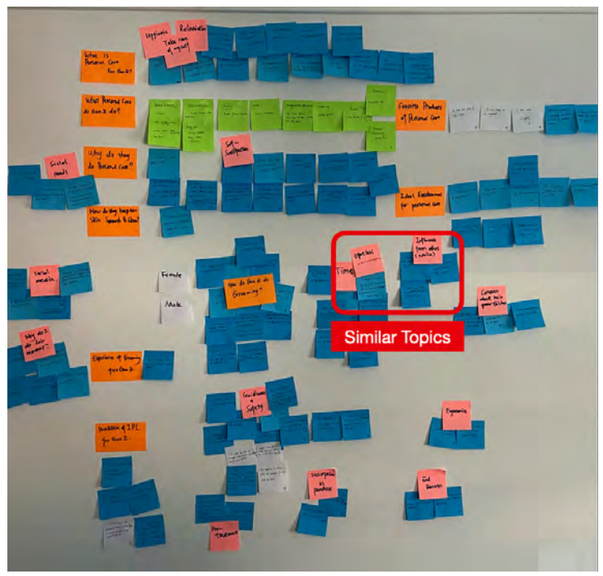


Figure 28 Cluster similar quotes into topics

3.5 Insights of Interviews

In section 3.5, the insights of interviews are collected. These insights cover the topics of personal care activities, personal care products, grooming experience, ideal personal care environment, and their opinions of the Philips IPL device.

3.5.1 Personal Care of Generation Z

In this subsection, insights of the general personal care attitudes, activities, and behaviours are concluded. In the end, design opportunities related to this topic are proposed.

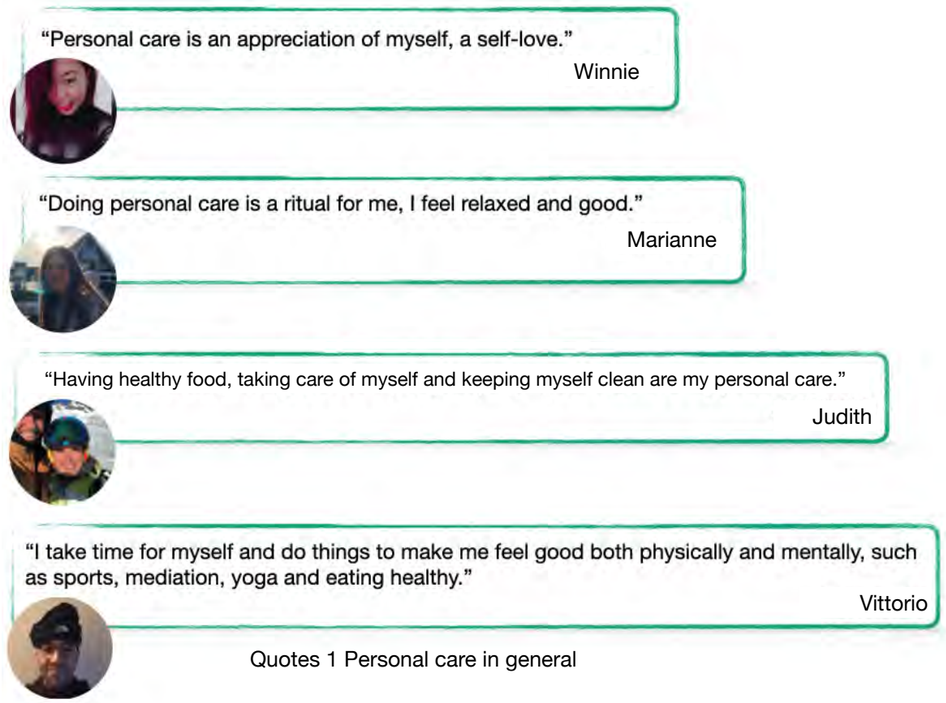
What does personal care mean for generation Z?

From the interview results, participants perceive personal care as various aspects and they gave their own definitions (quote 1):

External: From the external aspect of personal care, participants like to make themselves clean, look good and be presentable. For example, participants state that they would not want to join the online meeting if they have not done their make-up on their face.

Internal: From the internal aspect, participants consider what they eat, what they do for their diets, and how they do sports as their personal care. Participants think that having a healthy diet and doing sports are their personal care activities, which is good for their internal aspect.

Mental: From the mental aspect, participants think having relaxation as rituals, taking care of themselves mentally, and being self-love are their personal care. For example, participants do meditation for having a good and stable mental mood.



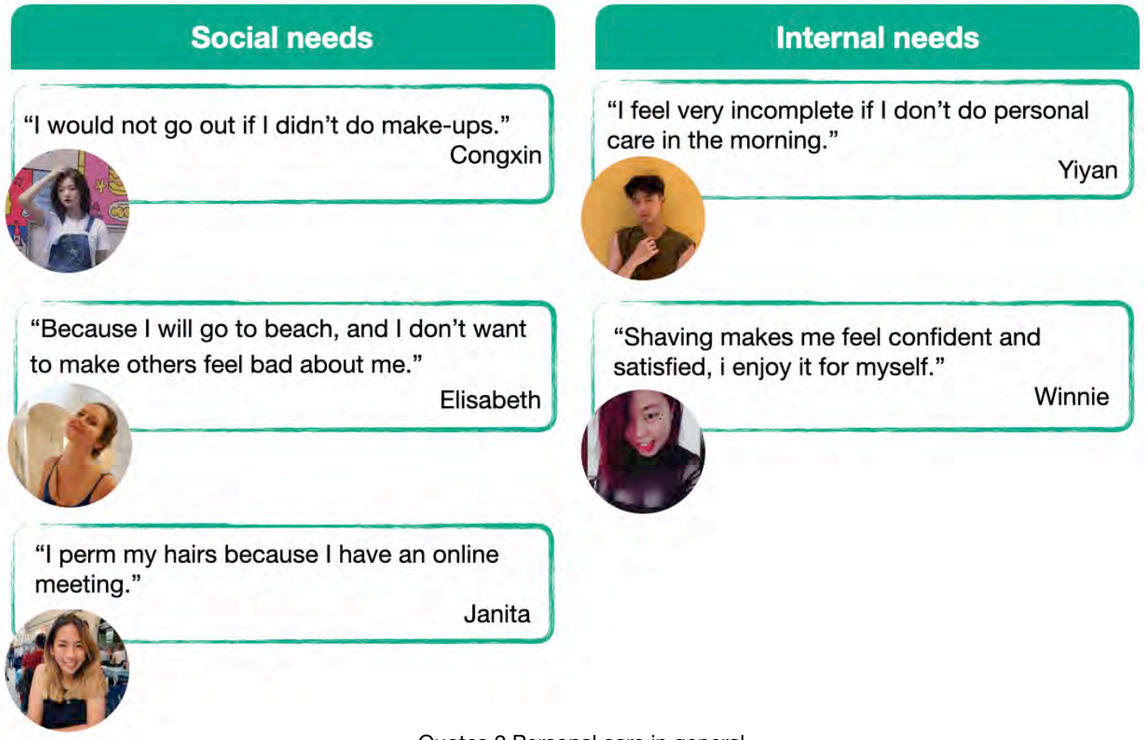
Quotes 1 Personal care in general

Why do they do personal care activities?

Generation Z participants perceive personal care as various aspects, however, there are several reasons why they do personal care activities.

For social needs: most participants state that they do personal care because they need to meet someone and some social events. They want to make themselves presentable, which is also a respect for others (see quotes 2).

For internal needs: some participants think that doing personal care makes them feel satisfied and confident, and it is a sense of relaxation for them which can influence their mood (see quotes 2).



Quotes 2 Personal care in general

What personal care activities do Generation Z do?

After understanding the meanings and reasons of personal care from Generation Z participants, the most popular personal care activities are collected as well. Generation Z participants do all kinds of personal care activities, not just for their appearance but also for their physical well-being.

•**Skin care:** Participants mentioned that they use moisturising lotion, do skin scrubbing, skin cleaning, use body lotion, and skin tanning. These activities will help them to have a presentable appearance.

•**Hair:** They wash and brush their hairs very often, they sometimes dye, perm, and brush their hairs for fashion needs. These activities can help them feel more fresh and confident when they socialise with people.

•**Teeth:** They brush teeth everyday, and sometimes they floss their teeth. They think this is very important to keep oral health good, which is also a respect for others.

•**Nails:** Generation Z participants go to beauty salons to polish, colour, and manicure their nails. These activities can add bonus points to their appearance and it is also a relaxation for them when they go to salons.

•**Hair removal:** Generation Z participants do all kinds of hair removal activities, some of them even combine certain hair removal methods, such as shaving, waxing/sugaring waxing, epilating, IPL, and laser treatment. Some male participants also do beard trimming. Hair removal activities are very important for the participants, and it shows they are clean, decent and well-presentable.

•**Make-ups:** Female participants spend a lot of money and efforts on make-ups.They search make-up tips on social media, purchase make-up products after watching their favourite vloggers' videos, and they even purchase the product if their star idol endorses the product commercially.

•**Deodorant:** This is essential for participants for a daily activity, which is for a hygienic reason and a respect for others.

•**Physical activities:** 4 out of 11 participants think physical activities are also personal care activities, such as doing sports, yoga, and muscle stretching. These activities can provide them good body conditions and health, which are also important for them.

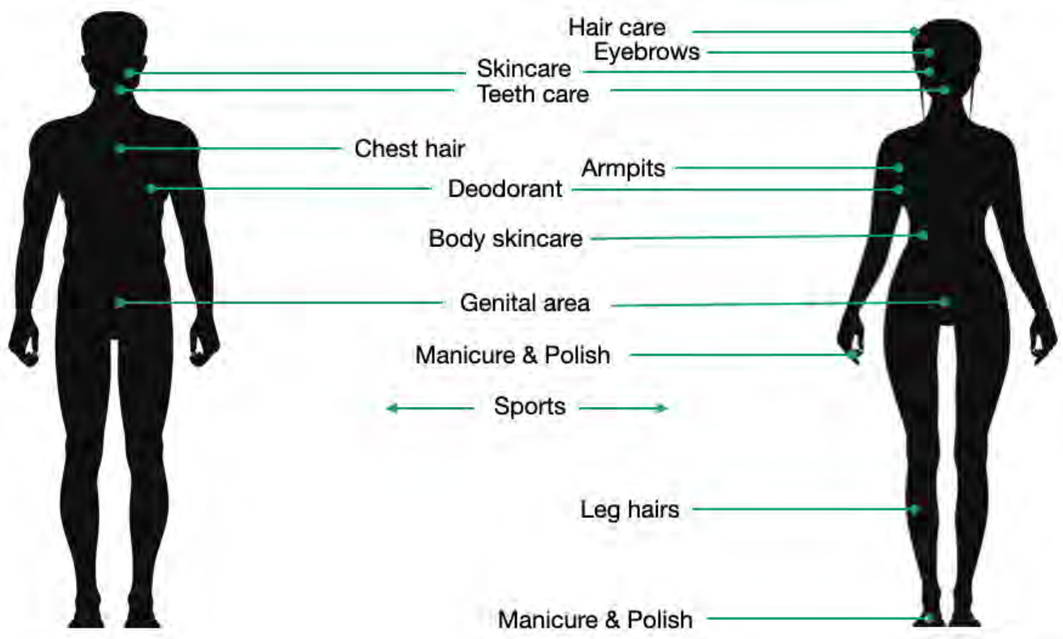


Figure 29 Personal care activities

3.5.2 Personal Care Product Preferences

After understanding the overall personal care activities from generation Z participants, the next topic is about understanding what are the preferences when generation Z purchase a personal product. From the sensitising booklet, all participants need to list and explain three of their favourite personal care products that they own. From this question, participants explained why they like their products and what aspects of the product attract them the most. In the end, the preferences of personal care products are concluded below.

•**Ergonomics:** Participants like the product which has ergonomics comfort, even if the product is simple and cheap. If the product is comfortable to hold, to operate and easily do the tasks, then it can make participants feel willing to keep using it. From table 1, participant states: “i really love the grip of my comb.”

•**Scent:** There are 6 participants mentioned about the scent of their products. If they like the scent of the product, they would highly possible buy it.

•**Product aesthetics:** Appealing product appearance will influence their purchase decisions. If the product fits their personal style or if the product looks aesthetically appealing, then participants tend to purchase this product.

•**Influence from friends/families:** Participants listen to their friends and families in the first place when they need suggestions on their personal care products(see quote in table 1). This will have a large influence on participants’ purchase decisions.

•**Influence from social media** (Instagram, TikTok, Weibo and Youtube): Online social media has a huge impact on participants when they purchase a new personal care product. Because, they can easily link their own experience with vloggers’ experience online, which is more convincing than TV advertisements and Website advertisements(see quote from table 1).

•**Technology interests:** Generation Z participants are familiar with new technologies nowadays, but they are skeptical about new offers. They would not blindly follow new offers but they would try to understand the technical knowledge behind the product. Future generation Z households will drive demand for smart technologies and appliances such as connectivity, digitalisation and artificial intelligence, particularly those that help them to save time in doing domestic chores and offer in-home entertainment and personalised experiences and services (MI&A Personal Health Philips, 2020).

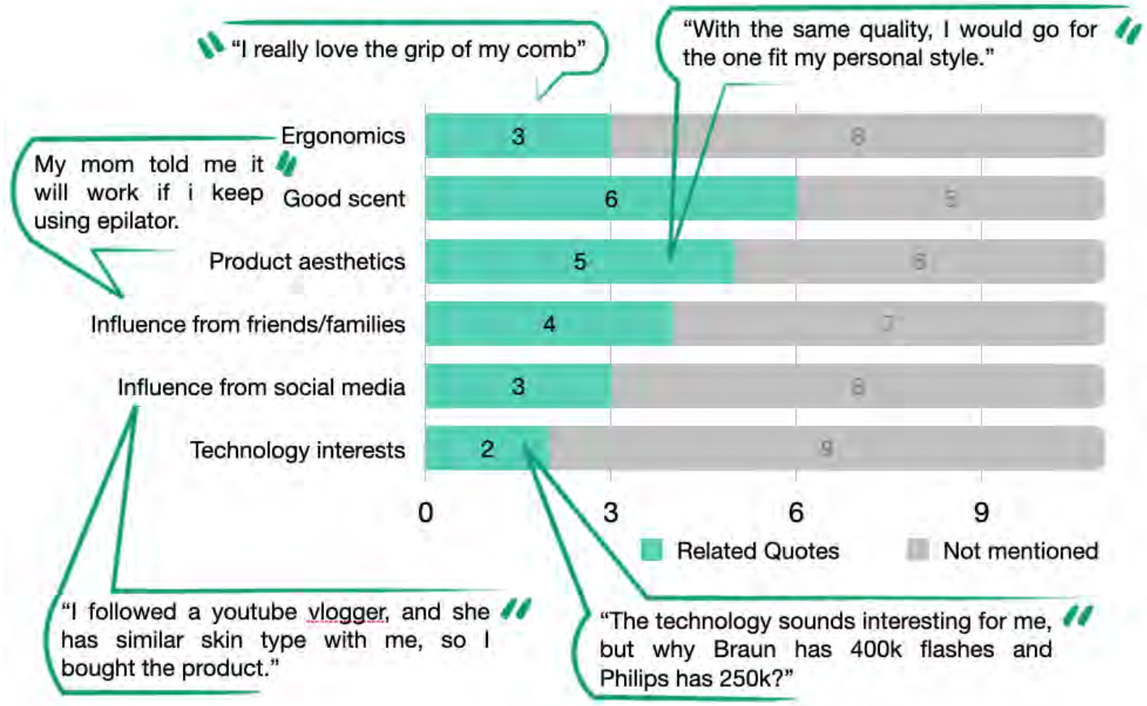


Table 1 Personal care products preferences

Key insights from 3.5.1 and 3.5.2

After understanding generation Z personal care opinions, behaviours, routines, and activities, the insights are summarised which are relevant for Philips IPL device. When Generation Z consumers purchase a new personal care product, the most significant influences would be:

Product ergonomics & Aesthetics: Ergonomically comfort and aesthetics appealing will make generation Z like the personal care product more. If the product can be comfortable to hold(both shapes and materials), easy to operate and finish tasks, then it can make participants feel willing to keep using it.

Influence from social media: Social media has a significant influence on generation Z. When they choose their new personal care product. they intend to use social media to search for information and interests, such as youtube videos, instagram influencers and TikTok videos.

Technology interests: New technology will draw generation Z attention, however, the technology should be well explained to generation Z. Future generation Z households will drive demand for smart technologies and appliances such as connectivity, digitalisation and artificial intelligence.

Design opportunities from 3.5.1 and 3.5.2

For the Philips IPL device, product ergonomics and aesthetics are the fastest and convenient way to have an influence on generation Z consumers. Technology and social media can be the ways of approaching generation Z consumers in the future.

The IPL device ergonomics and aesthetics can be improved to allow users to have an easier usage. For instance, the weight, the handling, the shapes, the positioning of the device on the skin, and the colours can be reconsidered for generation Z users.

3.5.3 Grooming Experience of Generation Z

Having understood what personal care activities that generation Z like to do, the next topic focuses specifically on grooming experience. In this section, current grooming activities, issues, and preferences are collected, which can be converted to opportunities for Philips IPL hair removal device.

How do generation Z do grooming?

Most participants say they do grooming while taking a shower, because it is very easy to clean. And they usually do hair removal in the evening. Sometimes, they do a detailed hair removal activity in the afternoon at weekends, such as full body epilation and sugary waxing. For the weekend grooming activity, participants consider it as a ritual and relaxation, which is the time that they treat themselves good.

Figure 30 Quotes of why i remove my body hairs

Hair removal methods

Generation Z participants use different hair removal methods such as blades shaving, waxing, epilating, IPL, laser treatment, electrical razor and trimmer. However, the participants are not satisfied with their current hair removal methods, these methods are either painful or time-consuming. More details of hair removal issues will be explained in the next section.

In the figure 31, it shows which parts of the body they remove their hairs. Generation Z participants do hair removal on their arms, face, chest, genital areas, armpits, and legs.

Grooming between female and male

From the participants, there are some differences in grooming between female and male participants as well.

For female participants:

- They have a strong need to be hair-free, because of the pressure from society and stereotypes.
- Hair removal is a must for personal care, which is time-consuming for them.
- Female participants are more willing to invest money on hair removal products.
- They don't feel confident at all if they forget to remove their body hairs. For example, participants do not want to go out or go to the beach if they do not remove body hairs.

For male participants:

- They do beard trimming for looking good and clean on their face.
- They don't feel the need to be hair-free but it needs to be hygienic.
- They have less problems if they forget to remove their body hairs.Male participants have less social pressure on body hairs.

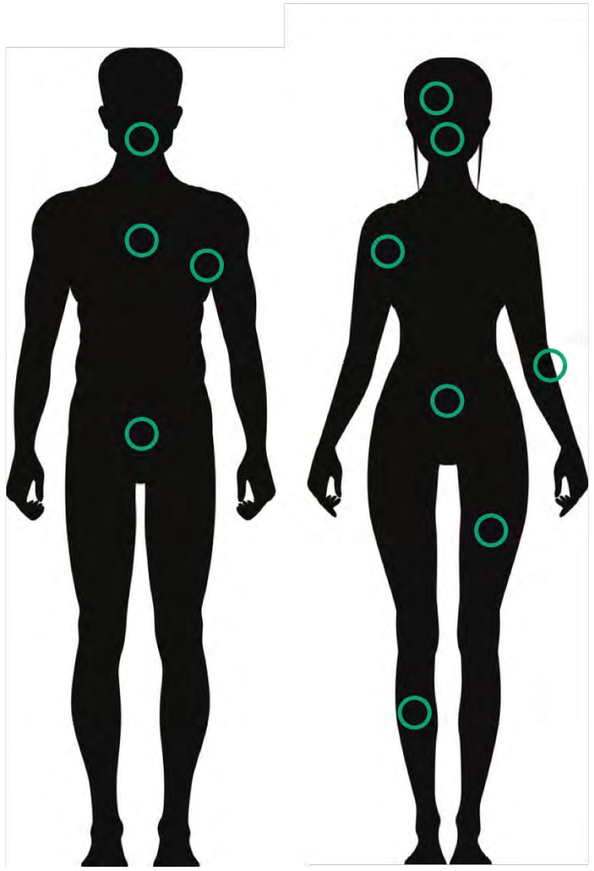


Figure 31 Hair removal areas

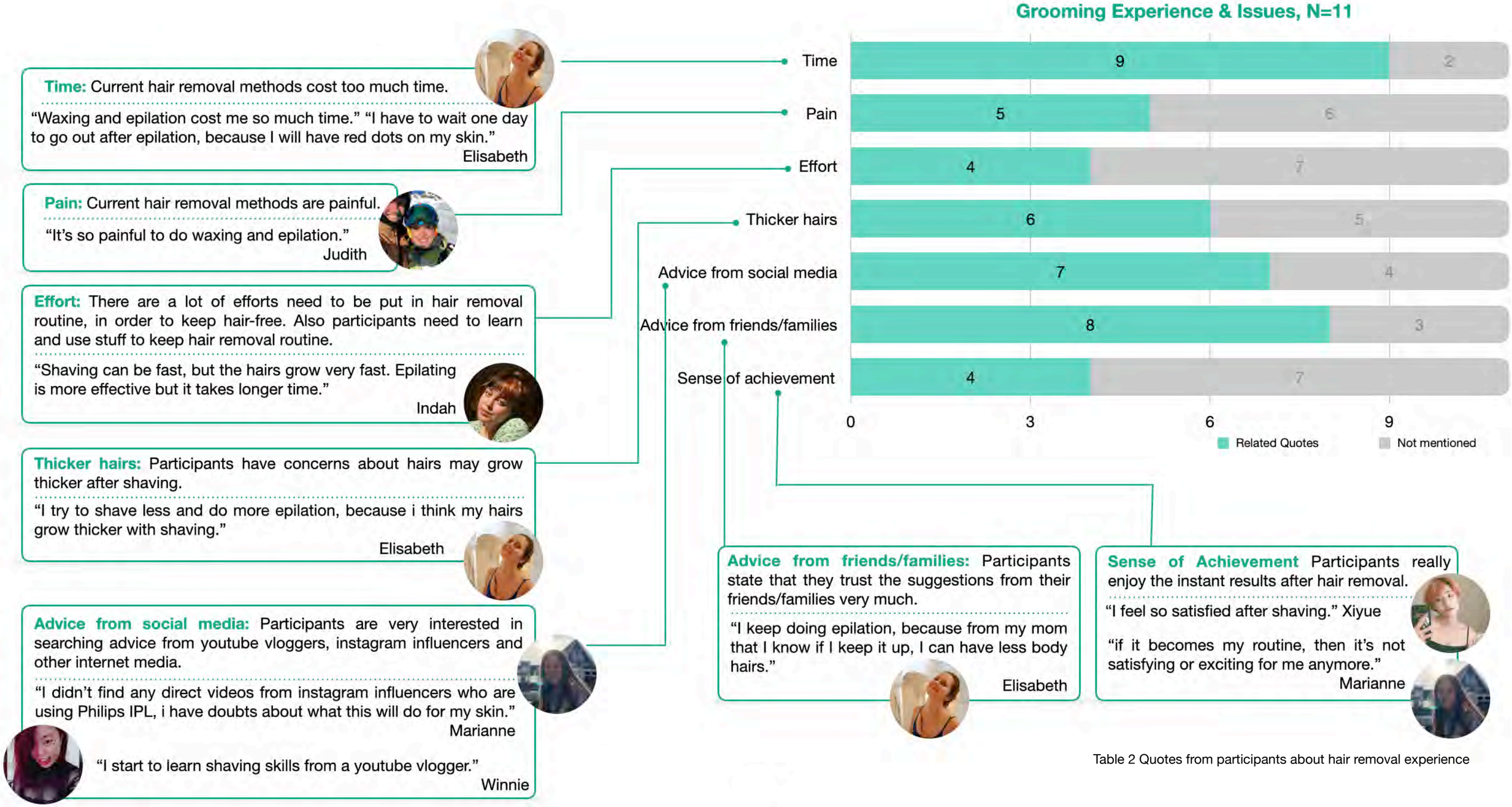


Table 2 Quotes from participants about hair removal experience

The issues of grooming

During the interviews, participants complained about the issues of their current grooming experience. The main issues are collected and summarised below. The quotes which are related to each topic can be seen in table 2.

Time: Hair removal activity is time consuming for participants. For instance, waxing and epilating take a long time for one treatment. Although shaving is fast, participants need to shave multiple times per week in order to keep them hair-free.

Pain: Current hair removal methods are painful. Waxing and epilating are very painful for most participants. Although shaving is less painful, participants still happen to hurt themselves. From the quote, the participant complains that waxing and epilating are very painful for her.

Effort: Participants usually spend a lot of effort on their hair removal routines. From preparation, planning until cleaning. For example, participants need to plan epilation before they have an outdoor activity. Moreover, if participants want to try an unknown hair removal technology, they have to spend time on learning it before getting the optimal results.

Thicker hairs: Participants have concerns about hairs may grow thicker after shaving. So they intend to do less shaving activities. Because they do not want to see thick stubbles immediately if they forget to shave.

Advice from social media: Participants are very interested in searching advice from youtube vloggers, instagram influencers and TikTok videos. They feel more connected with these influencers, because they can find similar experience from the videos, which is more convincing than advertisements. For instance, participants search hair removal tips and even IPL devices on social media, because they want to know how is the experience from a real person.

Advice from friends/families: Suggestions from friends and families are very influential for the participants on decisions. Truthful experience and conversation will convince the participants to follow tips from their friends and families.

Sense of Achievement: Hair removal activities take time and effort, therefore, participants seek the good end result after applying methods. They expect the instant feedback as well as the sense of achievement to reach their hair removal goals.

Key insights from 3.5.3

Generation Z do their grooming activities in various ways, they do it both for efficiency and relaxation, depending on their time and availability. There are 7 topics about their current grooming experience, and some of them are relevant for the Philips IPL device. Then a discussion with Philips researchers was carried out, the discussion focused on the consumer data trend, the feasibilities of the company, and company strategies. In the end, together with Philips researchers, the topics of time, effort, social media, and sense of achievement are chosen which will be relevant for Philips IPL device to further develop.

Time: Generation Z participants would prefer a flexible and efficient time schedule for grooming activities. They want to do a fast grooming activity when they are busy and a relaxing grooming activity when they have more time.

Effort: Current grooming activities need a lot of effort from generation Z participants, such as setting up schedules, learning and dedicating to the new grooming methods, and the difficulty of acquiring optimal results. Generation Z would prefer to be hair-free in an easier way.

Advice from social media: Social media is the key channel for generation Z to search grooming offers, tips, products and questions. Generation Z participants use Youtube, Instagram, and TikTok to find influencer videos which have similar experience. In this way, the generation Z participants feel more connected with these influencers, and they are more likely to believe the advice from these influencers.

Sense of achievement: Generation Z participants do hair removal activities for achieving their goal of removing hairs. The instant result of being hair-free is satisfying, and if they keep doing epilation for a long time, they can see less hairs growing which gives them a sense of achievement. Generation Z would prefer to see instant results and build a sense of achievement after investing their time, money and efforts on their grooming activities.

Design opportunities from 3.5.3

In order to make the Philips IPL device fit in generation Z grooming routine, the most influential aspects are time, effort, and sense of achievement. Because these aspects are feasible and relevant for the Philips IPL device where design can have a direct improvement on the product itself. Thus, there are two design opportunities summarised below.

Time & Effort: The IPL device should preferably provide a flexible and efficient treatment schedule, where users can have less effort to plan the treatment in their daily routine. Moreover, users should easily start using the IPL device and keep using it in an effortless way to have an effective result, and they don’t need to spend a lot of time on searching for tips and answers to questions.

Sense of achievement: The current IPL device does not show instant treatment results to users, which makes users confused and unmotivated. The IPL device should give users a sense of achievement after each treatment, which can keep users motivated using the IPL device in the long-term.

3.5.4 Ideal Environment for Personal Care

Another important aspect is the environment where participants do their personal care activities. The context where the design is used is very important, which can influence the product performances. During the interviews, the participants were asked to explain the drawings of the imagination about their ideal personal care environment. Some of them typed what they liked and some of them gave some drawings.

In the end, 8 out of 11 participants strongly prefer natural lighting with a warm and welcoming feeling(table 3), and one of participants even gave a drawing about it (see figure 32). Moreover, it should be easy for them to clean the room after hair removal, which is a hassle for them at the moment. Some of them say: “It should feel good to be bare-feet on” and “It’s hard to clean the floor after I epilate my hairs”. Besides, a good scent in the room is highly preferred by participants. Last but not least, participants showed their personal care product collections in their room. And participants say they would buy new products which can fit their other products and room style. They think this is one of the ways of showing their personal characters.

In summary, participants prefer their cozy and natural environment and products which can show their identities during their personal care activities.

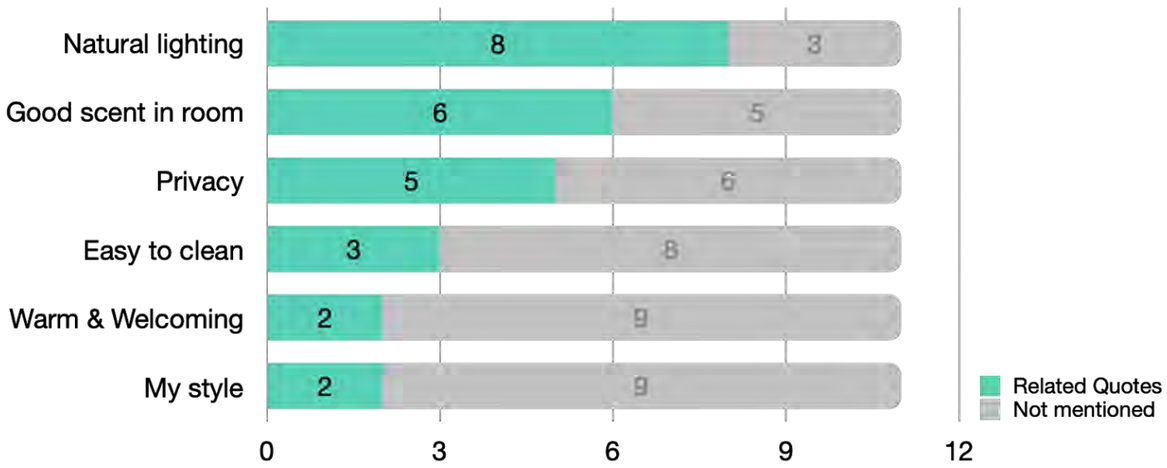


Table 3 Main topics about ideal personal care environment

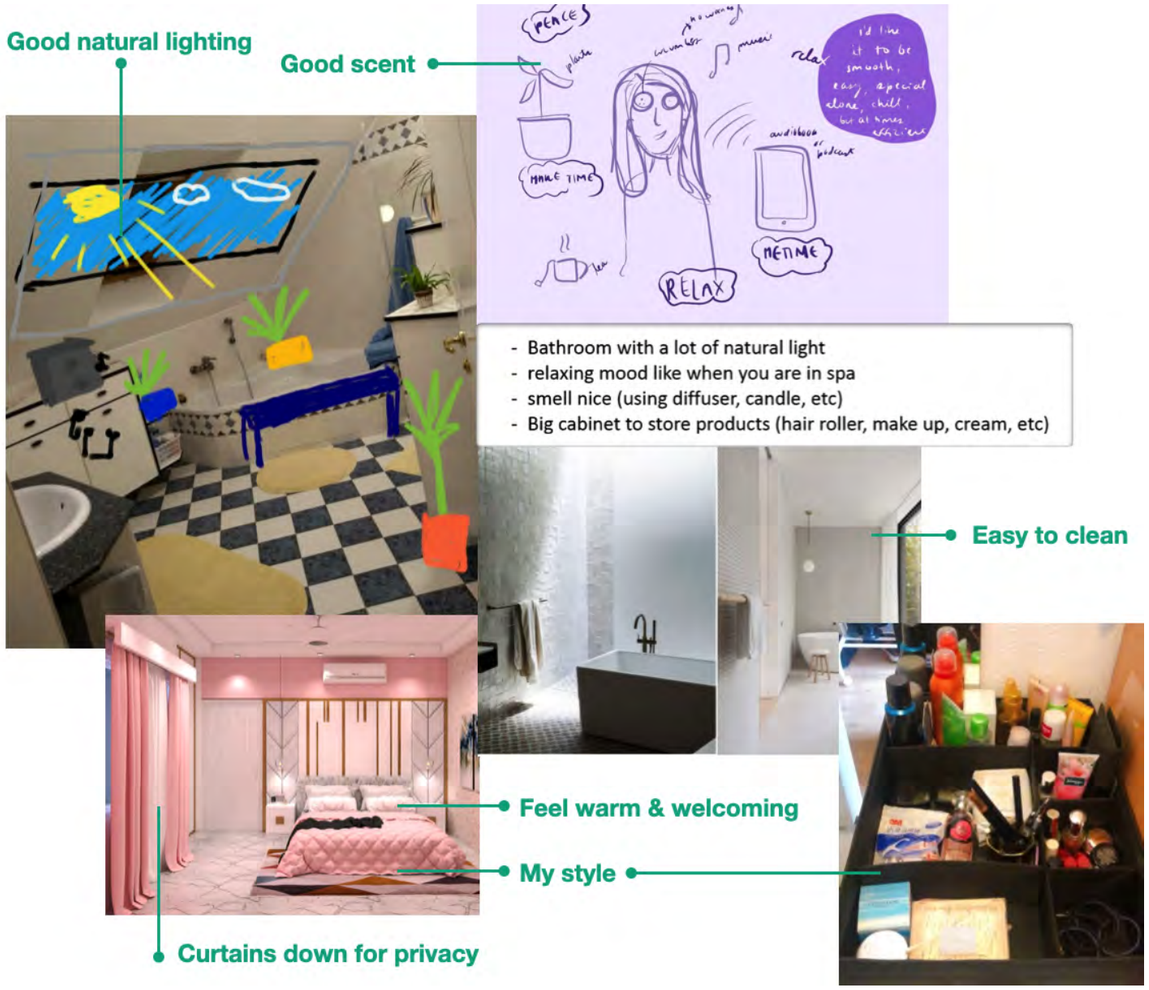


Figure 32 Drawings and pictures from interview participants on sensitising booklet

3.5.5 Opinions from Generation Z about Philips IPL Device

As this project focuses on the Philips IPL device, thus, participants were asked to give opinions about the current Philips IPL device if they showed interest during the interview. The main topics are mentioned below.

Personalised Guidance & Support

Participants are concerned about this IPL technology at home, because of their previous experience at salons which looks very professional. 7 out of 11 participants (table 4) would like to have personalised guidance and support to solve their concerns and questions, instead of a regular customer call centre. For example, a pick-up store for first-time users, where they can have a personal workshop of how to use it correctly

End results

Participants are skeptical about the end results of using this IPL device, because they can't see the results immediately. Therefore, clear communication and lasting commitment are important for the Philips IPL device.

Influencers

9 out of 11 participants mentioned that they are highly influenced by their friends, families and social media (table 4). Especially, social media is the key for Generation Z to look for new offers and advice, such as Youtube, TikTok, and Instagram. They would use these social media for IPL related questions and tips.

Subscription VS Purchase

5 out of 11 participants prefer to have a subscription to rent the Philips IPL for a try-out due to their limited income and awareness of sustainability (table 4). Philips IPL device has this offer already at the moment, which is attractive for the generation Z Participants.

Pre-treatment

Before using the IPL device, participants have to do pre-treatment for removing their body hairs, which is annoying and not attractive for the participants. If they need to shave themselves first, they may skip IPL treatment directly. Therefore, how to emerge pre-treatment with IPL treatment together into a seamless experience is also important.

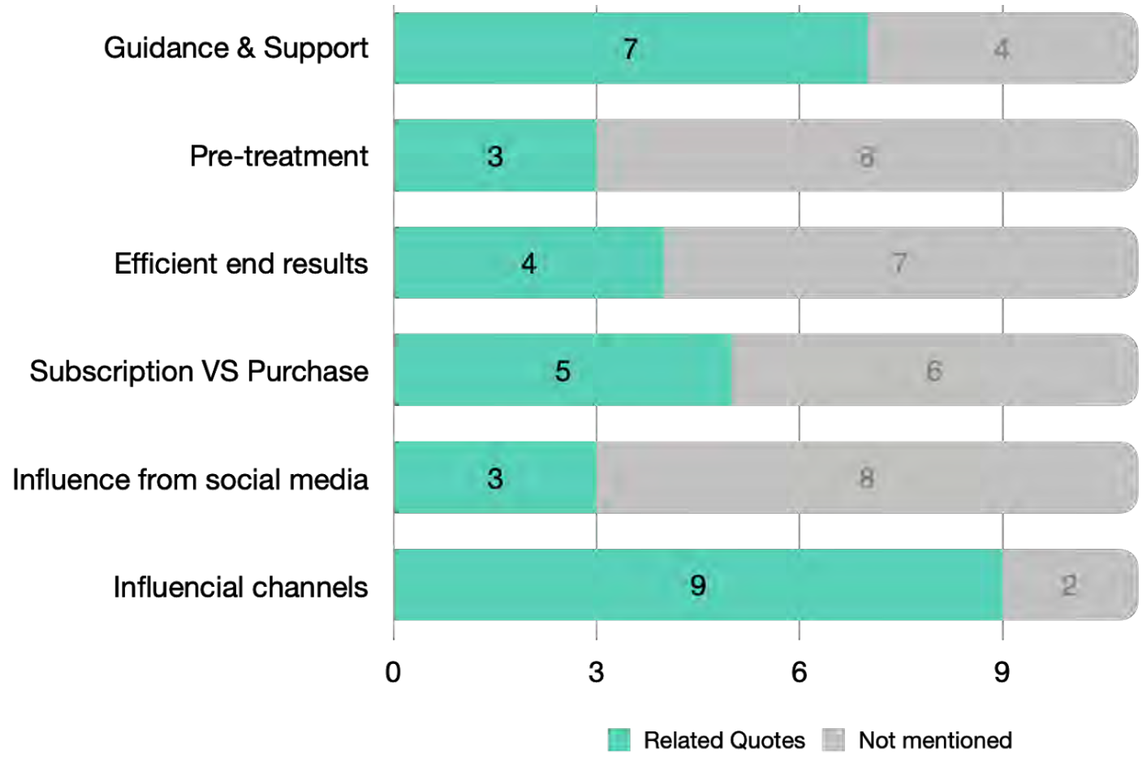


Table 4 Opinions about Philips IPL device

Key insights from 3.5.4 and 3.5.5

In the previous sections, opinions from Generation Z towards the personal care environment and expectations of the IPL device are summarised. Here are the most relevant insights for the Philips IPL device.

Effectiveness: The end results of the IPL method is not clear for the participants, it should be clearly and effectively communicated.

Price: Affordable and sustainable business model is preferred, such as subscription.

Personalised guidance: Participants showed large interest in having personal guidance on using the IPL device when they have concerns and questions. It means that personal guidance and support should be considered in the IPL device for generation Z users.

Identity shaping: Generation Z prefer the product which can show their identities, such as special colour and similar style with their room. Moreover, a private, cozy and natural environment is interesting for generation Z during their personal care activities.

Design opportunities from 3.5.4 and 3.5.5

From the research of generation Z consumers, the most relevant aspect is personalised guidance, which is a relevant problem from current consumers as well. It is also relevant and feasible for Philips to implement. The aspect of effectiveness is considered already in the previous section of sense of achievement. The aspect of price has already been solved by Philips at the moment, which is about having a subscription purchase model.

Personalised guidance: Personalised guidance and support of the IPL device should be offered to generation Z consumers from the beginning and during the treatments. For instance, the guide and support when users first-time use the device, the support during the long treatment period, the help when they do not see good results and guidance for helping them conduct a correct IPL treatment.

3.6 Personas

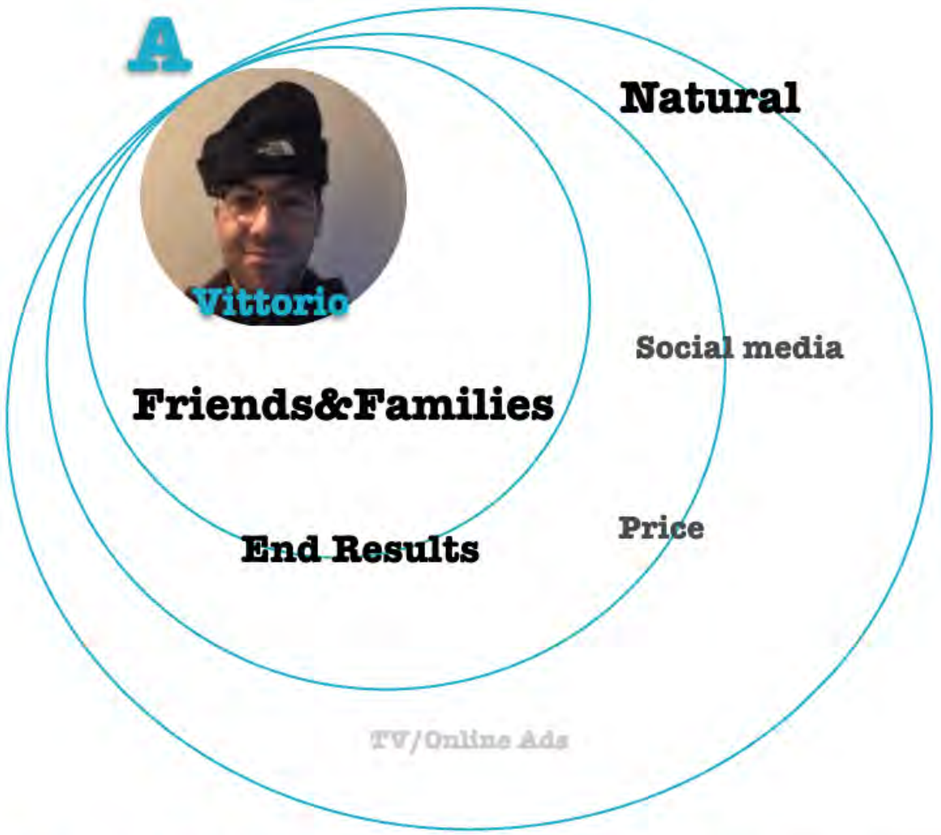
In this section, four personas about the generation Z users are created, which are based on their personal care behaviours. Two personas are selected for designing the new IPL device, which are suitable for the Philips IPL device target users.

3.6.1 Personas of Generation Z

After the user research and interviews, the four personas are concluded from Generation Z personal care behaviours.

Persona A

Vittorio is the type of person who likes nature very much. Personal care is important for him but it is in a natural way.



Something special about me

"Physical and mental health are the most important for me, other personal care products are less interesting for me."
Vittorio

- Sport lover who thinks being heathy is his personal care.
- Natural looking is the best.

Importance of Personal Care: 3

1 ■ 5

Grooming Experience

Goal:

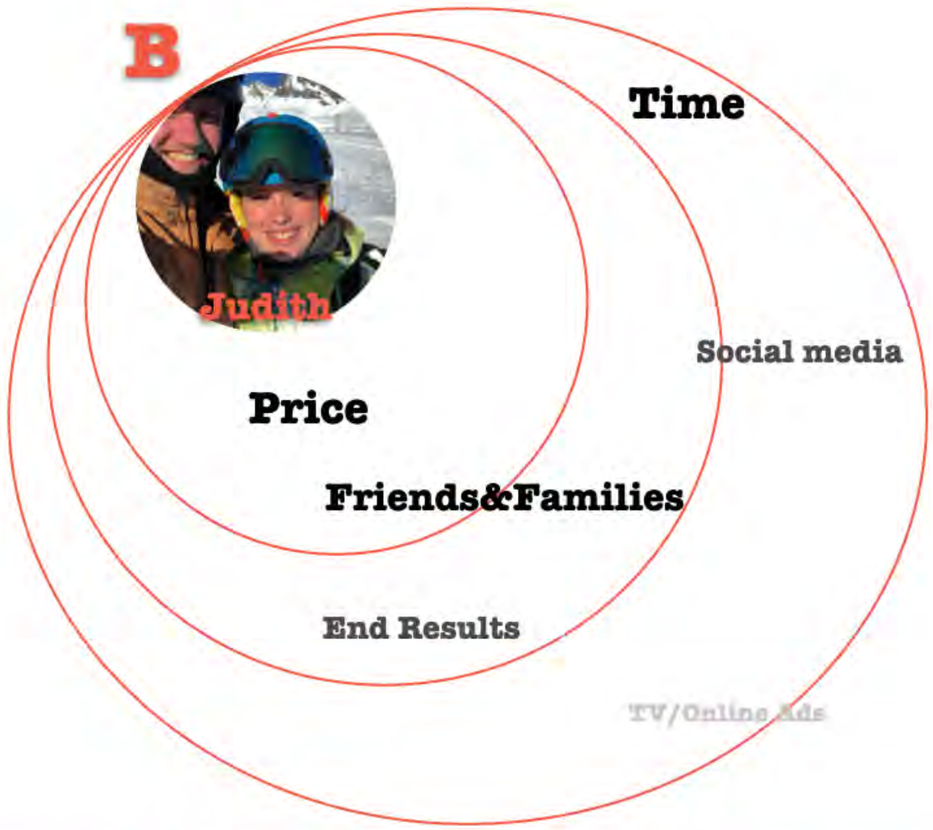
I want to shave quickly and not much efforts. I don't have the need to be hair-free

Frustration:

Sometimes i forget to shave, then it takes me longer to shave.

Persona B

Judith is the type of person who does basic personal care activities because of time concern. If there is something that can make the personal care activities very fast, she would like it.



Something special about me

"Personal care takes me too much time, but i do care about it. Thus, i do basic stuff to make myself presentable."

Judith

- Interested in personal care but lazy to spend time on it.
- Can there is an invention to make it easier?

Importance of Personal Care: 3

1 ■ 5

Grooming Experience

Goal:

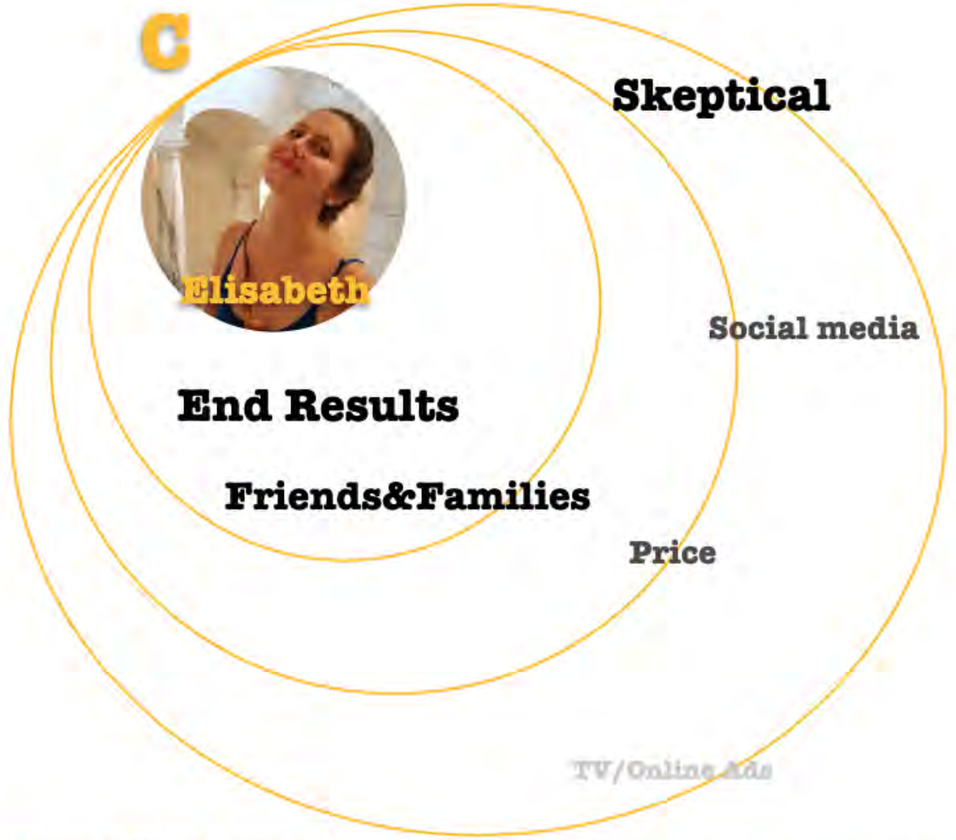
I can remove my body hair easily but not too much efforts. I will only invest more time on it if there is something important.

Frustration:

Removing my whole body hair costs me too much time, especially when i need to do some outdoor activities.

Persona C

Elisabeth is the type of person who cares about personal care very much, but she is skeptical about new offers. She will not blindly follow the commercial promotion unless she knows that this personal care offer will effectively work on her personally.



Something special about me

"I have strong needs to look good and do my personal care both mentally and physically, but i'm very skeptical about new offers."

Elisabeth

- Conscious of what others think about me, so i need to look good when i meet others.
- I don't blindly follow new promotions, i can be myself.

Importance of Personal Care: 4

1 ■ 5

Grooming Experience

Goal:

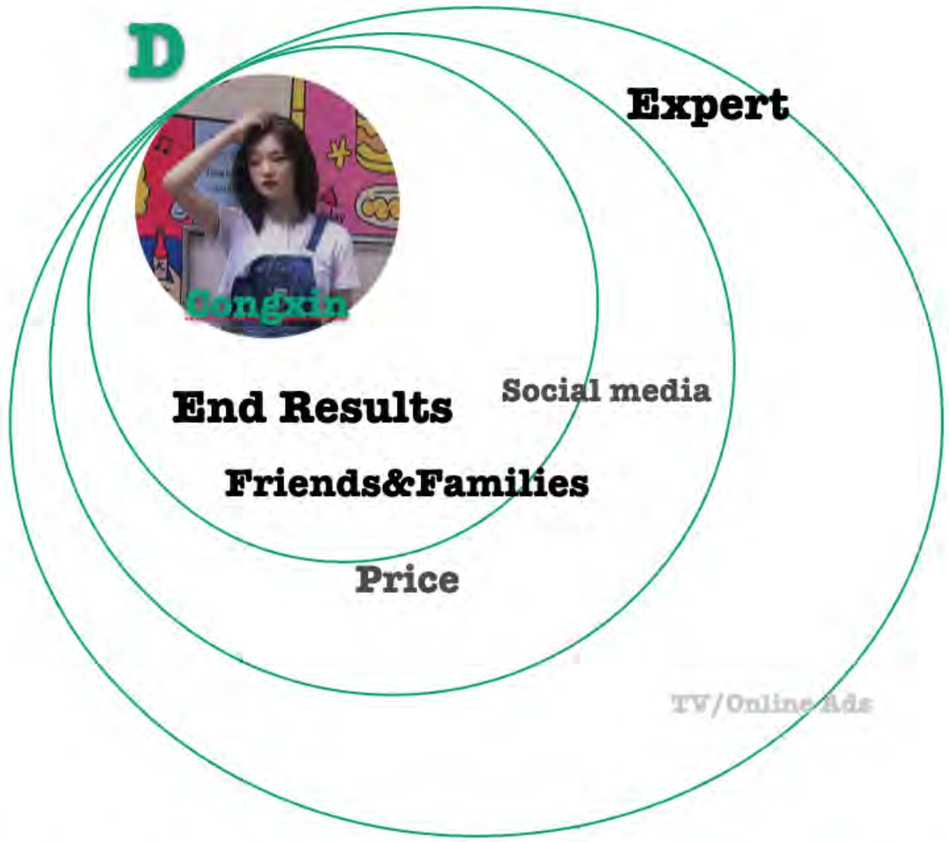
I really want to have something which i can trust and be hair-free. If it can convince me with the results, you can have all my money.

Frustration:

I do epilation regularly to have less body hair, but some short hairs can't be epilated. I don't want to shave them, because it may ruin my efforts on epilation.

Persona D

Congxin is the type of person who is very interested in personal care. She knows a lot of things about personal care and she is almost like an expert. Thus, she really pays attention to the experience and details from the new personal care offers.



Something special about me

"I care about my personal care very much and i know a lot about different personal care products. I'm a semi-expert of it!"
Congxin

- Perfectionist about personal care, and very knowledgable about various personal care offers.
- I will not go out if i look bad.

Importance of Personal Care: 4.5

1 ■ 5

Grooming Experience

Goal:
I would try my best to be hair-free, i'm getting my results with IPL/laser at Salon.

Frustration:
I keep changing my location due to my study and work, so i can't be stick to one beauty salon. To do IPL at Salon, i need to dedicate long period time on it.

3.6.2 Selected Personas of Generation Z

In order to approach the future generation Z consumers, the persona A and B will not be considered as the target group in this project, because their motivation and passion about investing in new personal care products are very low. Moreover, personal care has less priorities in their daily life. Persona C and D are ideal target groups for the Philips IPL device, because they are both willing to invest more on personal care products and they have high priority towards their personal care activities. From the literature study of generation Z, gender equality is one of the identities of generation Z users, although the persona C and D are female, the possible male users can also be included in this type of persona. The design appearance should consider the gender neutral style.

Persona C: This group is very interested in personal care. They are willing to invest more but they are skeptical. The challenge would be to convince them at the beginning phase via considering their key influencers. Such as social media, friends/families and end results. Making them take the first step to try-out, then the later phases would be easier.

Persona D: This group is knowledgeable about personal care, they know what is good for them and what needs to be improved. They can be committed to the treatment by their own study and motivation. Therefore, the user experience and product details are vital for this group, which can influence their opinions about the offer. The challenge would be to offer optimal experience for the user with better end results.

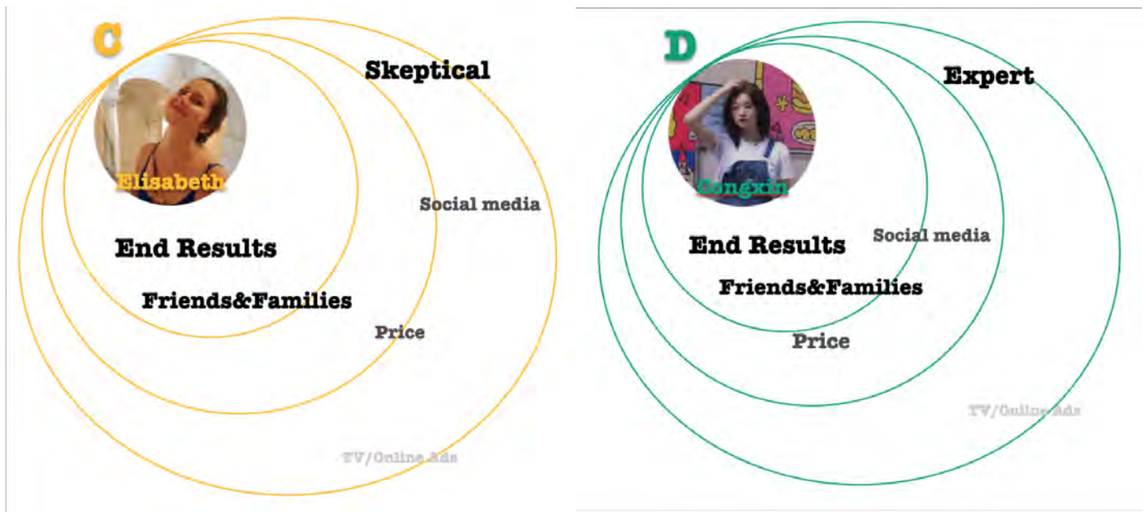


Figure 33 Selected personas of generation Z

3.7 Design Directions

From the user research, a completed IPL journey (figure 34) should start before the IPL journey until the end results show up. This will include IPL product itself and product service. For the optimal new Philips IPL device, all design opportunities mentioned should be considered for generation Z users, which meet the needs of generation Z for IPL journey.

In chapter 2.4, there are 4 main issues of the current IPL devices, which are product ergonomics & aesthetics, user interface, skin contact and communication. By matching the chapter 3, the relevant problems of generation Z users are concluded, which have been converted to design directions below.

Figure 34 IPL Journey

The main design directions on this IPL journey are:

- Product ergonomics & Aesthetics: providing an easier usage of Philips IPL device for generation Z users via offering ergonomically comfort during treatments.
- Sense of achievement: creating a sense of achievement for generation Z users of Philips IPL device via providing effective communication and feedback on the device during treatments.
- Personalised guidance: providing generation Z users a personalised guidance on the IPL device to enable them feel secured and help them conduct a correct IPL treatment.
- Approach generation Z via social media and digital solutions.

However, due to the time limitation, this project will focus on a specific direction, which will show on the next chapter.

3.8 Conclusion of User Research

In this chapter, the user research about generation Z personal care has been conducted via methods of contextmapping. User interviews have been conducted with a sensitising booklet for deeper understanding the participants. After the interviews, the main topics about general personal care behaviours, grooming experience, ideal personal care environment and opinions about the Philips IPL device are concluded. Besides, 2 out of 4 personas are selected from the generation Z users, which can be the target group in the design phase.

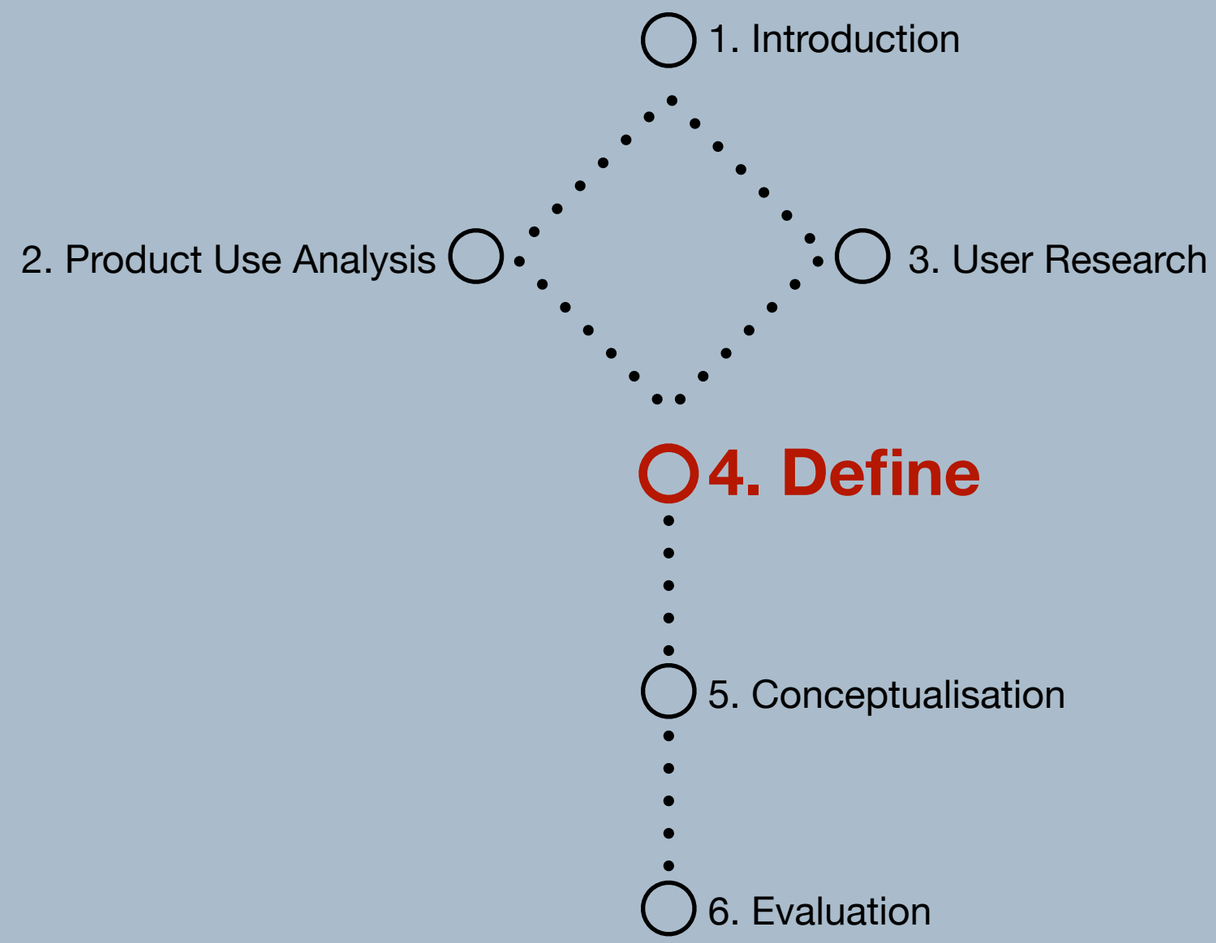
Throughout these research activities, generation Z users are interested in identity expression of their personal care products, gender equality, personalisation and social media. These match the literature study from chapter 1.3, which the generation Z likes to show identity, be inclusive, and digitalised. Moreover, they seek the sense of achievement when they conduct personal care activities and they seek for personal experience. Besides, they are highly influenced by social media for most personal care tips.

At the moment, the main insights from the current IPL device and main insights from target users are known. By matching the insights from chapter 1 and 2, the four design directions are concluded. They are product ergonomics & aesthetics, sense of achievement, personalised guidance and digital social media channels. In the next chapter, a design focus and direction will be decided.

4. Define

- 4.1 Brainstorm & Co-Creation
- 4.2 Defined Direction and Design Goal
- 4.3 List of Requirements
- 4.4 Conclusion

This chapter is about defining the design goal and direction. A brainstorm and co-creation session has been conducted in order to find what is the most relevant design goal and direction for the generation Z users. After the session, a detailed design direction has been explained and the criteria for reaching the design goal is defined as well. In the end, the criteria for reaching the design goal has been created as well.



4.1 Brainstorm & Co-Creation

From the previous chapter, there are four different directions for designing a new IPL device for generation Z, ergonomic comfort grip on the IPL device, personal guidance, sense of achievement and social media.

In order to acquire inspiration on how to give personal guidance and how the communication should be improved, a brainstorm and co-creation session with real generation Z participants was conducted. The purposes of a Co-Creation Session are to convene the target group generation Z and involve them into the design process. This is to enable users to think and work together with designers, and empower the users to generate ideas and concepts collaboratively (Bertini, P. and Plumley, E., 2020). In the co-creation session, the users can express their needs and abilities, where the designer would be able to create a better solution (Van Boeijen, Daalhuizen, and Zijlstra, 2020). Therefore, after this co-creation session, possible solutions for personal guidance and communication issues should be solved.

4.1.1 Research Questions:

- How do generation Z participants define personalisation in products or services.
- What kinds of personal guidance would Generation Z like to have in the IPL device?
- What are the most relevant communication problems of the IPL device for generation Z users?
- What are the new ideas that generation Z participants offer?

4.1.2 Participants

In the brainstorm session, there are four participants and one moderator. Participants are all females who are aged from 18-25 years old. Two participants have experience with the IPL device and other two participants have IPL experience in the salon. They are all beauty oriented, and they are either skeptical about new offers or they have deep understanding about beauty products. which means that they fit the selected persona from Chapter 3.6.2.

4.1.3 Procedure

Participants were asked one day before to prepare sensitising questions:

- What does personalisation mean for you?
- Describe a personalised function in a product or service. And why do you like it?

The brainstorm session is two hours and it was conducted online by a platform called Miro. The session includes steps of the introduction, understanding the Philips IPL device, reviewing prepared questions about personalised products and services, exploring personalisation in IPL journey, giving ideas about a personalised IPL device. In the end, participants were asked to cluster their ideas to similar topics.

4.1.4 Personalised Products

Generation Z participants would like to have the product or service which can personally speak to them and adjust to their needs. For instance, one of the participants has a gym app which tells her many functions from the gym (figure 35). However, what she needs is not different colours of the App or gym facilities. She would like to have motivation for keeping going to the gym in order to reach her fitness goal. This is her personal needs which the app does not fulfil.

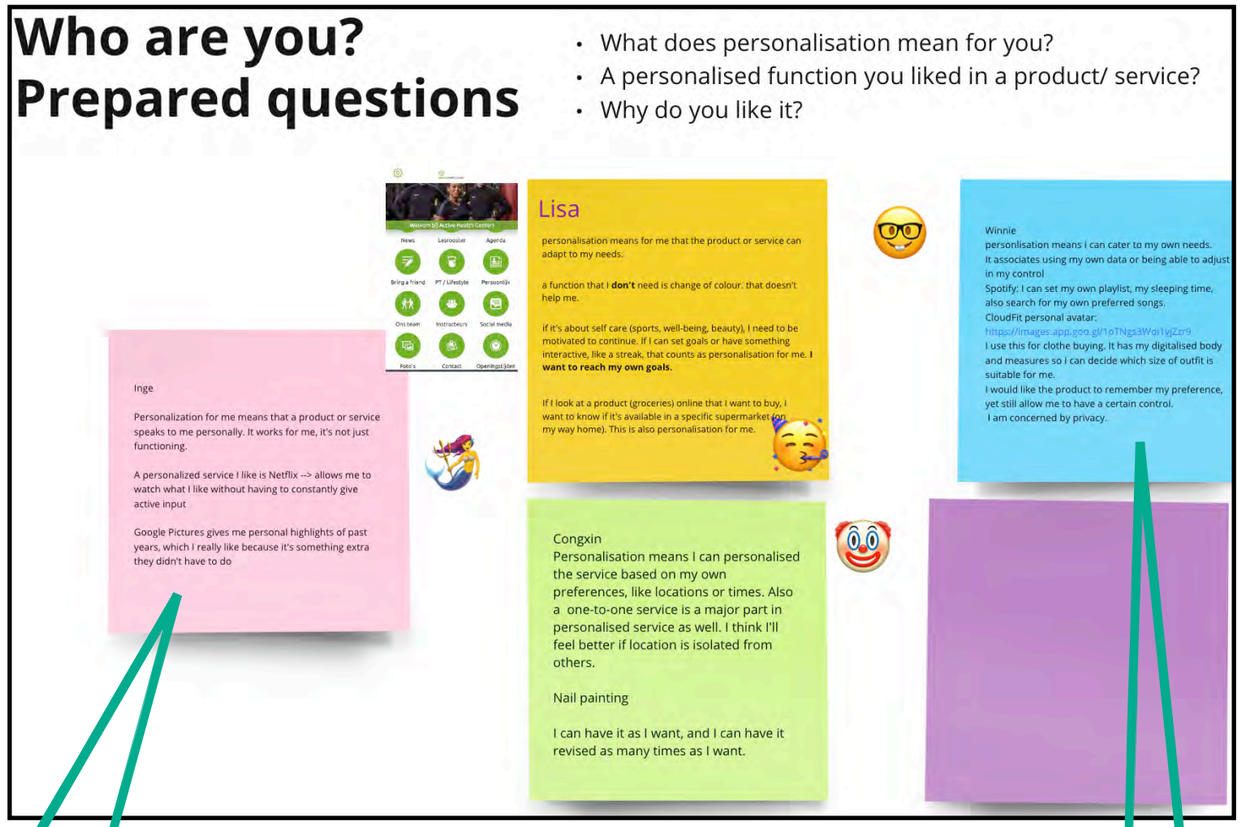


Figure 35 Answers of personalised Products

> Personalisation for me means that a product or service speaks to me personally. It works for me, it's not just functioning.

> Personalisation means I can cater to my own needs. It associates using my own data or being able to adjust in my control

Key Insight

For generation Z, a personalised product means that a product can fulfil the personal needs. Therefore, the IPL device should fulfil the user's personal needs, and these needs should be the main needs which can help the user to reach the goal.

4.1.5 Personalisation of the IPL Journey

After discussing prepared questions, a detailed explanation about how Philips IPL works was given by the moderator, because two participants have no experience with the Philips IPL device. Next, the second activity is about thinking what kinds of personalisation would you expect in Philips IPL journey? Participants gave many different ideas about where and what personalisation they would like to have during the IPL journey.

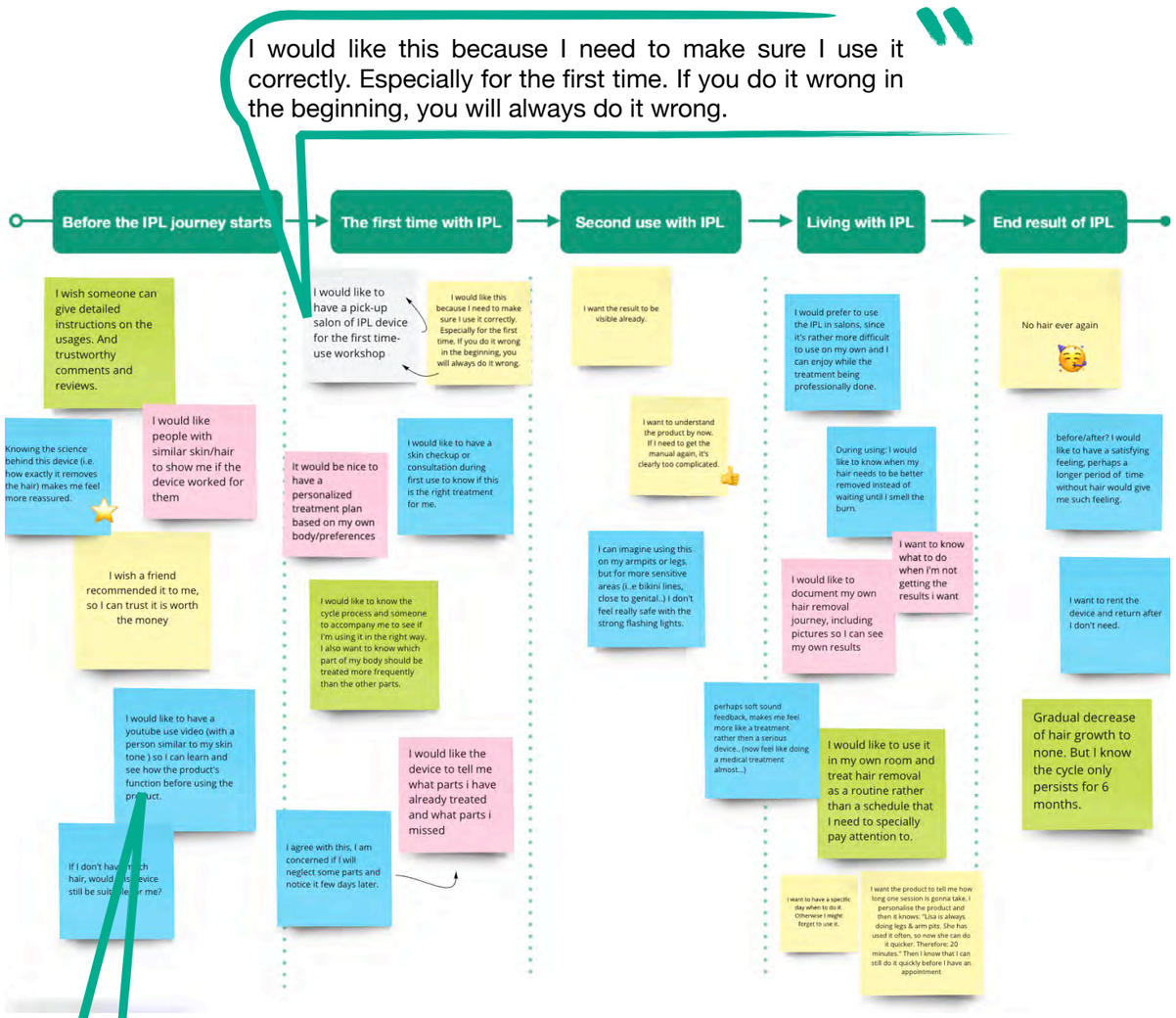


Figure 36 Personalisation in IPL journey in overall

Key Insights

From the answers of figure 36, the insights are generated from the beginning of IPL journey and end of the journey. The main insights are collected into similar topics which can be seen below.

- **Personalised guidance and support.**

Participants would like to have personalised guidance when they first use the IPL device, which they think it is very important to use it correctly for the first time. For instance, they would like to have some Youtube usage video matched with their skin tone, and they would like to know how to use it correctly. And a pick-up salon for the first time with the device can also be very helpful. Meanwhile, the support should personally fit their needs, such as scheduling treatment, detecting skin tones and hair colours.

- **Treatment progress for motivation**

During the Philips IPL treatment journey, participants would like to have a track on their treatment process in order to have motivation to continue, such as a record to show the progress.

- **Flexible schedules**

The IPL should make treatment schedules fit the personal routine. If the user often treats their armpits, then the App or the device should adjust the schedule to a more convenient way of treatment for the user.

- **The App**

The App is good for planning treatments. Participants think the App is necessary to plan the treatments, however, it should not disturb the users while they are using the device. They feel it would be annoying if they need to look at the phone and use the device at the same time.

- **Support for having positive end results**

Most of the time, participants are not aware of what went wrong when they did not have good end results. Participants would like to get help if they could not reach positive end results, and what they should do in order to have better results. For instance, correction on the treatment behaviours, schedules or settings.

- **Ritual experience instead of feeling like treatments**

In the end, the treatment process should give users a ritual experience instead of a feeling of having a medical treatment. This can give the users a pleasant feeling, which users feel more motivated to conduct the next treatment.

4.1.6 Personalised Functions on the IPL Device.

After understanding the personalisation in the IPL journey, then the third activity is about understanding what kind of personalised functions they would like to have on the device. Participants were asked to give at least 3 ideas in different directions, such as light setting, attachments, handling, sound, buttons, and user interface.

After giving ideas, participants were asked to cluster their ideas to similar topics from these activities. After clustering all ideas, they were asked to place red dots on the topics which they think is most relevant for them. In the end, the topics of missing spots, new user interface, and personal guidance and support have the highest popularity. The details of all ideas can be seen in appendix F. The most popular topics are collected below.

Personal guidance on missing Spots

One of the most concerning problems from the participants is the missing spots. Participants would like the device to personally guide and support them to have less missing spots during the treatments. For example, some interesting ideas are shown below (figure 37):

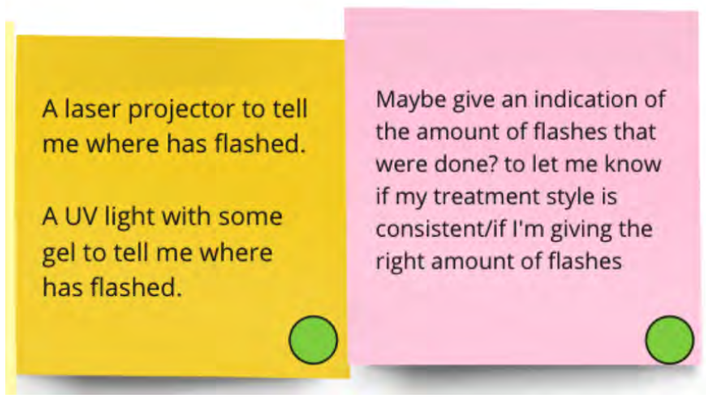


Figure 37 Ideas of personal guidance

Key Insight

To summarise it, generation Z participants would like to have personal guidance to do a correct treatment, which may help them have less missing spots.

New user interface

Another popular topic is the user interface. Generation Z participants think the current interface does not effectively communicate with them. For instance, the setting numbers are confusing for them, which they think it's about their skin tone. Thus, they would prefer a clear new user interface. The main ideas from participants are below (figure 38).

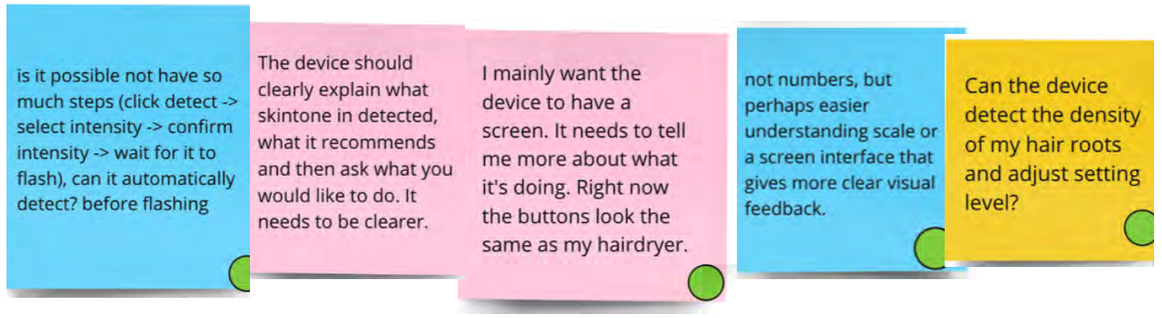


Figure 38 Ideas of new user interface

Key Insight

To summarise it, the device should have a more intuitive user interface, which allows the user to better understand and communicate with the device. Moreover, it should have easier and more personalised choices, such as the light intensity selection according to skin tones, hair thickness, and the amounts of hairs.

Personalised guidance and support

The third important aspect is that generation Z would like to have the personalised guidance and support. Not only from the beginning of the IPL journey, but also during the IPL treatments. The main ideas are below (figure 39).

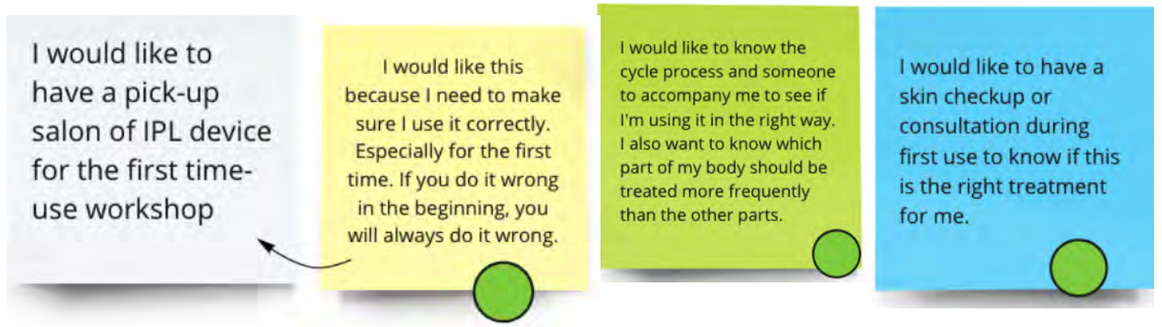


Figure 39 Ideas of personal guidance and support for IPL journey

Key Insight

To summarise it, generation Z participants would like to have personalised guidance and support along the whole IPL journey, in order to ensure a good end result.

4.1.7 Conclusion of Brainstorm & Co-coreation

From the brainstorm and co-creation session, the research questions have been answered.

Generation Z participants prefer the personalisation which can fulfil their personal needs.

They would like to have the personal guidance during the whole IPL journey, however, the guidance of having less missing spots is the most relevant one for them.

The user interface should be improved to better communicate with the users, such as light intensity settings.

4.2 Defined Direction and Design Goal

In this section, the problems are defined and four directions are merged into one design direction. Then the design goal is created with a deeper dive on design direction.

4.2.1 Problem Definitions

- The users experience discomfort when using the device on their lower legs for 30 minutes.
- The users lack personal guidance on how to conduct a correct IPL treatment.
- The users do not see the results immediately and they are not sure if they did treatments correctly, thus, they lack the sense of achievement for reaching their hair-free goal.
- The communication channel for generation Z users is not effective, because they receive information mostly from social media.

4.2.2 Merging four directions

The four directions of ergonomic comfort grip on the IPL device, personal guidance, sense of achievement and social media have the possibility to be merged into one direction, because there are overlaps among these four directions.

Ergonomic Comfort

The weight and centre of mass from the current IPL device cause discomfort when the users hold the device on the lower legs. Although the handle is comfortable to grab, the holding posture is not ideal. A new shape should be designed for a better holding posture.

Personal Guidance

The generation Z participants showed large interests in having personal guidance while they are using the device. Especially, they would like to have the personal guidance on how to conduct a correct treatment for having less missing spots.

Create a Sense of Achievement

Consumers buy personal care products in order to fulfil their personal care needs, which are their goals. This applies to generation Z users of the IPL device as well: Users want to have hair-free skin for a long-term period. The IPL device offers a faster and easier way to users for having hair-free skin for a long-term period, however, this can not always be fulfilled. Therefore, the users lose the sense of achievement after using the IPL device. From the user interview, generation Z users perceive personal care activities as their personal time for satisfaction and rituals, which give them a sense of achievement when they see the effective results. Therefore, in this project, triggering the sense of achievement will be the goal of a new IPL device.

During the usage of the IPL device, one of the biggest issues is that the device does not well communicate with users. Users do not know how their treatments go and if they are doing treatments correctly. An effective communication and personal guidance on the device itself should be provided for the users, in order to ensure the users that they are reaching their goal of being hair-free in a correct way. Moreover, the device should communicate and update treatment results with users. By this way, a sense of achievement can be built up.

Communication on Social Media

Generation Z users prefer personalisation in their personal care activities and they are largely influenced by social media and digitisation. Generation Z appreciate the personalised products more than the brand itself , and they would switch the brand easily if the brand does not satisfy their personal needs (MI&A Personal Health Philips, 2020). Therefore, a more personal guidance on the IPL device with preferably digital solutions can be created for better communicating with generation Z users. The direction of social media is not the design goal, but it will be a key design element to approach the generation Z users.

In summary, a more comfortable shape can provide better posture for the users, and personal guidance can help the user to do a correct IPL treatment for having less missing spots. With the personal guidance, the end results can be improved which can allow the user to feel more confident to reach their hair-free goal. In the end, a sense of achievement can be built up with an effective digital communication channel.

4.2.3 Design Goal

After the discovery of how to merge the design directions into one direction, the final design goal is

By designing an Effective Communication on the IPL device, a more Comfortable IPL device with Personal Guidance on the IPL device will be created in order to reach A Sense of Achievement.

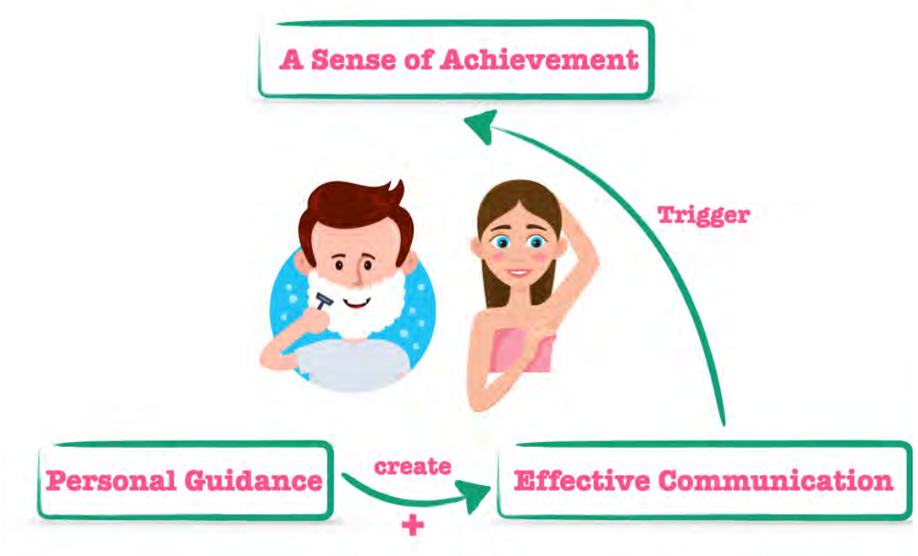


Figure 40 Design goal

From the figure 40 above, it explains that the personal guidance should be created to provide effective communication. With better communication, the users might be able to do a correct treatment, thus, the end results can be better. In this way, they will feel more confident to reach their end goal, which can build up a sense of achievement.

4.2.4 Design Direction

After understanding what kind of personalised guidance and what kind of communication problems should be solved, the detailed design direction has been decided.

An **intuitive user interface** should be designed, in order to allow the IPL device to **effectively communicate** with users. In this way, users can have **more personal choices on light intensity selection**, and they can get **guidance about conducting a correct IPL treatment**. Moreover, a new shape should be designed to provide more **comfortable usage of holding the device.** With these aspects included, a new design should be able to help users to have a **better end result**, which enables them to reach their **hair-free goal** and build up **a sense of achievement** in the end.

An intuitive user interface: Users should be able to understand the user interface without referring to the user manual. Generation Z participants should feel this is a clearly understandable interface which can guide them during the treatment.

Comfortable usage of holding the device: The users should feel comfortable of using the new shape while conducting most body parts. The users should feel comfortable with using the device on the main body parts which are lips, armpits, arms, legs, belly and bikini lines.

More personal choices: The users should be able to understand the device can provide various light intensity setting choices for their personal IPL treatment needs. It will make their treatment process easier to complete in different usage situations. Moreover, this device should also be easier for them to operate the treatment.

Personal guidance: With the personal guidance from the device, the users should be guided to conduct a correct IPL treatment and feel more confident to finish the treatment with having less missing spots.

A better end result: With the personal guidance on the device for a correct IPL treatment, it should be possible for the users to have a better end result. In this way, they should feel more confident to reach their hair-free goal. Thus, it would be possible for them to build up a sense of achievement in the end when they see a better end result.

The new design will follow this design direction and these design aspects will be considered in the new design.

Solution Feasibility

This project is supported by Philips, thus, the stakeholder would like to have the solutions with available technologies or the technologies can be further developed within 5 years.

4.3 List of Requirements

In this section, requirements about how to reach the design goal have been drafted. The requirements instruct how the final design can reach the design goal in different aspects. This should be able to be the guidelines for the evaluation of the final design.

4.3.1 General

Comfort:

The new device should be comfortable to hold and conduct IPL treatment, which means user should not feel physical pain in their muscles of hands. From Kuijt-Evers (2007),there are six aspects of evaluating comfortness in hand tools(such as screwdriver, driller and hammer), they are functionality, posture and muscles, irritation and pain of hand and fingers, irritation of hand surface, handle characteristics, and aesthetics. The most influential factor of comfort in hand tools is the functionality, and the least influential factor is the aesthetics(Kuijt-Evers, 2007).

For using the new design of the IPL device, the user has to keep good skin contact in order to be able to flash. If the skin contact is maintained, then the user will be able to release the flashes and conduct treatment. This is the aspect of the functionality from the six evaluation aspects.

Therefore, the requirements of comfort in using the new IPL are:

- The user should be able to keep a good skin contact while conducting lower leg treatment. And they should not feel pain or soreness on the hands while keeping the skin contact for at least 20 minutes.
- On the other body parts, the user should be able to find at least one posture to keep good skin contact with 90° angle on the skin, which can provide comfort during the treatment. The user should not feel any pain and soreness on their hands.

Appearance:

The appearance of the new device should be gender neutral style, which represents the generation Z characteristics of being inclusive. (chap 1.3)

- The user should not feel this device is for female only and male only.

4.3.2 Effective Communication

User interface:

- The user should be able to understand the icons of the attachments at the first time.
- The icons on the interfaces should be understandable. If the user had problems at the first time, they are allowed to refer to user manual, then they should be able to understand it at the second time after referring to the user manual.
- The user should be able to understand the press buttons on the interfaces at the first time.
- The user should be able to understand the main product features on display without referring to the user manual. The main product features are: personal guidance on missing spots, light intensity settings, auto-detection of skin tone, auto-flashing, and charging methods.

4.3.3 Personal Guidance

- Users should understand the animation of personal guidance feature on the screen at the first time.
- Users should be able to follow the tracking sensor guidance during the treatment at the first time.
- The user should be able to operate the device and complete the treatment by himself/ herself at the first time.
- Users should understand the “ready to flash” light feedback for the guidance at the first time.

4.3.4 A sense of achievement

- Users should follow the personal guidance correctly at the first time in order to have the confidence to conduct a correct IPL treatment.
- Users should agree that conduct a correct IPL treatment with personal guidance can help them to reach their hair-free goal
- At the first time use, the confidence of building a sense of achievement should be evoked after the users can conduct the correct IPL treatment with personal guidance.

4.4 Conclusion

In this chapter, a brainstorm and co-creation session has been conducted in order to decide the design goal and direction for generation Z users. The final design goal is to design an effective communication on the IPL device, a more comfortable IPL device with personal guidance will be created in order to reach the sense of achievement.

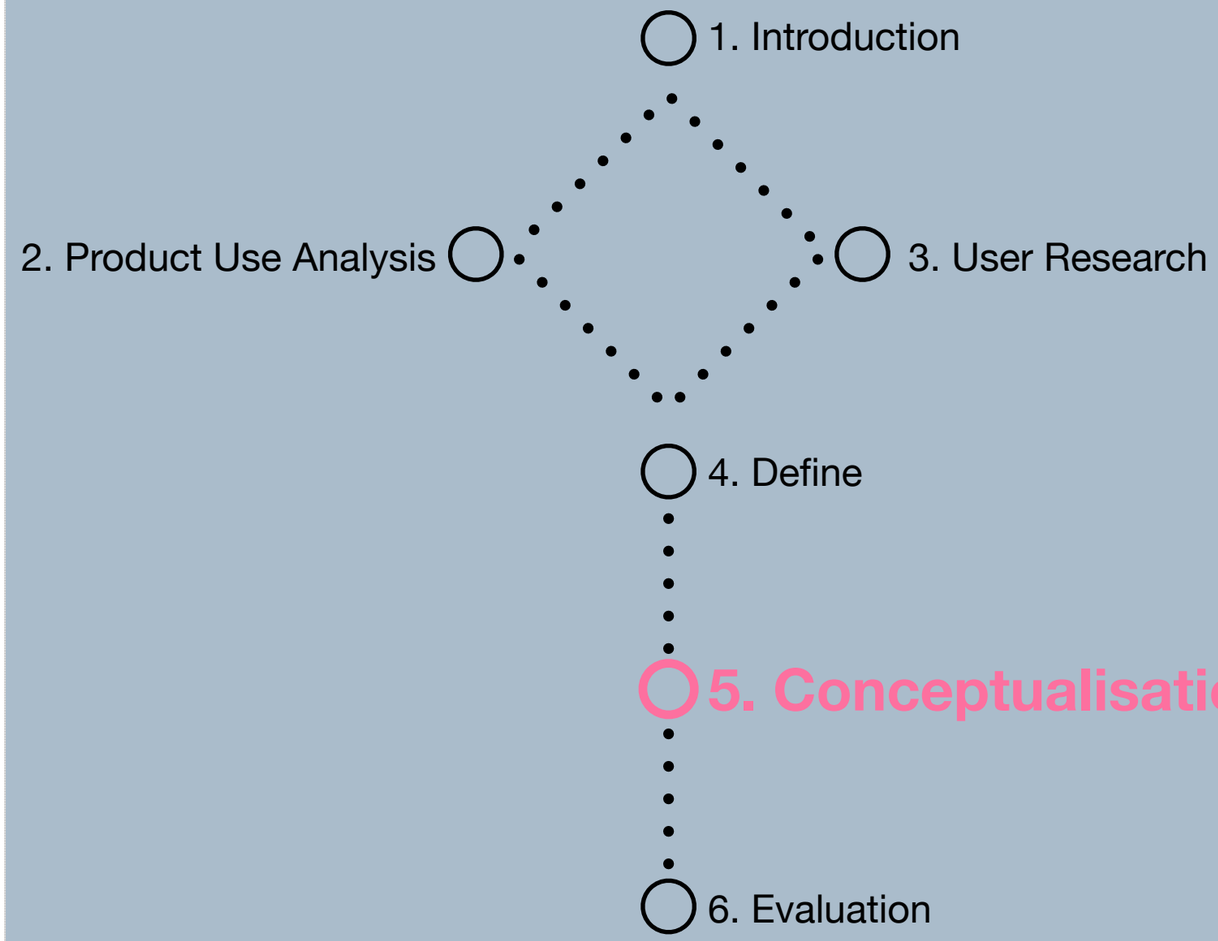
- The effective communication is about a new user interface which can allow users to select correct light intensity settings and understand the product features on the device.
- The new shape of the IPL device should provide the user better grip on the handle and it should feel more comfortable to hold and keep skin contact.
- The personal guidance is about helping the users to conduct a correct IPL treatment, which may help them have less missing spots.
- The sense of achievement is about the users will feel more confident to do IPL treatments with the personal guidance, and they are confident to reach their hair-free goal which may build up a sense of achievement in the end.

The next chapter, the ideation about how to provide personal guidance will be done and it will explain how the design concept is developed in order to reach this design goal.

5. Conceptualisation

- 5.1 Ideation
- 5.2 Concept Development
- 5.3 Final Concept
- 5.4 Conclusion

Chapter 5 is about developing the design concepts. Competitor products are analysed for inspiration for ideation. Different user storyboards will be shown to explain the design concept. Moreover, an exploration on the shapes of IPL device has been conducted and a new shape is decided for the IPL device. Furthermore, design details are defined as well, such as physical buttons, light effect, screen size, digital interfaces and charger. In the end, the final design is presented.



5.1 Ideation

In this section, the ideation is conducted based on two user scenarios. Competitor products have been analysed for inspiration, and the ideation about personal guidance is conducted.

5.1.1 Two Main Scenarios

After defining the design goal and design direction, it is clear that the ideation should focus on personal guidance with effective communication on the device. However, there are different usage scenarios of the IPL device, there are two usage scenarios and the ideation will be based on these two usage scenarios(figure 41).

The first scenario is when the user has enough time for a precise IPL treatment. In this case, the user would like to have personal guidance on the large body areas. For small areas, the user has less missing spots, thus the personal guidance is not needed. The second scenario is when the user has no time but still wants to do an IPL treatment. For example, the user would like to have a fast IPL treatment in order to go to bed soon.

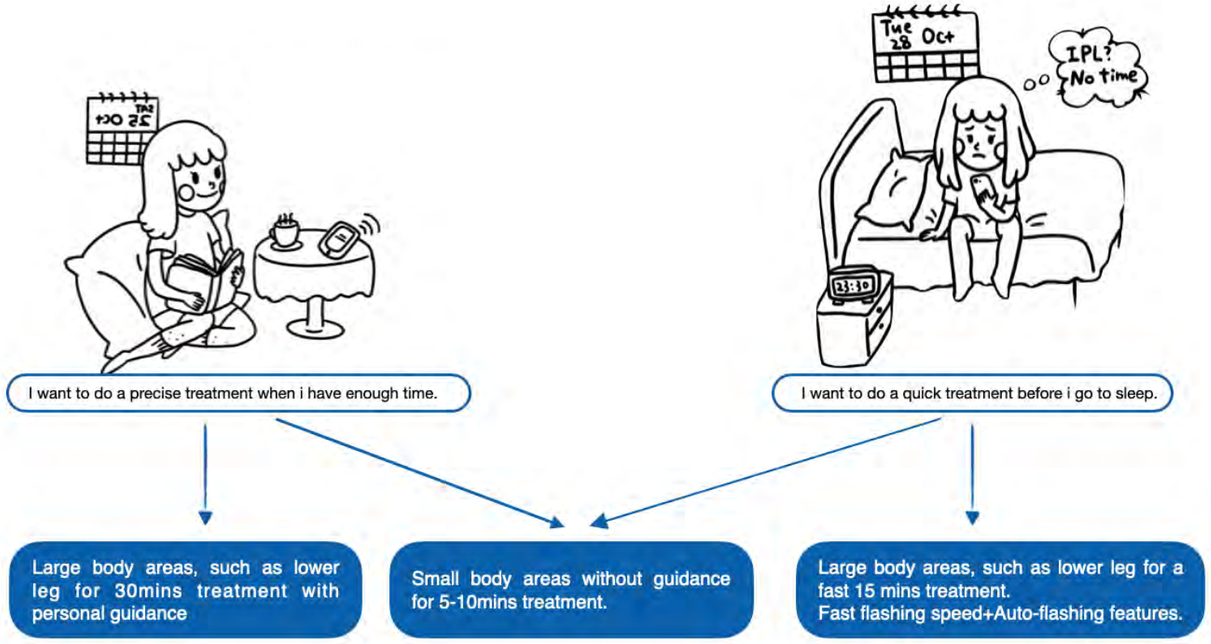


Figure 41 User Scenarios

5.1.2 Competitor's Products

Firstly, related competitor's products were analysed, in order to understand the current market trends and technologies. Secondly, an ideation about personal guidance was conducted.

3 competitor products and 1 relevant product(toothbrush) are analysed for inspiration.
Ulike IPL device(figure 42) has main functions of:

- Ice-cooling function for a better skin sensation during the treatment.
- Auto-detect function for detecting skin tone.
- Glide mode: when the skin contact is well maintained, the flashes will be automatically released.
- The light intensity can be manually adjusted during the treatment.

Smoothskin Pure IPL device (figure 43) has main functions of:

- It has 3 treatment modes, which are Power, Speed and Gentle. It provides different light intensity and flashing speed. The power mode has higher light intensity, the speed mode has faster speed for generating each flashes, and the gentle mode has lower light intensity.
- Auto-detect function for detecting skin tone.
- Glide mode: when the skin contact is well maintained, the flashes will be automatically released.

Braun IPL device (figure 44) has main functions of:

- It has 3 comfort modes, which are Normal, Gentle and Extra Gentle. Gentle and extra gentle settings reduce the energy level for beginners and sensitive areas.
- Auto-detect function for detecting skin tone
- 10 levels of light intensity
- Glide mode: when the skin contact is well maintained, the flashes will be automatically released.

Figure 42 Ulike IPL device

Figure 43 Smoothskin Pure IPL device

Figure 44 Braun IPL device

Oral-B Electric Toothbrush and App (figure 45):

This is not a competitor product in IPL devices, however, it has connected App service with the device which is similar to IPL App. In the App, users will get guidance about how to brush teeth correctly and which part of your teeth should be cleaned more often. The toothbrush will track the users' hand movements via a motion sensor in the brush-head. Meanwhile, the App will use AI technology to give real-time feedback on users' brushing behaviours. For example, the Phone camera will detect the users' hand movements, and then it will detect which part of your teeth you are brushing. Therefore, with the combination of motion sensor and AI camera, the App can give real-time feedback on tracking your brushing path. In this way, it can educate and guide users to develop a good brushing habit (New Scientist, 2016).

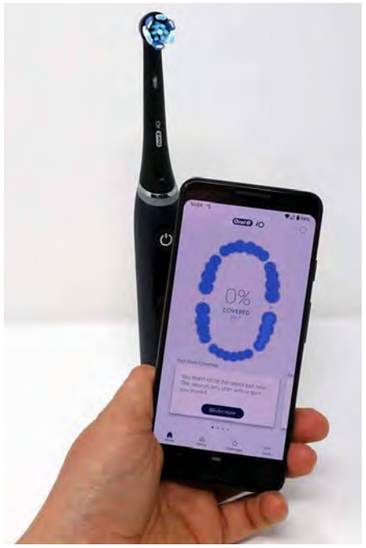


Figure 45 Oral-B Electric Toothbrush and App (New Scientist, 2016)

Key insight from 5.1.2

- From chapter 4.2.6, participants show interest in personal choices on light intensity, and competitor product also provide different usage modes for the user. Thus, different usage modes can be provided for the users for their personal needs. For instance, the modes can differ in flashing speed and light intensity.
- From Oral-B toothbrush, it tends to educate and guidance users to have the correct brushing behaviours. For IPL treatment, users are not aware of how to do a correct treatment. Thus, it can be useful to provide personal guidance for users to have a correct treatment.
- Oral-B uses the motion sensor to detect movement, pressure and angle of the user, in order to provide guidance. Moreover, a tracking sensor can detect the location and path where the user has passed. These two sensors can be useful for the IPL device for tracking and guiding the user's treatment behaviours.

5.1.3 Ideation about Personal Guidance

After the analysis of current competitor products, an ideation was conducted for generating ideas about personal guidance (figure 46). This guidance is about guiding users to have a correct treatment and possibly having less missing spots, meanwhile, some side ideas are also generated.

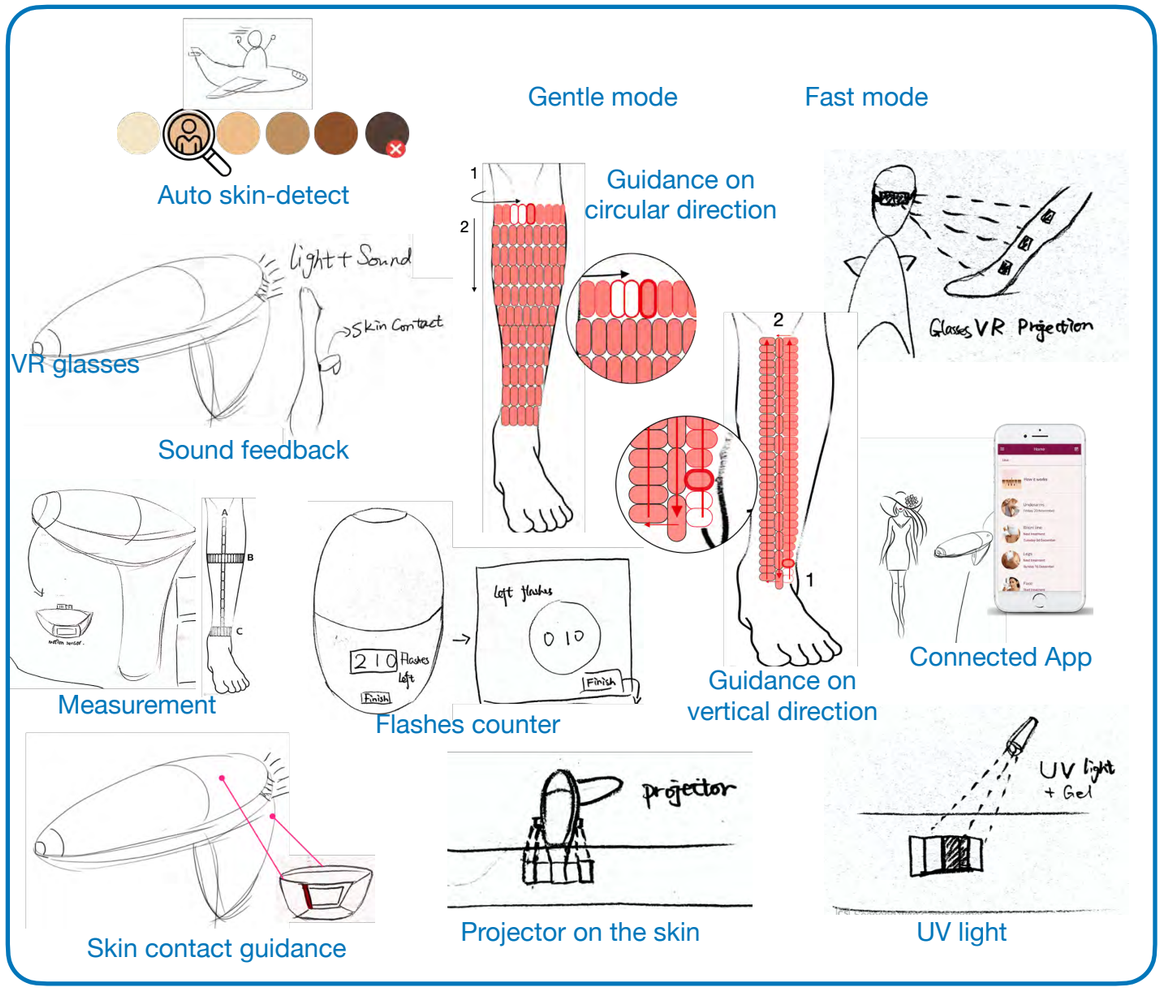


Figure 46 Ideation

According to the technology feasibility, company strategies, and consumer data, the ideas are evaluated and selected. In the next page, the selected idea are presented. The details of otter ideas can be seen in appendix G.

Selected Idea 1: Sensors

IMU sensor: This IMU sensor is the combination of accelerometer and gyroscope, which can measure translational accelerations and rotational speed (Wikipedia, 2020).

IR mouse sensor: The IR mouse sensor can measure and detect infrared radiation(Jost, 2019).

This idea will firstly ask the user to measure their treatment area, in order to calculate how many flashes the user needs for this area. For instance, on the lower leg, the user needs to measure the radius of the ankle (C) and wide middle part of the lower leg (B), and the length of their lower leg (A), see in figure 47. Next, the sensor can detect the movements of the user, which is possible to give guidance and feedback to the users during the treatment.

Idea Selection Decision:

This idea will be selected and Philips is already developing related technology for it. IMU and IR sensors are both possible for providing personal guidance. However, the limitation is that the users need to keep good skin contact all the time. Thus, the later design should be tested if the users can keep good skin contact during the whole treatment. Otherwise, the design should provide the users an easy way to keep the device on the skin.

Selected Idea 2: Guidance on vertical direction

The idea is about providing guidance on the lower leg in a vertical direction.The user will use a motion/mouse sensor to measure the treatment area first, and then the user can start treatment from the bottom to the top of the lower leg(figure 48). The device will inform the user how many flashes they need to apply on the first line. After the first line, the user can start with the second line. When the user moves the device to the second line, the motion sensor can indicate users how far to move. For instance, the device can say: “please move 2cm to your left to start your second line treatment." When the user has moved 2cm, the sensor can tell the user: “you have moved 2cm.” Moreover, when the user moves to the shin bone area, the motion sensor can indicate the user to rotate the device with 90 degree in order to have a better skin contact for the shin bone area.

However, in order to have a precise track of the treatment process, the user should keep the device on the skin during the treatment.

Idea Selection Decision:

The idea 9 is a better match with the design requirements. It guides users to know where and how to flash, it indicates the users how many flashes per line, and it has the same treatment behaviours like the most users have(from the bottom to the top on the lower leg). Therefore, the design concept on the guidance part will use this idea.

Moreover, because the users need to keep constant skin contact during a complete single line, thus, a sound feedback will be added to remind the users if they lose skin contact on the line.

Selected Idea 3: Auto-detect Skin Tone (figure 49)

The device can automatically detect the user’s skin tone and automatically chooses suitable light intensity settings for the user. During the treatment, the device can continue to detect your skin tone. If the user moves to a darker skin area, the light intensity will be automatically adjusted.

Figure 49 Auto-detect skin tone

Idea Selection Decision:

This idea is suitable for the users who prefer a fast way of auto-choosing suitable light intensity settings. The device can do it for the users and the users have the control to adjust it. This idea will be selected in the final design.

Selected Idea 4: Connected App for flexible treatment schedule (figure 50)

If the user chooses different modes on the device with different light intensity, the IPL Lumea App can adjust treatment schedule according to the user's choice.

Idea Selection Decision:

This idea will be selected, because the generation Z users are highly digital solution oriented(chapter 1.2.2), a connected product with an App can attract them and allow them to easily manage treatment schedule.

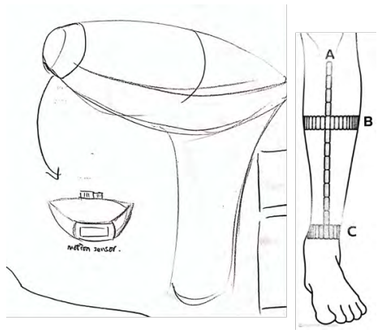


Figure 47 Sensors and measurement

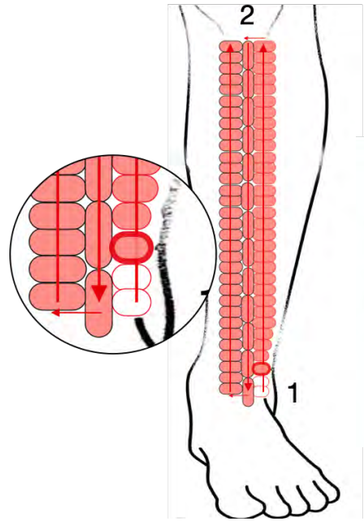


Figure 48 Guidance on vertical direction

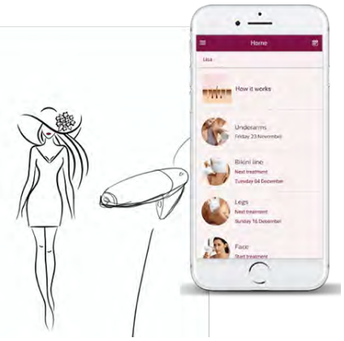


Figure 50 Lumea App

5.2 Concept Development

In this section, user storyboards are created for understanding the concepts. The exploration of new shapes has been conducted, and other design elements are also defined, such as physical buttons, light, screen, and charger.

5.2.1 User Storyboards

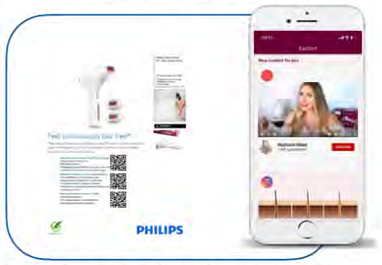
Based on the two main user scenarios, four storyboards were created. Each of the storyboards includes the selected ideas from chapter 5.1.3.

1. First time use of IPL device

1. When Beth uses the IPL device for the first time

2. She can QR code on packaging box and download the App, where she find some video instructions.

3. She can also find Youtube, Instagram and TikTok influencer videos of using IPL device for some tips.

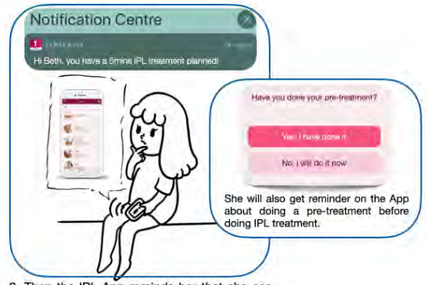


4. There is a flyer in the box, which shows her every step of using IPL. By scanning the QR code next to the step, she can watch video demonstrations.

5. After unboxing her IPL package, there is special pouch where she can put every IPL stuff in, such as attachments, charger and the device.

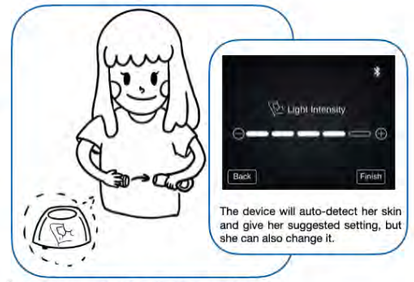
2. When users don't have enough time...

1. Beth needs to get up early in the morning but she wants have a IPL treatment.



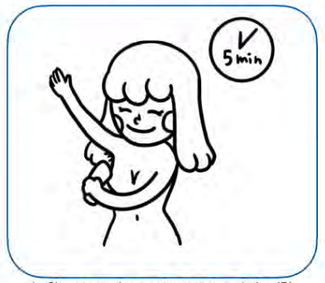
She will also get reminder on the App about doing a pre-treatment before doing IPL treatment.

2. Then the IPL App reminds her that she can do a quick treatment on her armpits for 5mins.



The device will auto-detect her skin and give her suggested setting, but she can also change it.

3. She plugs in armpits attachment which will activate the related screen on the device.



4. She starts the pre-treatment and the IPL treatment, it takes her only 5 mins!

5. After 5mins, she finished the treatment and the IPL device update her treatment schedule with the App.

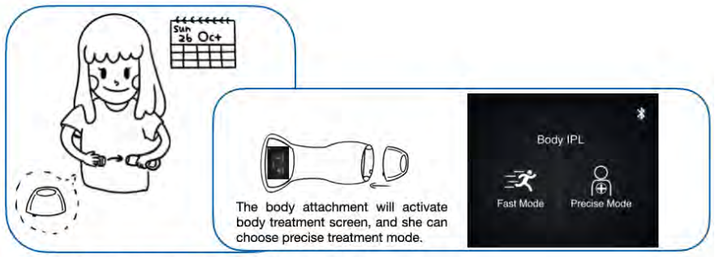
6. Now she can have a good sleep and get up freshly in the morning.

By plugging in different attachments, related treatment mode will be activated on the screen. Beth can do a quick treatment on her armpits, bikini lines, and face (fast leg treatment will be in storyboard 4).

3. When users have enough time and want to do IPL for an enjoyment

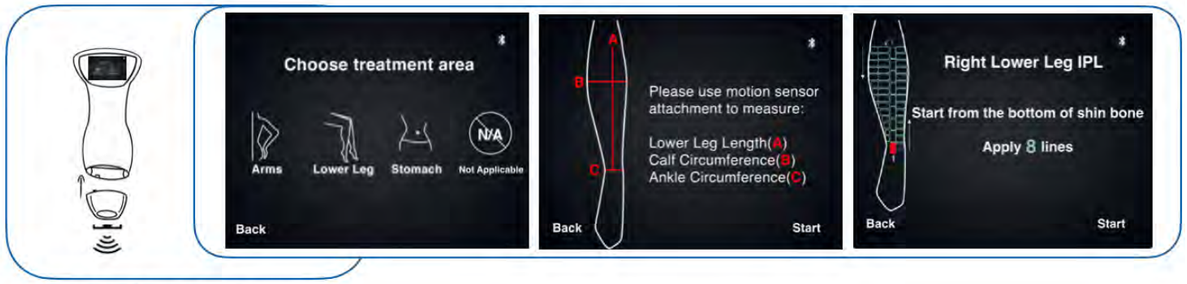
She will also get reminder on the App about doing a pre-treatment before doing IPL treatment.

1. Beth gets a notification from IPL App that she will have a 30mins IPL treatment on Sunday afternoon. She has the option to reschedule it.

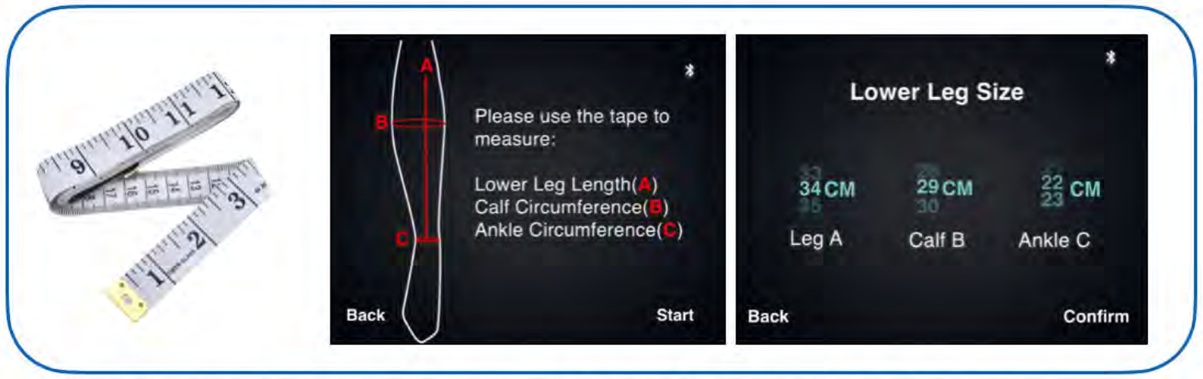


The body attachment will activate body treatment screen, and she can choose precise treatment mode.

2.On Sunday afternoon, she starts the treatment with using the body attachment for an enjoyable 30mins treatment.

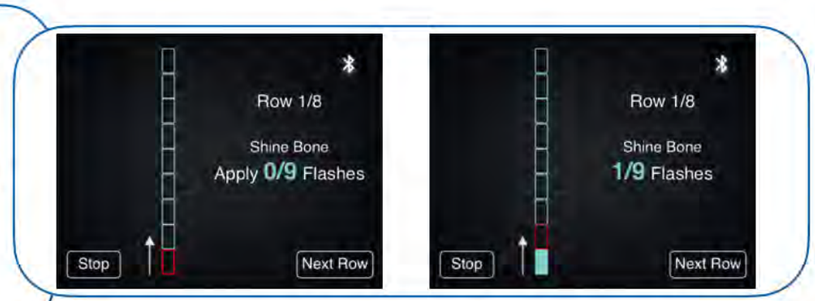


3. If this is her first time to use the precise mode, then she can use motion sensor to scan her leg size to allow the device to give her precise guidance



Method 2: she can use tape to measure her legs on position A, B and C. Then she can enter the date to the device.

4. If she already gave body data to the device, then she can start guidance immediately.



5. With the motion sensor on the body attachment, Beth can get precise guidance on how to do a detailed treatment on her lower leg.

6. After finishing the treatment, the device will update her treatment schedule with the IPL App.

7. Meanwhile, she can find usage videos of instagram influencers and youtube vloggers who have similar skin type and hair colour with herself.

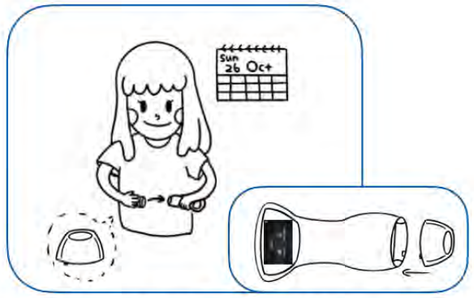
8. She can quickly leave the IPL device on the charging base, the device will charge automatically.

Storyboard 3 has two methods of measuring the treatment area. One is to use the sensor, another one is to use the tape. However, it is not clear yet which one would be better for the users. This will be tested in the usability testing in next chapter.

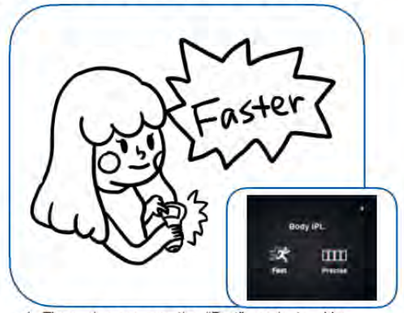
4. When users feel leg treatment takes too long...

1. Beth wants to do a lower leg IPL treatment before going to a party, but 30mins lower leg treatment is too long for her.

2. She wants to do the lower leg or larger body area treatment faster!



3. She plugs in the body attachment which will activate the related screen on the device.



4. Then, she can use the "Fast" mode to skip detailed guidance and have faster flashing speed.

She can even use "Auto" feature to have the flashes automatically released! (Only when skin contact is well remained)

5. With auto flashing and fast flashing speed, it only takes her 15mins for the lower leg treatment.

6. After 15mins, she finished the treatment and the IPL device will update her treatment schedule with the App.

7. After the quick treatment, she can now go to her friend's party on time!

Based on these four user storyboards, the design concept is defined. In the next section, the details of how concept is developed will be explained.

5.2.2 Exploration of Shapes

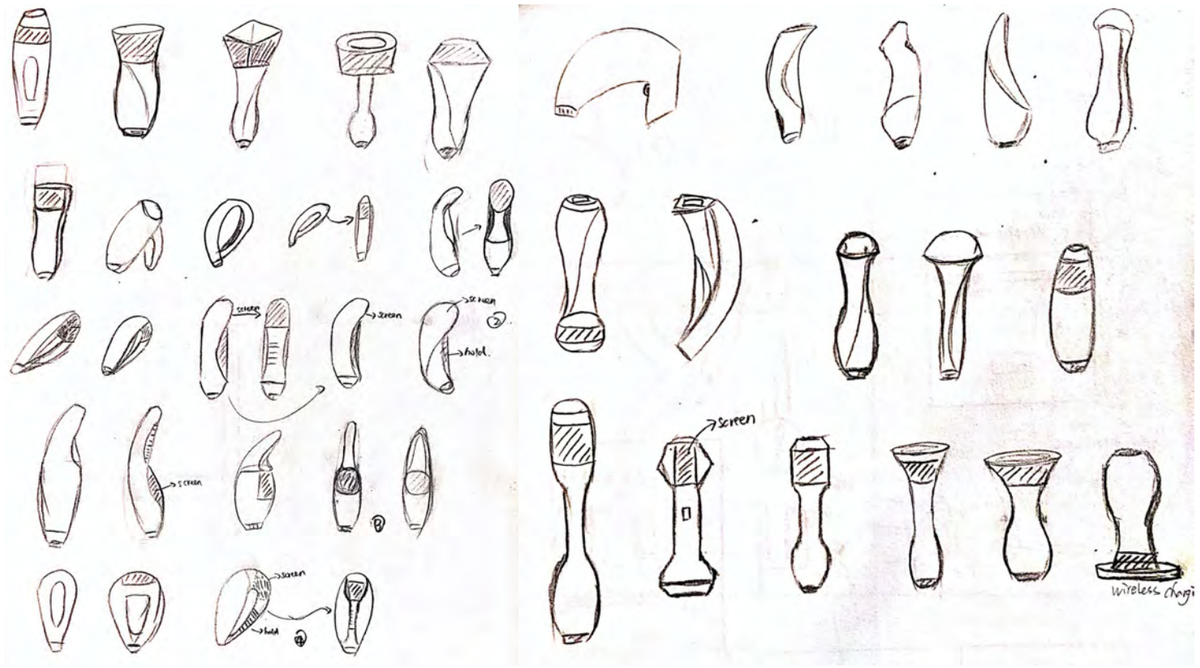


Figure 51 Exploration of shapes

From chapter 2.2.5, the current shape of Philips IPL Lumea device is not optimal for easy usage. Users feel discomfort on their wrists during their treatments, especially the lower leg treatment. Therefore, an exploration has been conducted for finding a new shape. Based on the comfort and easy usage, four shapes are made by clay prototypes for further analysis. The shapes are tested by two participants, one is a 25 years old male and another one is a 19 years old female. The clay prototypes are heavier than the real product, thus, the discomfort might be greater with clay prototypes.

Shape 1

The shape 1 has a rotational screen on the top, where users can rotate the screen when they can not see the screen in certain positions. The centre of mass is in the middle of the handle. Participants are able to keep a 90° angle between their wrist and the device on the holding positions on the lower leg, belly, face and arms, which are defined as comfortable postures from chapter 2.2.5 (Moore et al., 2011). The participants feel comfortable on the positions of face, arms, lower leg and belly area. However, participants had discomfort in the armpits area, but the treatment time is only for 5 minutes, thus, the discomfort is accepted.

Figure 52 Shape 1 analysis

Shape 2

The shape 2 has a bendable screen on the top with a holding position in the middle. The participants feel comfortable on the positions of face, lower leg, armpits and belly areas. However, the varieties of postures are very limited. Each position only has one most comfortable posture, and other postures have significant discomfort. Moreover, the visibility of the screen is low, when it turns to the back of the leg and rotates the device for a vertical flashing spot, then it is very hard for participants to see the display. Thus, this shape will not be considered

Figure 53 Shape 2 analysis

Shape3

The shape 3 has a curved handle with a display on the top. The participants showed large interest in the appearance of the shape, because they think it is very new and nice to hold. However, on the positions of face, arms, belly, and lower leg, the participants have significant inconvenience of watching the display and discomfort of holding the device. This handle only allows a fixed holding position, however, when the user conducts the IPL treatment, the hands' postures are constantly changing. Thus, this shape will not be considered.

Figure 54 Shape 3 analysis

Shape 4

Shape 4 has a screen on the bottom and bendable handle. The participants feel comfortable on the positions of face, arms, belly, armpits and lower leg. It also provides the variety of different handling positions on the lower leg. However, during the IPL treatment, the flashing light is relatively bright for the participants to watch, and this screen is very close to the attachment. It would be hard and annoying for the users if they need to watch the screen while seeing the flashing light next to it. However, there is not much space left for the display to change another location, because the handle is on the top already. Therefore, this shape will not be considered.

Figure 55 Shape 4 analysis

Further development of shape 1

From the exploration of shapes, one of the most comfortable shapes is shape 1, which has more freedom for the users to hold in different positions and better visibility of the screen (rotational screen). Moreover, the shape 1 enables the user to hold the device 90° perpendicular on the skin with the study of a neutral hand postures from Moore et al. (2011).

In order to further develop the shape 1, ergonomics guidelines from Dined (2020) have been referred for defining a more suitable size of shape. From Dined (2020) and Lindqvist (1998), the recommended diameter of cylinder handle (both for female and male) is 34mm to 45mm, and the length is from 90mm to 130mm (male and female). Thus, a 3D CAD model has been made to have the precise size of the shape for the evaluation.

After the development of shape 1, the second analysis of shape 1 has been done with the 3D printed model. The participant is a 19 years old female.

The participant feels comfortable on positions of face, arm, belly and lower leg. These areas have different holding positions as well. However, on the armpits, the “armpits position 1” is not comfortable, but the “armpits position 2” and “armpits position 3” are comfortable. The users can press the flash button with different positions as well. In the end, the new version of shape 1 is decided for the new design.

Figure 56 Shape 1 second analysis

5.2.3 Define the Physical Buttons and Light Effect

Flash Button

There is a flash button on the Philips IPL Lumea device for users to release flashes. In the new design, this flash button should also be added. Therefore, possible positions of the flash button are considered below (figure 57).

An analysis has been conducted to explore which positions are most comfortable. After trying out the three possible positions, the position 1 is the most comfortable, the position 2 is the second comfortable. Position 3 is not comfortable to press.

Moreover, a further improvement is added for the button size, with larger and longer space (figure 58), the users can have more space to press the button with position 1 and position 2.

Figure 57 Flash button positions

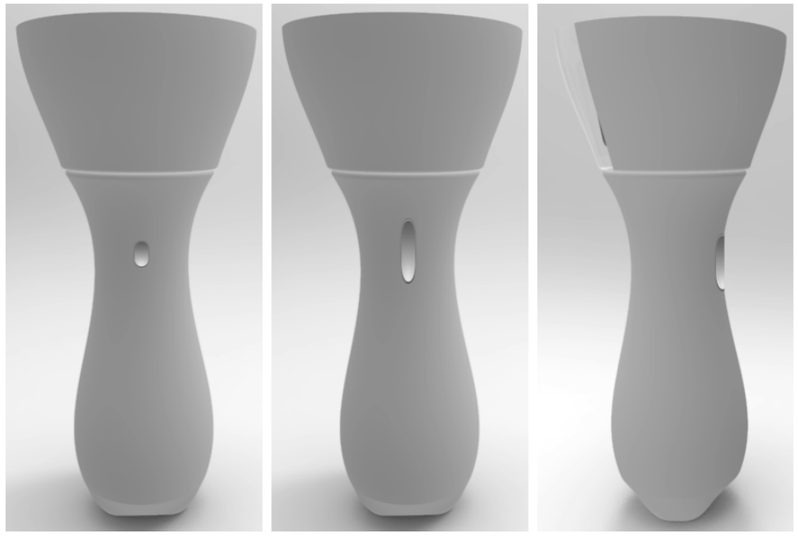


Figure 58 Large press button

Switch On/Off Button

Four locations of the on/off button have been explored, the last one on the right side of figure 59 will be chosen. It is integrated with the digital interface, which is easy for the users to see and operate.

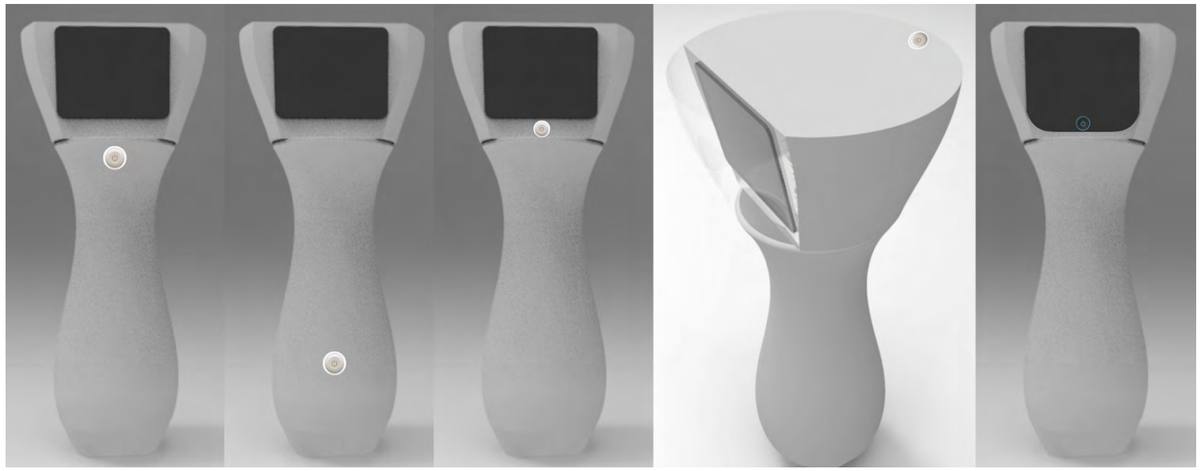


Figure 59 Switch On/Off button positions

Ready to Flash Light

Four locations of “ready to flash light” have been explored (figure 60). The locations of 1,2 and 3 are all on the digital screen. This is difficult for the users to see, because there will be enough information for the users already on the screen. Therefore, the location 4 is preferred, which is easier for the users to see.

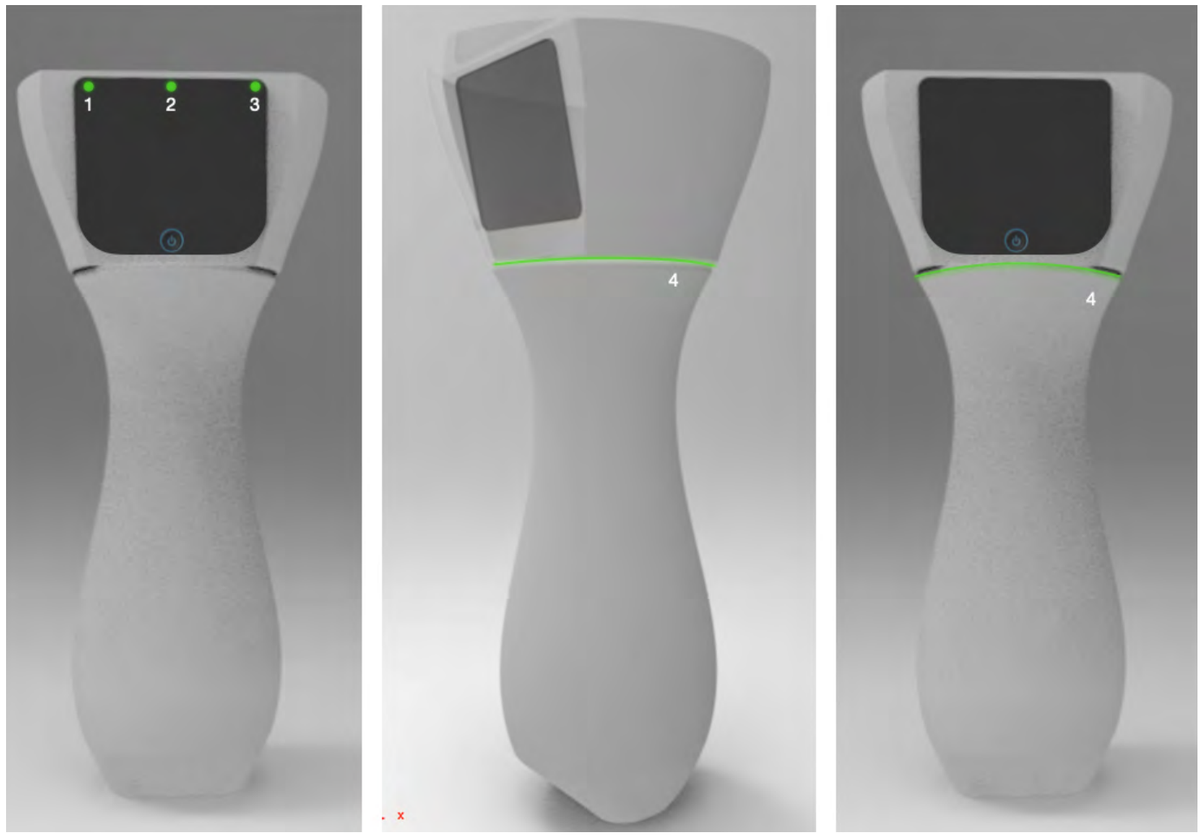


Figure 60 Ready to flash light positions

5.2.4 Define the Screen

Define the screen size

A short test was done for defining the size of the screen. 6 types of screen size have drawn on the paper (figure 61), the participant was asked to evaluate if he can see the words on the screen on the longest distance of his lower leg. Moreover, according to the experts from Philips, the screen should be a flat screen, because a curved screen can be very expensive and the disability on a curved screen might not be as good as a flat screen on this shape.

Figure 61 Define the screen size

In the end the proposed screen size range is:

Width range: 6-9cm

Height range: 4-6cm

However, the screen should also fit into the shape itself, therefore, after trying the screen on the CAD model on the computer, the proposed size for fitting the shape is 6.4x5cm (figure 62).

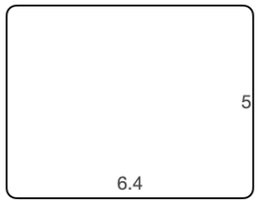


Figure 62 Proposed screen size. Unit: cm

Define the screen style

There are many different styles of screen, but which one could be suitable for the new IPL device remains to be decided. Most users use the IPL device in their bedroom and bathroom, where they usually have dark lighting and lower visibility. However, the user manual suggests the users to use it in a well-lit room, so the screen can be even better seen. Therefore, the requirements of screen style is listed below:

- High contrast of screen for visibility at bathroom and bedroom settings
- High contrast for easy readability when the flash light is released. The less colour it has, the less distractions the users might have.
- Current trend for sense and simplicity from generation Z consumers (MI&A Personal Health Philips, 2020).

Figure 63 Examples of screen style (Pinterest, 2020)

Define the Interfaces with Paper Prototypes

After defining the screen size, the paper version of all interfaces are made. This includes all the product features related to the design concept. The paper version interfaces were tested with one participant (figure 64), this is for checking the logic of interfaces, which is a preparation for a real digital interface prototype.

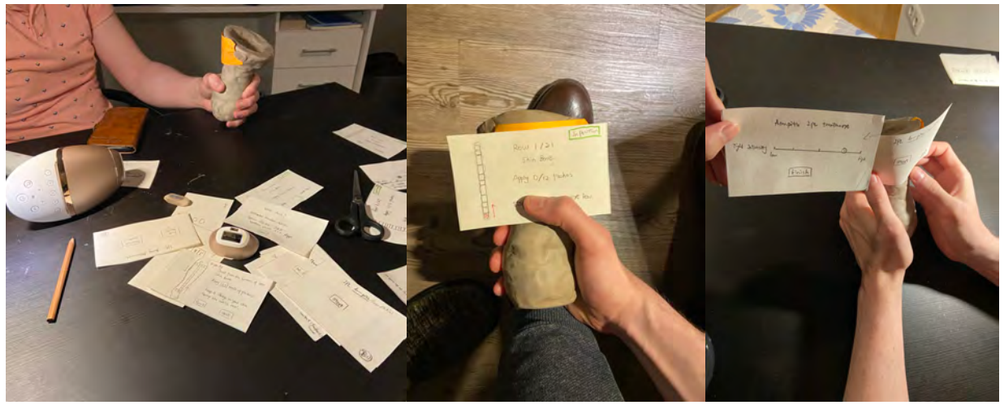
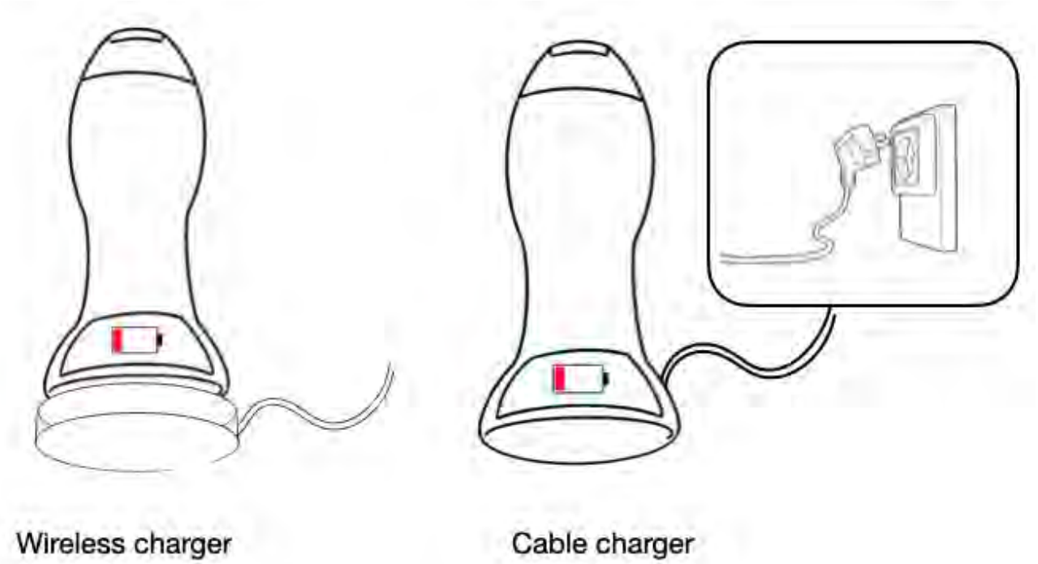


Figure 64 Paper version interfaces

5.2.5 Define the Charging Methods

There are 3 ways of charging the device, wireless charging, cable charging and box charging. The user will have two chargers which are the wireless charger and box charger, because:

- The wireless charger has a flexible location.
- The wireless charger takes less space.
- The wireless charger can be a storage place for the device and it fits into the product appearance.
- The box charger can be useful for users who travel frequently, then they can carry this box charger with their attachments in it.
- The users can storage their attachments in box charger.



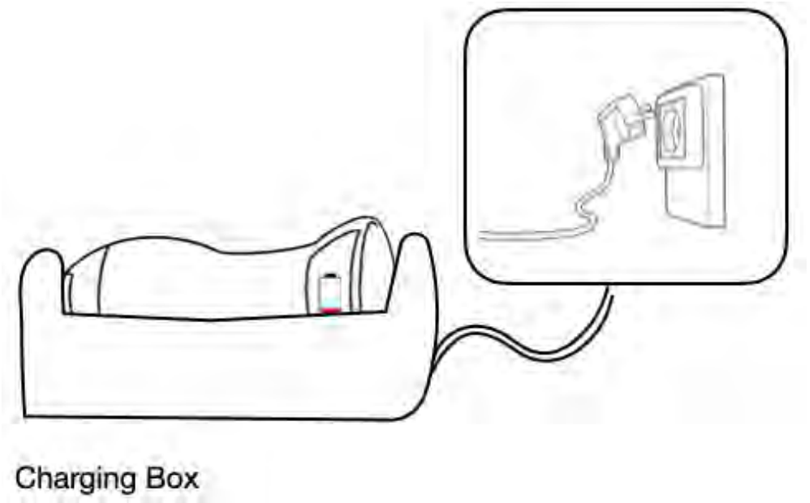


Figure 65 Charging methods

5.3 Final Concept

Gender neutral style

The final design uses the gender neutral style, as the “Generation Z seek for inclusive life attitudes, such as gender equality, LGBT+ equality and ethnical equality.” (MI&A Personal Health Philips, 2020).

Moreover, the colours are also defined, because “light browns, greys, black and white are all gender-neutral colours. Since blue is a colour liked by both genders, it can be considered a gender-neutral colour.” (Velarde, 2018).

Product Features

Product Holding Postures

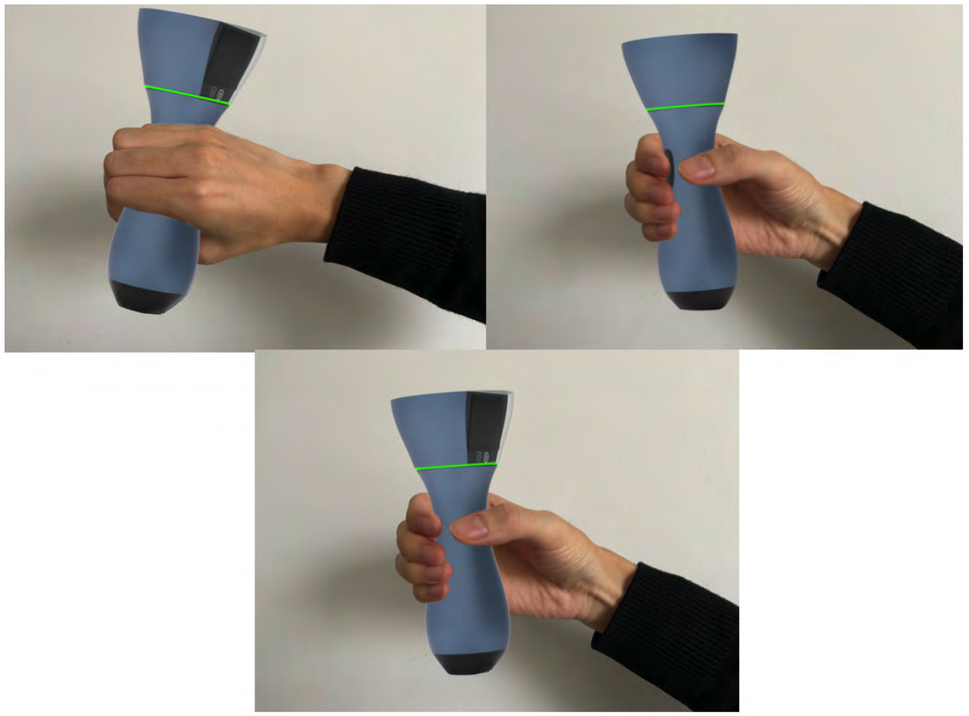


Figure 66 Holding positions

Rotational screen

There are different ways of holding the device, which allow the users to have more freedom during the treatment (figure 66). The screen on the top can be rotated, if the users place the device on the body part where the users can not see the screen, the users can rotate the screen for better view.

Charging Methods

Figure 67 Charging methods

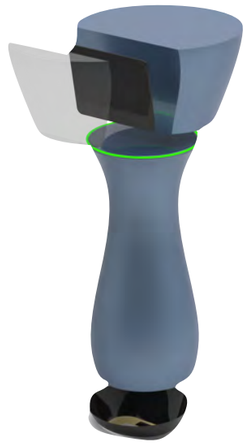


Figure 68 Exploded view

There are two different ways of charging the device (figure 67). Users can charge it on a wireless charger when they are at home. If they users need to travel, they can have the charging box with all attachments in the box. The exploded view of the device is presented as well in figure 68.

Usage Context

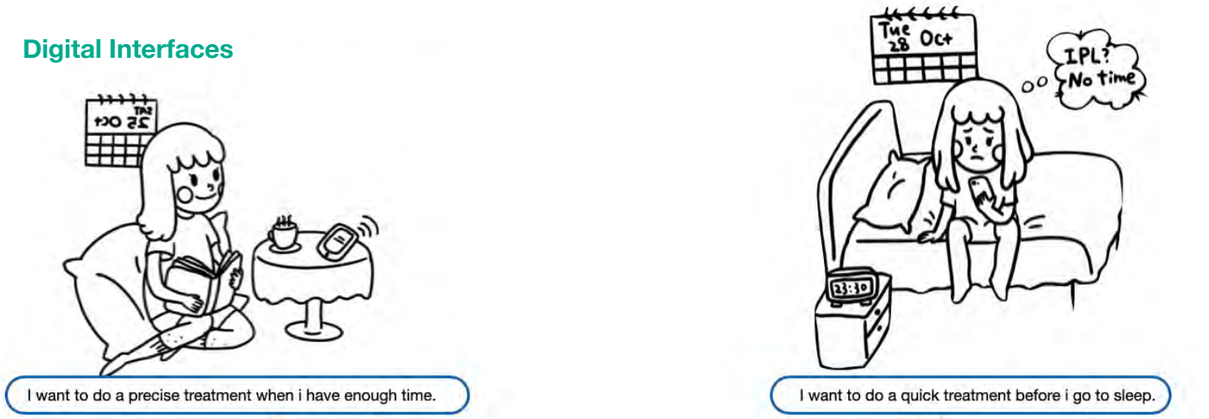
Possible usage contexts are presented, the users can use this device in their bedrooms, living rooms, and bathrooms.

Figure 69. Bedroom context (Daly, 2019)

Figure 70. Living room context (Diyroomideas, 2020).

Figure 71. Bathroom context (Chard, 2019)

Digital Interfaces



According to the user scenarios, there are three possible treatment procedures for the users. They are fast mode for quick treatment on a large body area, normal mode for armpits/face/bikini line attachment with immediately start, and a precise mode with personal guidance on large body areas.

If the users plug in face, armpits and bikini line attachments, the related display will be activated. For example, if the users plug in armpits attachment, the display on figure 72 will show. Armpits, face and bikini line attachments have similar display, they are mainly about light intensity selection. When the user place the device on the skin, the light intensity will automatically choose a suitable setting for the user. In this scenario, the users will not have personal guidance and auto-flashing functions. Because the treatment areas are relatively small, so the users have less problems with missing spots. All digital interfaces can be seen in appendix H.

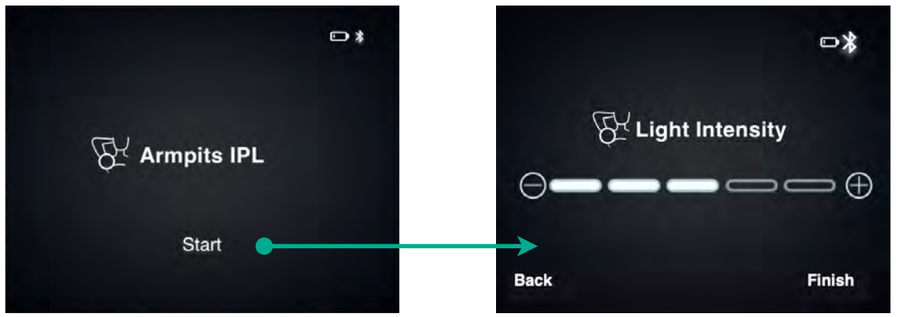


Figure 72 Related display for armpits attachment

If the users plug in body attachment, the screen will be automatically activated with the following interfaces (figure 73). It contains fast mode and precise mode. In the fast mode, the users will have a faster flashing speed and the auto-flashing function. In the precise mode, the users will have personal guidance on how to apply correct flashes. In the end, both modes will update treatment schedule with the Lumea App.

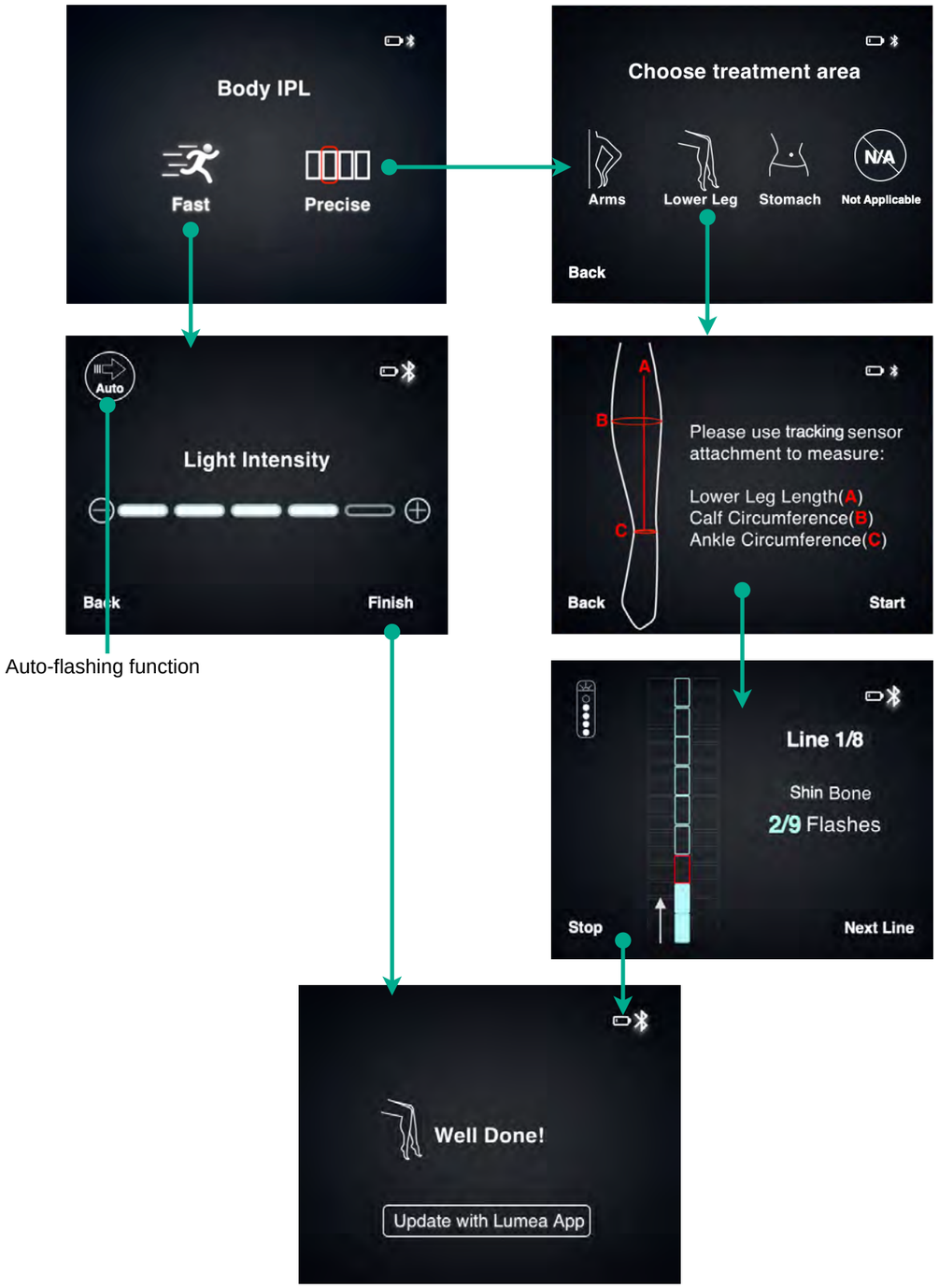
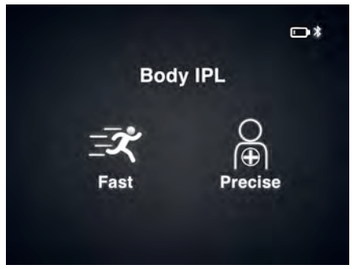


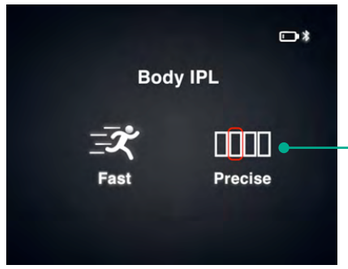
Figure 73 Related display for body attachment

Iteration on Digital Interfaces

During designing the interfaces, iterations on the interface were also conducted.

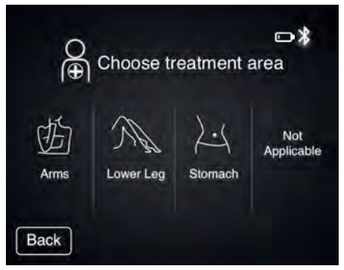


Old

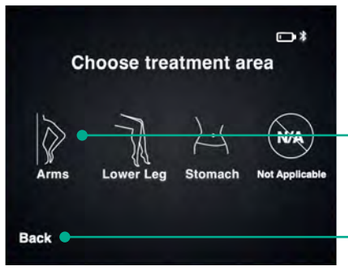


New

New icon for matching the precise mode function



Old

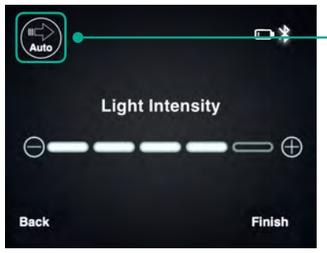


New

New icon for better understanding of different body areas.

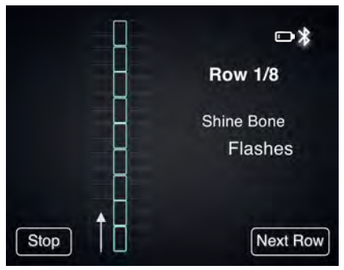
Distinguish the function button and back/next button, this is for consistency.

Old



New

Different positions and icons of “Auto-flashing” feature are explored for making this feature more understandable.



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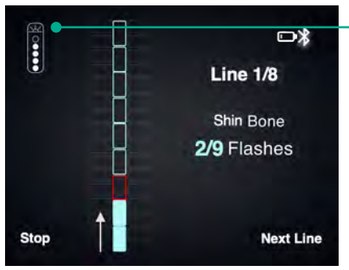


New

New

A light intensity indication can be seen in precise mode. If the user clicks the icon, it will turn to the light intensity selection interface.

5.4 Conclusion

In this chapter, competitor products are analysed for ideation inspiration. Concept development has been done in aspects of shapes, colour, physical buttons, light effect, screen size, digital interfaces and chargers.

The key insights from this chapter are:

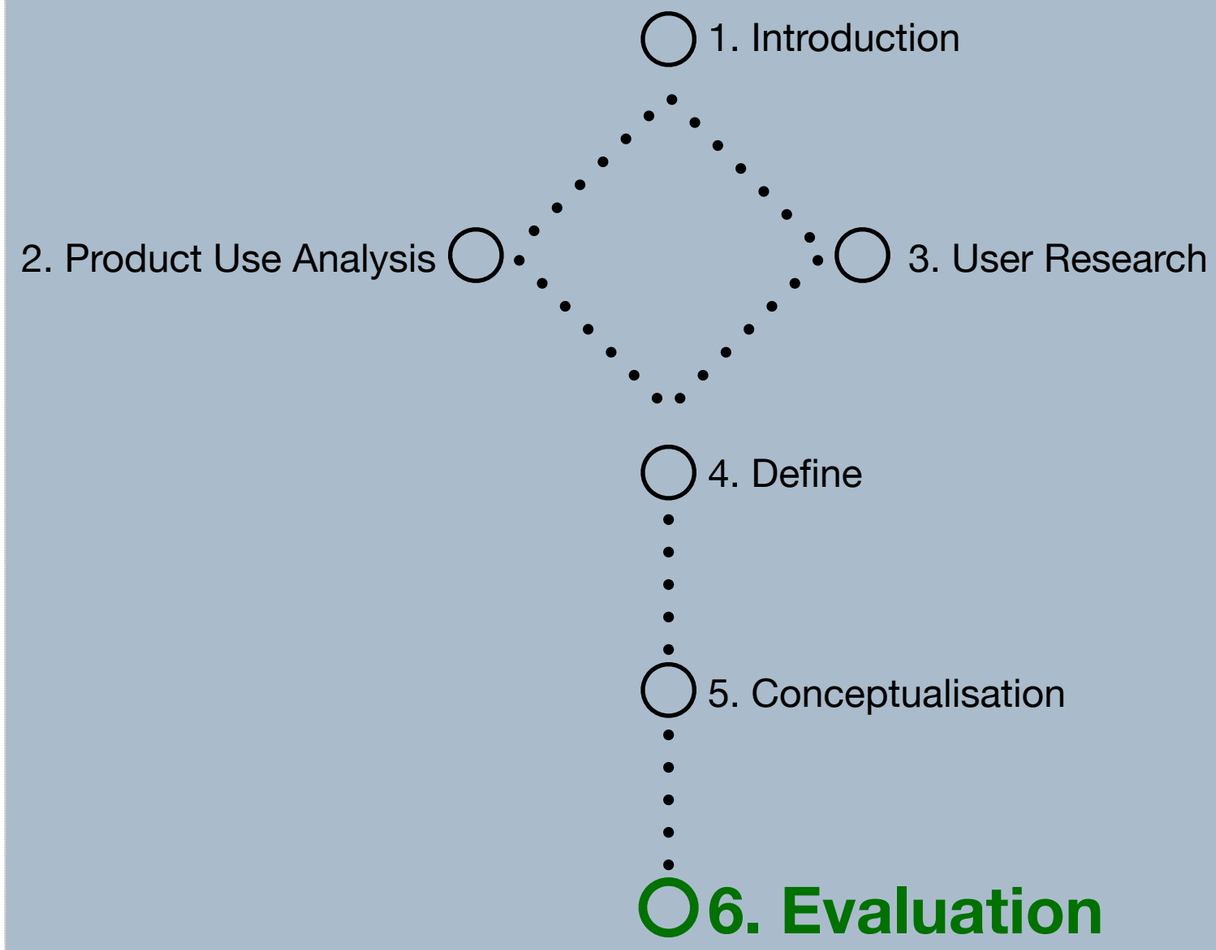
- Competitor products are analysed, possible ideas of tracking sensor, light intensity selection and different treatment modes are inspired.
- Four different user storyboards are presented and three different treatment procedures are introduced. They are precise mode with personal guidance function (for body attachment), fast mode on large body areas (for body attachment), normal mode with an immediately start(for armpits, face and bikini line attachments).
- Four different shapes are explored and eventually a new shape is defined for a more comfortable holding posture.
- Personal guidance on a vertical direction is decided, which is similar to normal shaving behaviour and it is more user friendly.
- The positions of flash button, switch on/off button, and “ready to flash” light are explored. In the end, solutions are created for allowing user to understand and use the device easily.
- The display size and display style are defined for the users to watch the display easily at different contexts.
- Two ways of charging are presented for users to charge at home easily and charge it easily while travelling.
- A gender neutral style of the appearance is presented in order to match the generation Z characteristics of being inclusive.

In the next chapter, prototypes will be made for usability testing. This testing will help to evaluate the design and decide a suitable measurement method on personal guidance mode.

6. Evaluation

- 6.1 Usability Testing
- 6.2Results and Analysis
- 6.3 Improvements
- 6.4 Recommendations and Conclusions
- 6.5 Reflection and Acknowledgements

Chapter 6 is about the evaluation of the final design. A physical prototype and a digital prototype are made for a usability testing. 8 participants from generation Z group joined the usability testing. Then the data is collected and results are analysed. Afterwards, based on the usability testing and evaluation, main improvements are implemented in the final design.



6.1 Usability Testing

After having the prototypes, it is important to evaluate if this design can meet the original design goal. The usability testing has been set up in order to evaluate the final design.

6.1.1 Research Goal

The scope of the usability testing is about evaluating the design based on the design goal. There are three elements that will be evaluated: the effective communication of the display, the personal guidance from the display, and the confidence on building a sense of achievement after using the personal guidance. This testing is for qualitative research and the research questions are below.

6.1.2 Research Questions

1. Is the communication of the digital user interface clear for the user?
2. Can users understand the personal guidance from the screen?
3. Does the personal guidance from the screen help the user to do a correct treatment?
4. Which measurement method does the user prefer, tape or tracking sensor?
5. Does the user understand the tape measurement and the tracking sensor measurement?
6. With the personal guidance interfaces, does the user feel more confident to reach their hair-free goal?
7. Does the user feel comfortable to hold the device and press the button on main body areas?

6.1.3 Method

Participants

There are 8 participants who participated in the usability testing and they are all from generation Z group. Due to the covid-19 situation, there are 5 participants joined the testing in person and 3 participants joined it online. The characteristics of participants are presented in Table 5. All participants were asked to sign up privacy consent form before the testing (appendix I). They all have suitable skin tones and hair colour for the IPL treatment and they are interested in hair removal activities. During the testing, participants were only allowed to use lowest setting 1 to release the IPL flashes, which is for the safety concern. All participants were asked to shave before they join the testing and they have signed the privacy consent form before the testing.

Participant Number	Gender	Age	Ethnic group	Familiar with IPL devices?	Willing to invest more on hair removal activities?
1	male	25	Caucasian	Yes	Maybe
2(online)	female	24	Asian	Yes	Yes
3	male	22	Caucasian	Yes	Maybe
4	female	19	Asian	Yes	Yes
5	female	21	Caucasian	Yes	Yes
6	male	24	Latino	Yes	Yes
7(online)	female	20	Caucasian	Yes	Yes
8(online)	male	24	Asian	Yes	Yes

Table 5 Participant list

6.1.4 Prototyping

For the usability testing, prototypes are made for the specific testing requirements. For the user interface, a working digital display prototype has been made by software Principle, it has animations to stimulate the real user experience(figure 74). Participants can watch the display on the laptop with the same interface size as the final design, which is 6.4x5cm.

Figure 74 Digital interface prototype with animation

For physical shape, a 1:1 scaled 3D printed model is made for the participants to hold and use. It has the main shape and the wireless charger (figure 75). The 2D technical drawing (figure 76) shows the details of how the model is made.

Figure 75 3D printed model.

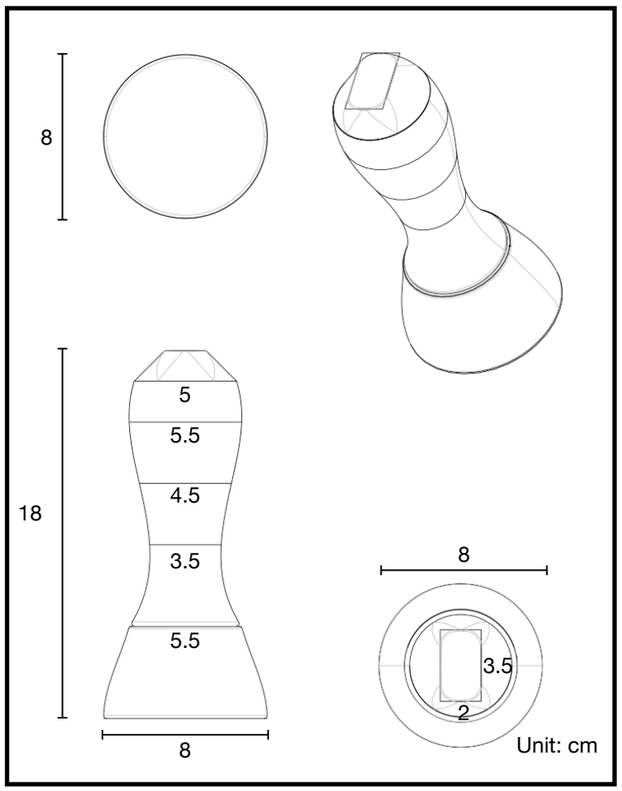


Figure 76 2D Technical drawings

6.1.5 Equipments

The equipments for the usability testing are(figure 77):

1. 3D printed shape of the new IPL device: Participants will hold this model to stimulate treatment process
2. One Philips IPL Lumea Device: This is for participants to understand and compare current IPL device with the new design.
3. A display: A 1:1 scale size of display is on the laptop, participants can watch the screen and conduct tasks. Due to time limit, the display is not implemented in the 3D model, thus, participants were asked to imagine this display would be on the model.
4. Printed privacy notice and questionnaire.
5. Disinfection materials for Covid-19 measures.
6. Tape: for assignment 4, to compare different measurement method.

Note: For 3 online participants, they used their own IPL devices to conduct tasks, but they were asked to follow the shared display online to conduct assignments.

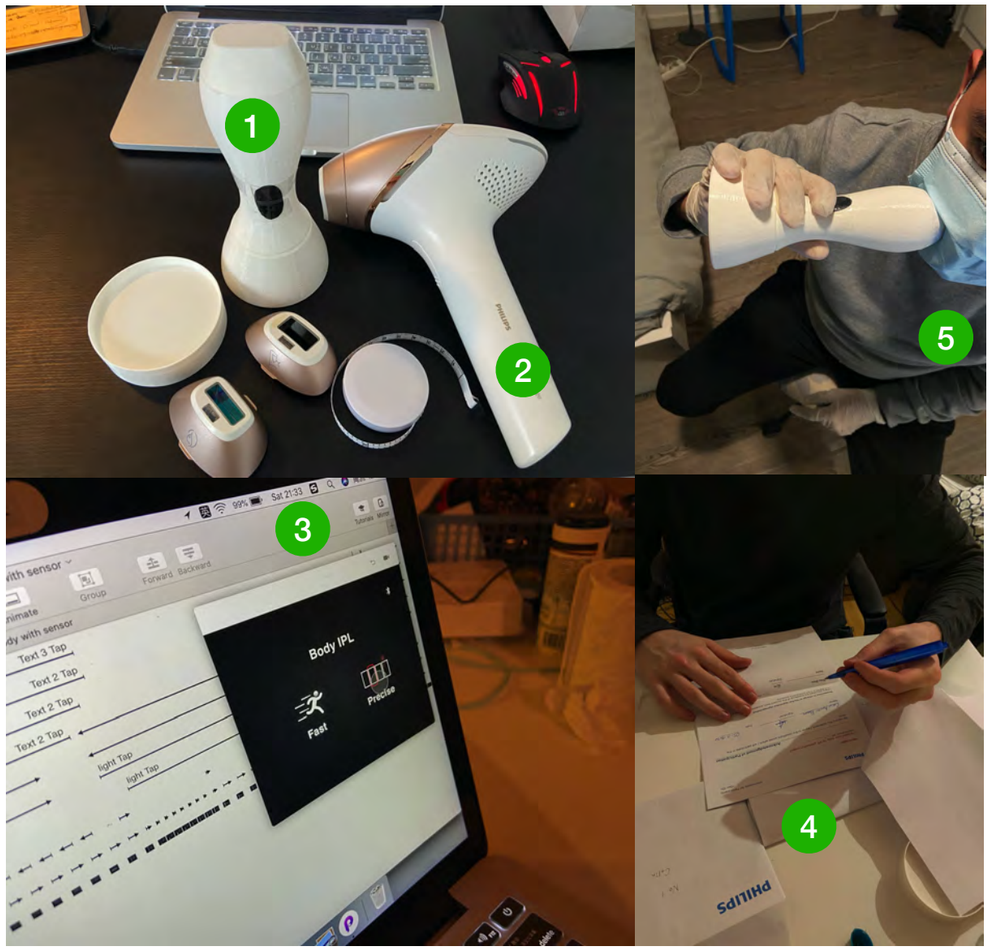


Figure 77 Testing equipments

6.1.6 Procedures

There are 5 participants who did face-to-face testing and 3 participants did online testing.
The overview of the testing can be seen from figure 78. First, participants will have an introduction about the test. An explanation of Philips IPL device and new design will be given to the participants. Participants will be able to see the CAD model of the new designed IPL device.

After introducing the participants to the test and design, the 3D printed model will be given to the participants for conducting tasks for the testing. Participants will use this model to move on the treatment area. At the same time, they will be asked to look the interfaces from the display. This display is the same size as on the original model. Then, participants will conduct tasks by the instructions from the display. Moreover, each assignment will follow a short questionnaire. During the questionnaire, there will be a discussion with the participant. There are 5 Assignments in total and each task is less than 15 minutes. This is for a better engagement when the testing is done remotely, where participants can follow and concentrate better(Usability.gov, 2020). The details of the testing plan, set-up and metrics can be seen in Appendix J.

Pilot Testing

A pilot testing was done with the first participant. This is for checking if the testing set-up, materials, questionnaires and instructions are clear or not. During the pilot testing, the participant conducted the tasks very well and gave relevant insights about the design. The result of this participant is valid for later data analysis.

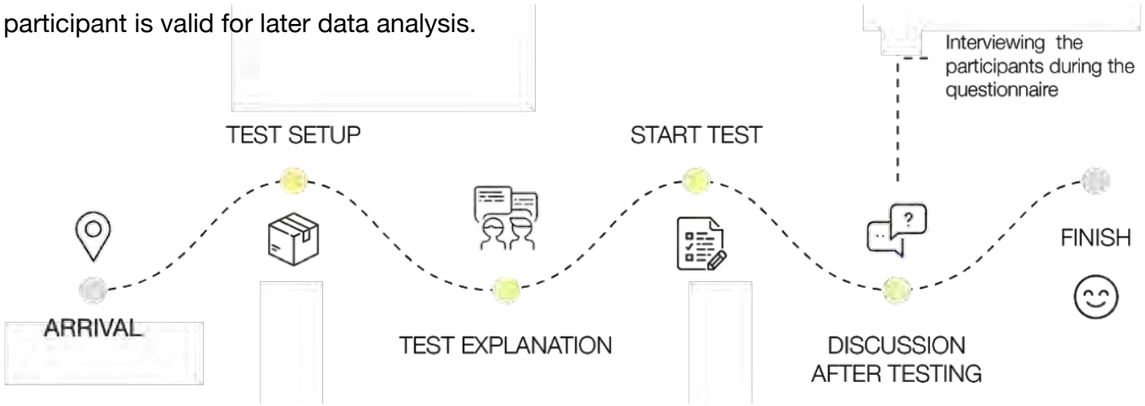


Figure 78 Procedure of usability testing

6.1.7 Assignments

There are 5 assignments in the usability testing, each assignment has different tasks for the participants. Details of every assignment can be seen in Appendix J.

Assignments 1

Imagine you are going to do a IPL treatment on your armpits by using the new Philips IPL device. Please choose the attachment and watch the digital screen when you conduct your treatment.

Task flow

1. Change the armpits attachment.
2. Switch on the device.
3. Use the correct light intensity.
4. Put the 3D model on the armpit.
5. Press the flash button.

Assignments 2

Please use the body attachment for conducting a lower leg treatment. Please choose the fast mode for your lower leg treatment. (You will be informed when you need to stop the treatment)

Task flow

1. Change the body attachment.
2. Switch on the device.
3. Choose fast mode
4. Use the correct light intensity.
5. Put the 3D model on the lower leg.
6. Press the flash button.
7. Check the button of the “Auto” flashing feature.

Assignments 3 (Tracking sensor measurement)

Please choose the precise mode for your lower leg treatment and follow the instructions on the screen.

Task flow

1. Change the body attachment.
2. Switch on the device.
3. Choose precise mode.
4. Use the tracking sensor feature to measure lower legs.
5. Check the light intensity.
6. Follow the shin bone guidance to release flashes
7. Follow the tracking spot icon and animation to change to another treatment line.
8. Complete the treatment for two lines.

Assignments 4 (Tape measurement)

Please choose the precise mode for your lower leg treatment and follow the instructions on the screen. (Assignment 4 follow the similar steps with assignment 3, but it has a different measurement method. Participants will stop the task when they finish the measurement)

Task flow

1. Change the body attachment.
2. Switch on the device.
3. Choose precise mode.
4. Use the tape to measure lower legs.
5. Enter the measurement data on the laptop.

Assignments 5

Please hold the 3D printed model and use it on your armpits, lower leg, bikini line, arms, and upper lip. Press the black flash button one time. (Participants who conduct online testing will not do this task)

Task flow

1. Hold the 3D model on your armpit for 2mins.
2. Hold the 3D model on your bikini line for 2mins.
3. Hold the 3D model on your upper lip for 1mins.
4. Hold the 3D model on your arm for 2mins (finish one line treatment may cost 2mins).
5. Hold the 3D model on your lower leg for 2mins(finish one line treatment may cost 2mins).
6. Hold the 3D model on your upper leg for 2mins (finish one line treatment may cost 2mins).

6.1.8 Data Collection

During the task, the moderator observes and rates the severity of usability problems. After each assignment, participants are asked to fill in the questionnaire. The questionnaire contains the rating scales for design requirements and qualitative reasons of usability insights from participants. The usability insights are immediately collected and analysed after the session by Instant Data Analysis(IDA) method (Kjeldskov, Skov & Stage, 2004).

6.1.9 Data Analysis

After collecting the data, the analysis was conducted. In line with similar research in the field, conducted by Kejldskov, Skov and Stage (2004), the moderator collected and organised the identified usability problems. At the same time, the participants were asked the questions for clarification. After the IPL usability testing, the moderator planned time to use the Instant Data Analysis(IDA) method for analysing the occurred usability problems.

During the testing and discussion, the usability problems are observed and collected. Moderator rated severity of main usability problems during the discussion with the participants. For evaluating the severity of the usability tasks, a scale standard from Nielsen (1994) is used. The following 0 to 4 rating scales are used to rate the severity of usability problems:

0 = I don't agree that this is a usability problem at all

1 = Cosmetic problem only: need not be fixed unless extra time is available on project

2 = Minor usability problem: fixing this should be given low priority

3 = Major usability problem: important to fix, so should be given high priority

4 = Usability catastrophe: imperative to fix this before product can be released

The severity of the usability problems are rated and ranked, which can be seen in the next section. Moreover, the key insights of usability are concluded in the next section as well.

6.2 Results and Analysis

First of all, an overview of task completion has been made for each assignment, in order to evaluate the severity of the tasks. Participants were asked to try it by themselves at the first try, if they had problems, they would have help from moderator for short explanation to have a second try. If they still have problems, they would have a full explanation to have a third try.

6.2.1 Results of Assignments Completion

Assignment 1

Assignment 1 (table 6) is about conducting IPL treatment on the armpit. In this assignment, most participants finished the tasks at the first time. They understand the "auto-detect" skin tone feature and the light intensity selection. They didn't show any discomfort when they place the model on the armpit and press the button. In general, this assignment has been done by participants easily without significant usability issues.

Tasks	First Try	Second Try	Third Try	Usability Problems	Severity 0-4
1. Change the armpits attachment.	P2 P3 P4 P5 P6 P7 P8	P1			0
2. Switch on the device.	P1 P2 P3 P4 P5 P6 P7 P8				0
3. Use the correct light intensity.	P2 P3 P4 P5 P6 P8	P1 P7		Only two participants didn't understand the light intensity is automatically adjusted for them, but they understand it the second time.	0
4. Put the 3D model on the armpit.	P1 P2 P3 P5 P6 P7 P8	P4		Participant 4 waited few seconds, and then she realised that she needs to put it on the armpit.	0
5. Press the flash button.	P1 P2 P3 P4 P5 P6 P7 P8				0

Table 6 Assignment 1 task completion

P1 = Participant 1

Assignment 2

Assignment 2 (table 7) is about conducting a fast mode treatment on the lower leg. Most of the participants finished the required tasks. However, issues happened on task 3 and task 7.

For task 3, participant 2 and 7 felt confused about what does the fast mode exactly mean (figure 79). Because there are only one icon and words for the fast mode concept, participants were not sure what fast mode can do. They would prefer to have some explanation. However, this issue can be solved by adding an explanation of fast mode on the App, the user manual and package box.

Thus the severity of this issue is 2, which is needed to be fixed, otherwise the usability will be influenced.

For task 7, most participants did not recognise the "Auto" icon on the top-left corner (figure 80). They simply linked this icon with the light intensity on the same interface. Thus, they think it is for auto-detecting the skin tone and selecting light intensity. The position of this icon should be reconsidered and an explanation of this feature should be given on the App, the user manual and package box. The severity is 3, which is important to fix. Because the users will misunderstand the button with light intensity, and they might get confused again even they had explanation.

Tasks	First Try	Second Try	Third Try	Usability Problems	Severity 0-4
1. Change the body attachment.	P2 P3 P4 P5 P6 P7 P8	P1			0
2. Switch on the device.	P1 P2 P3 P4 P5 P6 P7 P8				0
3. Choose fast mode	P1 P3 P4 P5 P6 P8	P2 P7		Understanding of fast mode	2
4. Use the correct light intensity.	P1 P2 P3 P4 P5 P6 P7 P8			Note: All participants understand it from the first assignment.	0
5. Put the 3D model on the lower leg.	P1 P2 P3 P4 P5 P6 P7 P8				0
6. Press the flash button.	P1 P2 P3 P4 P5 P6 P7 P8				0
7. Check the button of the "Auto" flashing feature.	P1	P2 P3 P4 P5 P6 P7	P8	Auto-flashing feature	3

P1 = Participant 1

Table 7 Assignment 2 task completion

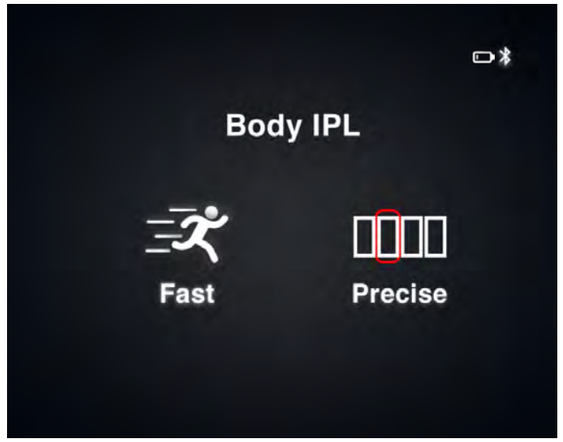


Figure 79 Body IPL interface

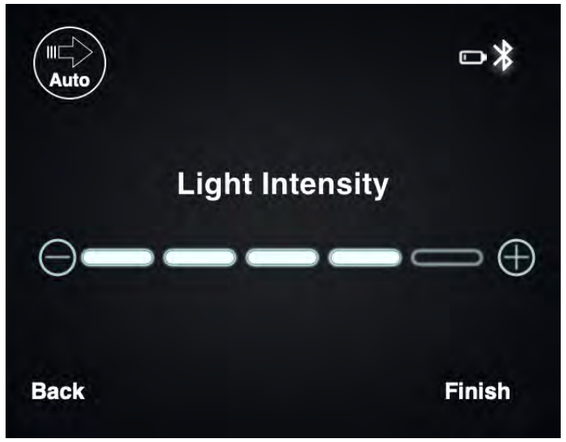


Figure 80 Auto-flashing interface

Assignment 3

The assignment 3 (table 8) is about using the precise mode(sensor measurement method) to conduct the IPL treatment on the lower leg. In general, participants showed large interest and passion about this personal guidance feature. They are very happy about how the device guided them throughout the treatment. However, participants encountered usability issues during the tasks.

For task 3, participant 5 did not fully understand the icon, because the rectangles on the icons are all hollow (figure 79). However, during the personal guidance, the rectangle will be filled if the flashes are released. This icon can be slightly adjusted by making some rectangles hollow and some rectangles filled. The severity is 2, because users misunderstand the icon which cause confusion.

For task 4, participants would like to know more information about the tacking sensor. For example, how this tracking sensor works and what they should pay attention to. These can be added on the App, the user manual and package box. The severity is 2, because explanation is needed for users to use this feature.

For task 7, participant 1 and 4 finished the task at the second time. They did not pay attention to the skin contact when they were switching the device to the next treatment line. The severity is 2, because users will accidentally lift the device if they do not get reminded.

For task 8, all participants had problems with finishing this task at the first time. This task is about sliding the device for all lines on the lower leg without lifting the device. All participants lifted the device when they treated their back of the lower leg. Participants need to take a break during the treatment, which they will lift the device out of the skin. However, participants were able to finish at least two lines of treatment without lifting the device. It gives the hint that the personal guidance procedure should give users a break after 1 or 2 lines of treatment. The severity is 4, because users can not finish the treatment without lifting the device, thus, urgent adjustment is needed.

Tasks	First Try	Second Try	Third Try	Usability Problems	Severity 0-4
1. Change the body attachment.	P1 P2 P3 P4 P5 P6 P7 P8				0
2. Switch on the device.	P1 P2 P3 P4 P5 P6 P7 P8				0
3. Choose precise mode	P1 P2 P3 P4 P6 P7 P8	P5		Precise mode icon	2
4. Use the tracking sensor feature to measure lower legs.	P3 P5 P6	P2 P4 P7 P8	P1	Explanation of tracking sensor	2
5. Check the light intensity.	P1 P2 P3 P5 P6 P7 P8	P4		Only one participant didn't notice the light intensity indication icon. But she understands it the second time.	0
6. Follow the shin bone guidance to release flashes.	P2 P3 P4 P5 P6 P7 P8	P1		Only one participant was confused where exactly he needs to put the first spot. But it actually would not influence the treatment result very much, as long as he follow the rest of guidance correctly.	0
7. Follow the tracking spot and animation to change to another treatment line.	P2 P3 P5 P6 P7 P8	P1 P4		Don't lift the device above your skin when switch to the next line	2
8. Complete the treatment.		P1 P2 P5 P6	P3 P4 P7 P8	Keep the device on the skin for precise tracking.	4

Table 8 Assignment 3 task completion

Assignment 4

Assignment 4 (table 9) is about using a different measure method(tape) to measure the lower leg data. In general, participants think it is very easy to use the tape to measure the lower leg data. Most participants did not have any problem using the tape measurement method, only one participant was not sure where exactly to measure for the calf circumference. However, participant 5 thought task 5 was not very easy, because it is not easy for her to enter 3 data numbers on the same page. She would like to have more space for scrolling the numbers(figure 81). Thus, the severity is 2, because users might make mistakes when entering data.

Tracking sensor or Tape measurement

Most of the participants prefer to have the tracking sensor to measure their body data instead of the tape. The reasons are:

1. They would like to have all stuff in one product instead of extra accessories.
2. Having the tracking sensor is more attractive in the technology aspect.

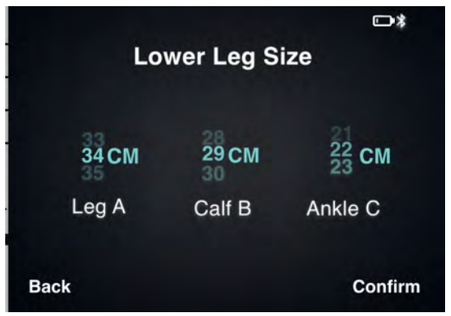


Figure 81 Enter lower leg data

Tasks	First Try	Second Try	Third Try	Usability Problems	Severity 0-4
1. Change the body attachment.	P1 P2 P3 P4 P5 P6 P7 P8				0
2. Switch on the device.	P1 P2 P3 P4 P5 P6 P7 P8				0
3. Choose precise mode	P1 P2 P3 P4 P5 P6 P7 P8				0
4.Use the tape to measure lower legs.	P2 P3 P4 P5 P6 P7 P8	P1		It was not clear for the participant 1 to find out where exactly he needs to measure his calf circumference.	1
5. Enter the measurement data on the laptop.	P1 P2 P3 P4 P6 P7 P8	P5		Interface size	2

P1 = Participant 1

Table 9 Assignment 4 task completion

Assignment 5

The assignment 5 (table 10) is about evaluating how the participants hold the new designed shape on different body parts, such as armpits, upper lip, bikini lines, arms, lower legs, and upper legs. This is also from the design requirements of comfort, where it explains that the user should not feel any muscle pain and soreness to hold the device, press the button and have good skin contact. However, this assignment was conducted only by 5 participants, because the other 3 participants joined the testing online due to Covid-19 restrictions.

Tasks	First Try	Second Try	Third Try	Usability Problems	Severity 0-4
1. Hold the 3D model on your armpit for 2mins.	P1 P3 P4 P6	P5		The participant found one position is not comfortable but she found another comfortable holding posture. This has already analysed in chapter 5.2.2 shape1.	0
2. Hold the 3D model on your bikini line for 2mins.	P1 P3 P4 P5 P6				0
3. Hold the 3D model on your upper lip for 1mins.	P1 P3 P4 P5 P6				0
4. Hold the 3D model on your arm for 2mins (finish one line treatment may cost 2mins).	P1 P3 P4 P5 P6				0
5. Hold the 3D model on your lower leg for 2mins(finish one line treatment may cost 2mins).	P1 P3 P4 P6	P5		Participant 5 thinks if the weight is heavier with battery, she would feel little tired after the whole lower leg treatment.	1
6. Hold the 3D model on your upper leg for 2mins (finish one line treatment may cost 2mins).	P1 P3 P6	P4 P5		Participant 4 and 5 thinks it is hard to treat the back of their upper leg, because they can not see the interface.	1

P1 = Participant 1 **Note:** Participant 1, 7, and 8 didn't conduct this assignment, because they joined the testing online.

Table 10 Assignment 5 task completion

All participants think it is more comfortable to hold this new shape than the original Philips IPL Lumea shape. Most of them did not experience any discomfort during the tasks. However, in the testing, the model is 3D printed, which is lighter than the original Philips IPL lumea device. Participant 5 thinks that it would be less comfortable to hold it on the lower leg if the device is heavy. Further testing can be done when the engineers define the internal structure of the device. At the moment, the accurate weight of the device is unknown. This could be a future step for Philips.

Moreover, participant 4 and 5 both think it is not easy to use the device on the back of the upper legs, because they have to turn their body in order to see the interface. However, this is a minor issue for them, because they think most of their hairs are on the front of their legs.

6.2.2 Main Usability Problems

After conducting all assignments, the main usability problems which need to be improved are listed in table 11. These usability problems have the severity higher than 2 (include 2), which means the problems should be solved when there is available time.

Usability Problems	Cause	Participants	Effect	Improvements
1. Understanding of fast mode	There was no clear explanation about what fast mode can exactly do, the participant only see an icon and a word.	P2 P7	The understanding of what fast mode can exactly do is not very clear at the first time.	Extra explanation can be added on App, user manual and package box.
2. Auto-flashing feature	The "Auto" icon is on the same interface with light intensity, participants got confused that this icon is linked with light intensity. 6 out of 8 participants think they would understand it at the second	P2 P3 P4 P8 P5 P6 P7	Most of the participants didn't understand the "Auto-flashing" feature. They thought it was for auto-detecting skin or auto-selecting light intensity.	Separate the "Auto" button from the interface. Add the "Auto" button out side of the screen.
3. Precise mode icon	The icon of precise mode is not well connected with the personal guidance process.	P5	Participant got confused at the first time, but she understood it after using the personal guidance.	Make two rectangles filled and two rectangles not filled, this can show closer connection with the personal guidance.
4. Explanation of tracking sensor	The information about how the tracking sensor works is not enough on the device. Participants would like to know more about this technology.	P2 P4 P1 P7 P8	Most of the participant understand how to follow the tracking sensor feature, however, they prefer to have detailed explanation on their App or user manual.	Add detailed explanation of tracking sensor feature on App, user manual and package box.
5. Don't lift the device above your skin when switch to the next line	Participants tend to lift the device when they finish one line, in order to take a short break.	P1 P4	Two participants lifted their device when they change to the next line, but they said they would do it better the second time.	A reminder on the screen to ask user do not lift the device.
6. Keep the device on the skin for precise tracking.	Participants tend to lift the device when they finish one line, in order to take a short break.	P1 P2 P3 P4 P5 P6 P7 P8	All participants were NOT able to complete all lines without lifting the device. But they were able to complete at least 2 lines without lifting device.	Separate the treatment process into parts, which can allow participants to lift the device to take a break after one line.
7. Interface size	The interface is too small for entering 3 types of data at the same time.	P5	Participant found it is very hard to scroll down the numbers.	Enter one data at one interface at one time.

Table 11 usability problems

6.2.3 Reach the Design Goal

From the research goal of this usability testing, there are three aspects that need to be fulfilled. These three aspects of the research goal are aligned with the design goal. During the testing, participants were asked questions about these three aspects and rate the scale of agreement on each question.

Effective communication of the screen (Requirement 4.3.2)

Participants were asked to rate from 1(not easy at all) to 5(very easy) how easy it is for them to understand and use the following features: light intensity, fast mode, tracking sensor measurement, personal guidance and tape measurement.

Participants understood the main features above very well. The ratings of each participants and average ratings are listed in the table 12, which are all higher than 4. During the discussion, participants think that even if they get confused at the first time when they see fast mode and tracking sensor features, they would easily understand these features at the second time. Moreover, Participants are very positive about the personal guidance feature, which they think it is very necessary for improving the end results.

“I really like the personal guidance feature, and I think it helps me to have less missing spots already! ”

-Participant 8

Icons (Requirement 4.3.2)

Participants were asked if they understand all icons of the design and which icons are not clear for them.

- Attachment icons: participants understood all the icons on the attachments.
- Auto-flashing icon: Participants are confused by this icon which is at the same interface of light intensity(figure 80).
- N/A icon: N/A means that other body parts do not have personal guidance. But participants were confused by this icon, they didn’t know what it meant exactly(figure 82). Further improvement on this needs to be done.
- Gender neutral icons: participants found on figure 82 that most body icons are for female, a chest icon can be added for male users.
- Precise mode icon: Participants thought this icon was not clear when they saw it at the first time, but they understood this icon at the second time after using the personal guidance feature (figure 79). Adjustment can be added to this icon for matching the personal guidance feature process closely.

In conclusion, the communication of the design is effective for them to understand the main features and conduct IPL treatments. Participants are very positive about how the device guides them during the treatment. All participants were able to finish the main tasks without asking for help. Although there are some details that can be improved for avoiding confusions, this will be in the later section of improvements.

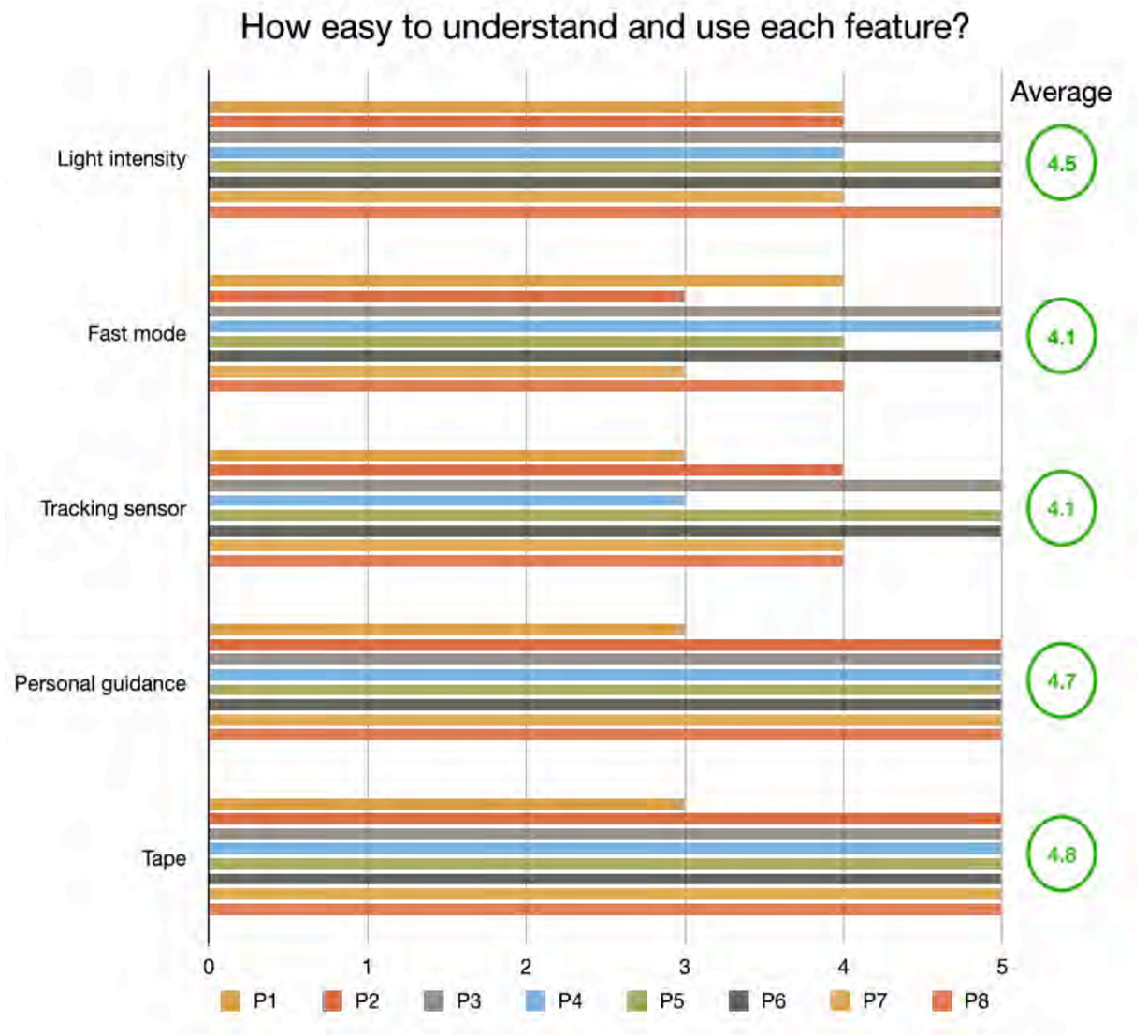


Table 12 rating scale from participants about understanding each feature

Figure 82 Choose treatment area interface

Personal guidance from the screen (Requirement 4.3.3)

For the understanding of the personal guidance feature, participants are very positive about it. Most of them think it is very easy to follow the animation, the tracking sensor guidance and follow the personal guidance. However, to complete the tasks without lifting the device is not easy. Adjustments will be made for providing the user a break during the treatment, which can be seen in the section of improvements.

Moreover, participants also rated how personal it is for them. After the calculation, participants rated in average 4.18 out of 5 for how personal this feature is for them (table 13).

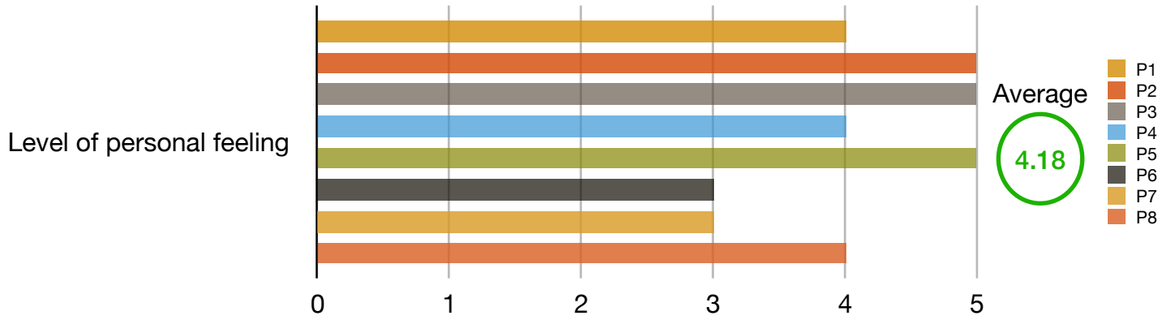


Table 13 Average rating for how personal of the guidance is

I can use the sensor to check my leg size, that's super cool! I can finally know if my legs are getting fat or not.
-Participant 4

In conclusion, participants agreed that the personal guidance feature is very personal for them and they are very positive about this guidance. Further improvements can be done for the user to lift the device above the skin during the treatments. For the measurement method, they prefer to have the tracking sensor for measuring the body data.

Confidence on building a sense of achievement (Requirement 4.3.4)

The third aspect is to make users have confidence in building a sense of achievement. In order to have a sense of achievement, the users need to be confident to conduct a correct IPL treatment. In the questionnaire, participants were asked to rate two questions:

1. How true do they think that personal guidance feature helps them to conduct a correct IPL treatment? (1: not true at all, 5: very true)

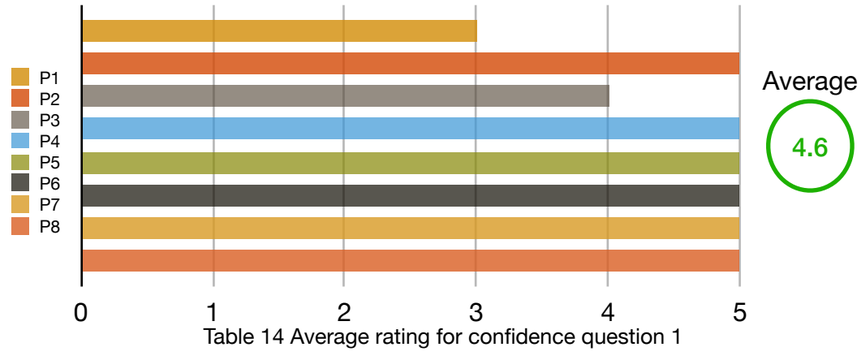


Table 14 Average rating for confidence question 1

The average rating scale for this question is 4.6, which is very high. Most participants have positive opinions about using the personal guidance feature. They believe this feature can actually help them to do a correct treatment and they feel very confident to conduct a correct IPL treatment by using the personal guidance feature.

I will know how many flashes to apply and I think this will guide me a lot!
-Participant 1

2. How confident do you feel to reach your hair-free goal after using this personal guidance feature? (1: not confident at all, 5: very confident)

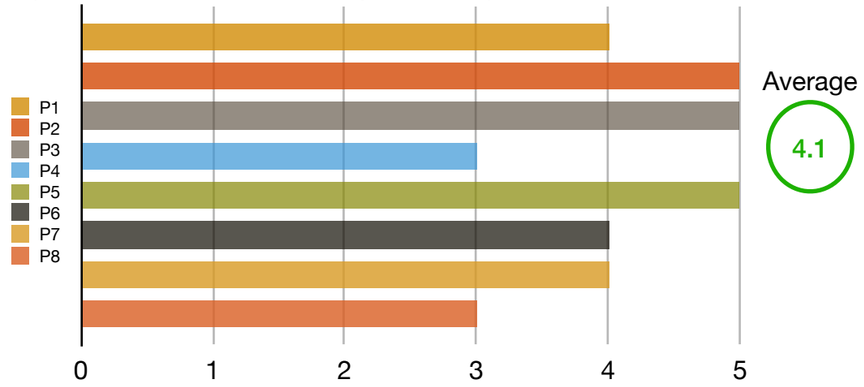


Table 15 Average rating for confidence question 2

The average rating scale for this question is 4.1, which is lower than the previous question. Participants are skeptical about being totally hair-free and they do not blindly trust the technology, which is the generation Z characteristic from Chapter 1.3. They would expect to have less hair-growth with IPL technology, but being totally hair-free is not convincing enough for them. Therefore, it leads to lower rating about the confidence of reaching the hair-free goal. However, they are still positive about the personal guidance feature, which can help them to have less missing spots. In this way, they believe the end results can be better with the personal guidance, thus, a sense of achievement is possible to build up in the end.

Other design requirements:

Appearance

Participants showed large interests towards the colour of the new design. All 8 participants think the colour of the design is gender neutral for them and they would use it either as male or female. However, the icons on the body page can be more gender neutral. For example, it only shows the female body parts for precise personal guidance (figure 82), however, it would be nice to also indicate that male body parts are possible to have personal guidance. Further improvement of this insight will be presented in the next section.

6.2.4 Discussion

In this usability testing, there are positive sides and negative sides. Participants found the simulation of the tracking sensor on the display is very attractive and intuitive, which makes the personal guidance feature very appealing to them. Moreover, providing the Philips IPL Lumea device for participants gives them the opportunity to compare the new design. However, there are several aspects which might influence the outcome. See them below.

First and second explanation: In real life usage situations, participants would not have a moderator to explain problems to them. Participants usually would search for the user manual, package box and internet. This might have different outcomes when the users read explanations by themselves and when someone explains to them in person. It would be more appropriate if a user manual was provided in advance.

Display: The real display is located on the top of the new design. However, due to time limitations and prototyping schedule, it was not possible to implement the display in the 3D printed model. Participants had to look at the display from a laptop screen, which might influence the usability of comfort while conducting treatments. Moreover, the usability issues of watching the display on the device are not discovered by this set-up.

Weight: The weight of the 3D printed model is very light, thus, it was comfortable for the most participants to conduct tasks. However, the actual weight can not be determined at this moment, which needs further study from mechanical and electrical engineers. Therefore, the actual comfort might be influenced when the weight of the model changes.

Technology: Participants showed large interest in the tracking sensor and personal guidance feature, because the animation and stimulation of the prototype was intuitive and attractive for them. However, the accuracy of the tracking sensor is not 100% precise. When users use the actual tracking sensor and personal guidance, the user experience will be influenced by the different accuracy of the sensor.

In the end, this design helped the participant to conduct a correct IPL treatment, and they believe they would have less missing spots. Although they had problems while switching to different treatment lines which might influence the accuracy, this problem happened mostly at back of the lower leg. However, at back of the lower legs, most users have very few hairs, therefore, the end results may still remain good.

6.3 Improvements

Based on the main usability problems and analysis of reaching the design goal, there are main improvements that need to be done.

1. Fast mode and tracking sensor explanation

The usability problem 1 and 4 can be improved by adding explanation in the App, packaging and user manual. The users can have detailed explanations about what are fast mode and precise mode. Moreover, the tracking sensor technology can also be explained to the users, the instructions about how it works can be presented in the App, user manual and packaging box.

2. Auto-flashing feature

The participants were confused by the Auto-flashing button, because it stays on the same interface with light intensity selection. The new Auto-flashing button will be removed from the interface, however, a physical auto-flashing button next to the switch on/off button will be added (figure 83). This button will be only activated when the users use the fast mode. Thus, the users can press this physical button when they are in fast mode.

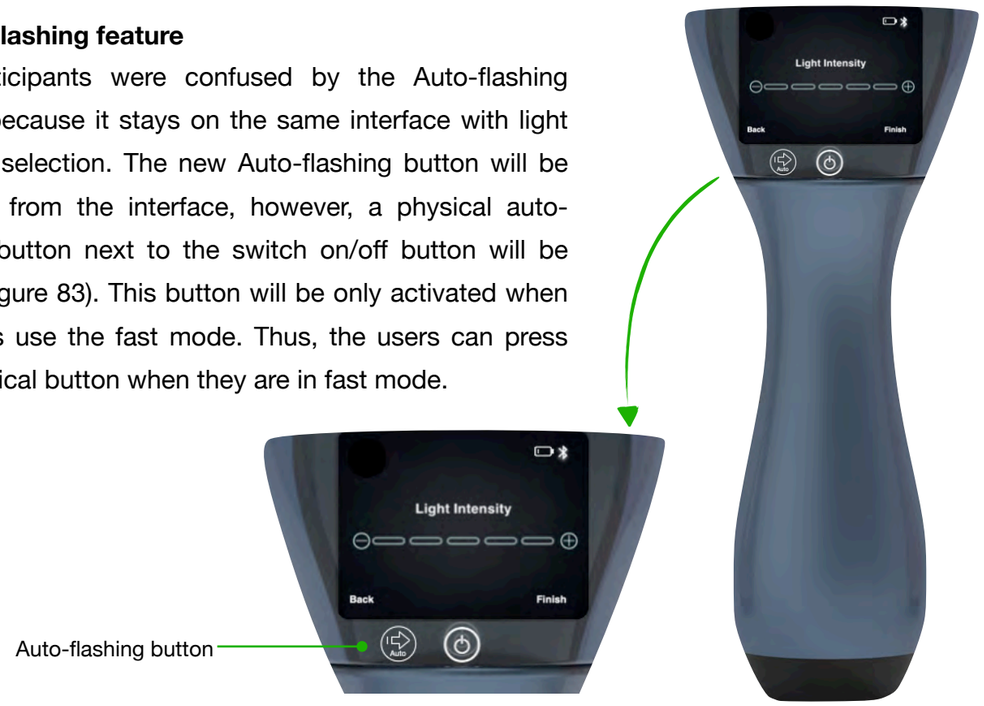


Figure 83 Auto-flashing button

3. Precise mode icon

A precise mode icon has been improved for the users better understanding the feature (figure 84).

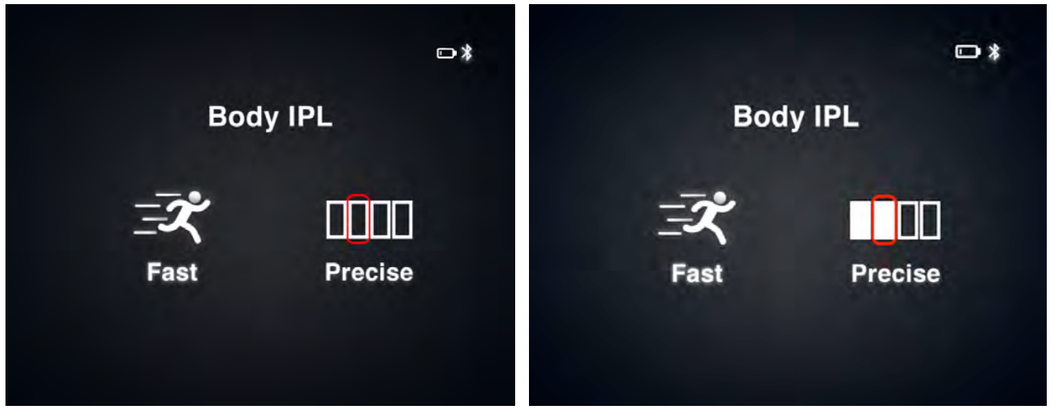


Figure 84 old and new precise mode icon

4. N/A and gender neutral icons

Most participants did not understand the N/A icon and they want to have body icons for male users as well. Therefore, a further improvement has been added on figure 85. The N/A is removed, if there are no available body parts to choose, the user can exit the precise mode. Besides, the personal guidance feature is possible on male chest as well, thus, a male chest icon is added.

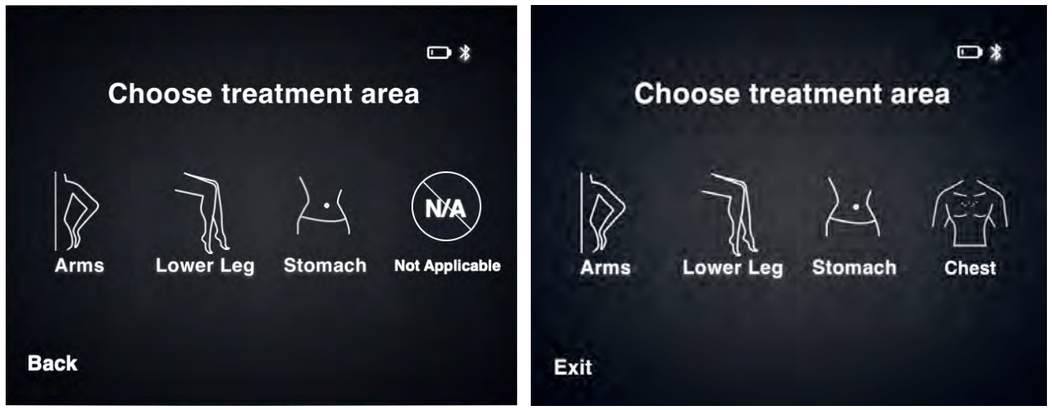


Figure 85 N/A and chest icon improvement

5. Reminder for not lifting device

There will be a reminder on the interface to remind the users not to lift the device during the one line treatment and switching to the next line (figure 86).

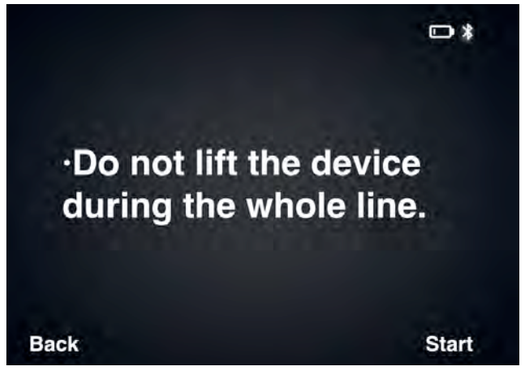


Figure 86 Reminder for not lifting device

6. Separate personal guidance process

As the participants had to lift the device to take a break during the whole lower leg treatment, thus, the treatment process should be separated in order to allow users to lift the device. A strip sticker will be provided for the users with flashing lamp size frames (figure 87). The user can lift the device if they finish one line. After the first line, they can start the second line by putting the device under the strip sticker.

Another solution is that the guidance will be divided into two parts. The first part would be from the shin bone to the left side of the lower leg. When the user finishes the left side of the single lower leg, the treatment will start again from the shin bone to the right side of the lower leg (figure 88). Starting the treatment both from shin bone is for locating the device for better accuracy.

7. Interface size for entering lower leg data (tape measurement)

This improvement will not be implemented, because from the participants, they all prefer to have the tracking sensor measurement instead of tape measurement.

Figure 87 Strip sticker

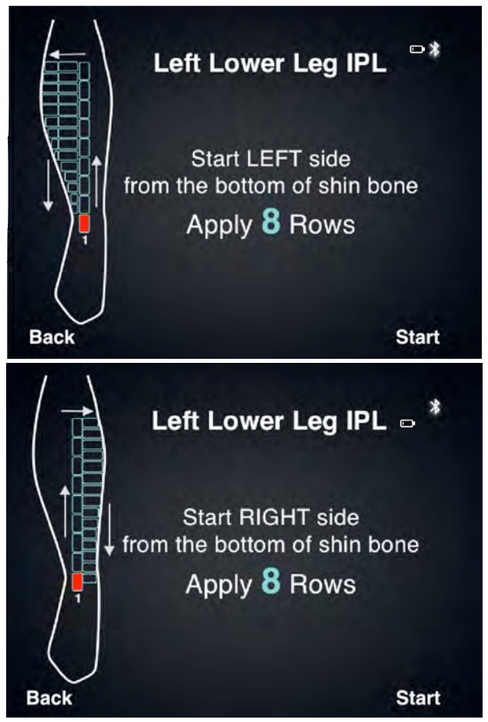


Figure 88 Two parts for lower leg treatment

6.4 Conclusions and Recommendations

Project Research Questions:

At the beginning of this project, the initial scope is to discover and analyse the usability issues of this product, and then find out what are the most relevant issues for the target group generation Z. In the end, match the insights and redesign the IPL device for the generation Z users.

During the usability analysis of the IPL Lumea device, the main usability problems are discovered.

Product ergonomics: The holding posture of the IPL device on the lower leg is not ideal. The user experienced discomfort because the weight, centre of mass and non-neutral postures on the lower legs.

User Interface: The current user interface is not easy to understand. The light intensity selection and confirming button can be improved with preferable digital solutions for generation Z users.

Skin contact: It is not easy for the users to keep having good skin contact while treating the lower legs. Easier skin contact solutions can be considered.

Communication: The device does not give any feedback about whether you are doing it right or effectively, therefore, users have missing spots on their skin during treatments which lead to an inefficient end result. Moreover, users do not read the user manual carefully which is not interesting to read the large amount of texts. Effective and fast communication should be reconsidered in the IPL device.

After the usability analysis of the IPL device, the user research on generation Z target group was conducted. The main topics cover the general personal care behaviours, grooming experience, ideal personal care environment and opinions about the Philips IPL device. Main insights are collected and converted to four directions:

- Product ergonomics & Aesthetics: providing an easier usage of Philips IPL device for generation Z users via offering ergonomically comfort during treatments.
- Sense of achievement: creating a sense of achievement for generation Z users of Philips IPL device via providing effective communication and feedback on the device during treatments.
- Personalised guidance: providing generation Z users a personalised guidance on the IPL device to enable them feel secured. Meanwhile, allowing them to express their identities and characteristics.
- Approach generation Z via social media and digital solutions.

According to the consumer insights of reaching hair-free goals and building a sense of achievement, the final design goal is to design an effective communication on the IPL device, a more comfortable IPL device with personal guidance will be created in order to reach the sense of achievement.

Usability Testing Research Questions:

1. Is the communication of the digital user interface clear for the user?

Participants understood the user interface on the display, they were able to conduct all tasks by the instructions from the display.

2. Can users understand the personal guidance from the screen?

Participants understand the personal guidance from the display. They were able to conduct IPL treatment with the personal guidance, and they showed large interests in this personal guidance feature.

3. Does the personal guidance from the screen help the user to do a correct treatment?

Participants were able to do a correct IPL treatment for at least one line without lifting the device above the skin. They all understood how to do a correct IPL treatment by using the personal guidance feature. However, due to the technology limitations, participants had difficulty with not lifting the device during the treatment. The related solutions have been provided in chapter 6.3, in order to enable the users to lift the device after one line treatment.

4. Which measurement method does the user prefer, tape or tracking sensor?

All participants prefer to have the tracking sensor measure method instead of tape measurement. They prefer to have all features in one product rather than other accessories.

5. Does the user understand the tape measurement and the tracking sensor measurement?

All participants understand the tape measurement. For the tracking sensor measurement, participants would like to have a detailed explanation on the App, user manual and packaging box.

6. With the personal guidance interfaces, does the user feel more confident to reach their hair-free goal?

Participants feel more confident to conduct a correct IPL treatment after using the personal guidance. They believe that with this personal guidance feature, their treatment results will be better; thus, they are more confident to reach their hair-free goal in the end and build up a sense of achievement.

Recommendations

During this master thesis project, not every key and marginal insights are validated and tested. There are still some question marks left unanswered, which can be done in the future if Philips would like to continue the project.

Precise mode on other body parts

The precise mode can be added on different body parts, such as belly, arms, upper legs and chest. Due to the time limitation and consumers showed large problems on the lower legs, thus, the personal guidance on the lower leg was developed first. However, the detailed procedure that how personal guidance can guide users on other body parts need to be further developed.

Technology improvement

The current tracking sensor technology is still under development, the accuracy of this technology can be further developed in order to give the users more trust on the technology. During the usability testing, the technology was not tested, thus, further testing can be done in the future when the technology is implemented in the prototype.

Test the new solutions

For the improvement 6, there are two ways of dividing the personal guidance treatment into different parts, which can allow the users to take a break and lift the device above the skin. These solutions should be further tested with the users. However, it would be ideal to test these solutions when the technology is implemented in the prototype.

Shape size

The size of the shape 1 was evaluated with participants, and they think it is very comfortable to hold and use, because it has more freedom on changing hand postures. However, the exact size of the handle can be further evaluated. At the moment, the diameter of the handle is between the suggested range from Dined (2020), however, what exact size is the most comfortable for the users should be further developed.

Test the display

During the usability testing, the participants need to watch the display from the laptop. Although the size of the display is as the same size as the design, the real interaction between the user and the display on the device is not tested. There might be some usability issues on the display when the users interact with it on the real device. This needs to be further tested when the display can be implemented on the prototype.

6.5 Reflection and Acknowledgements

This graduation project started right after the first Dutch national lockdown during Covid-19 pandemic. It was very lucky for me to still have the opportunity to continue this project with Philips Product Research Centre Beauty team. One of the biggest challenges for me is to work at home alone for 6-7 months without social contact. As a designer, I'm the type of person who gets inspiration from working with different people who are from different culture backgrounds. However, under the covid-19 situation, it was very difficult for me to keep motivated and inspired. Fortunately, I received a lot of help from my supervisors, from the company and my friends. And I also tried my methods to change my working environment to keep myself motivated and passionate. In my future career, this would be one of my biggest bonuses to be able to work alone in an extreme condition. Moreover, while working from home alone, I also learned how to evaluate my workload, efficiency and adjust my plan to a more feasible schedule.

The contexts of this project broadened my horizon of my life experience. From my personal experience, I didn’t have any experience with female hair removal activities. It was surprisingly interesting for me to conduct user research on different ethnic groups and understand how differently they do their personal care activities. Moreover, it also helped me to better understand people from different culture backgrounds and respect their rituals and privacy. Secondly, I stepped into the research area of ergonomics, which I had no experience before at all. At the beginning, I was a little reluctant to step into new areas, but I got encouragement and support from my supervisors. I understood how a designer should think correspondly when designing an integrated product. Interaction does not only happen at single touch point, and multiple touch points will bring multiple new interactions. In the end, i embraced the challenges and become more eager for new knowledge.

However, due to the covid-19 situation, I was not able to fully experience how Philips conducts product research. On the other hand, it gives me the chance to flexibly change and plan my usability testing online and offline, which was also a big learning for me.

In the end, I'm grateful and thankful for all experiences during my graduation journey, these made me more confident and ready for the new world outside of university.

Letter of Thanks

During the project, I’m grateful to be able to continue my graduation project during the pandemic time with all the people who supported me. This project educated me to be more considerate and respectful to different gender, ethnic groups, cultures and rituals.

I would like to thank my chair Anton Jellema, who supported me before the project started until the end. He supported me both academically and mentally for my difficulties during my project, which is one the best memories of my graduation journey. Special thanks to Anton for his dedicating time on coaching me.

I would like to thank my mentor Chen Hao, who helped me a lot with my user research and conveying my design language on paper in an intuitive way. She gave me detailed feedback on my writing and even communicated me with my mother-tone Chinese, in order to help me to understand the feedback better.

I would like to thank my Philips mentor Janneke Buse, who was closely working with me on this project and helped me a lot during the project. She supported me in all my research, designs, testing and even my career development. Without her, this project would not have come to this far with a satisfying design result.

Special thanks to my partner Colin, who loves and supports me all the time. He helped all my pilot tests and he was always the one who tried my draft idea first. Thanks to his critical mind, I evaluated my thesis in different points of views. Thanks to his encouragement, I was able to continue my project while working from home alone. It was an amazing journey to meet him and spend time together during pandemic time.

I would thank all my friends who helped me with my research and testing. For my friends and peer colleagues, Lisa, Paul, Janita, Nard, Judith, Pleun, Benedetta, Tom, Ale, Winnie, Xiyue, Congxin, Yiyan, Marianne, Vittorio, Inge, and my sister Yundi, thank you all very much!

In the end, I would like to thank all participants who joined my research and testing online and offline. With all your insightful feedback, I could finish this project in the end. Your life experience, cultures and kindness are the greatest memory of my graduation journey.

Thank you very much!
I wish you all good health and good luck in the future.

Sincerely
Zhou Zhou
Eindhoven, the Netherlands.
January 2021.

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8. Appendices

Appendix A: Graduation project brief

Appendix B: Cognitive walkthrough session

Appendix C: Privacy notice consent form for user interviews

Appendix D: Sensitising booklet

Appendix E: User interview questions

Appendix F: Co-creation ideas

Appendix G: Ideas from ideation

Appendix H: Digital interfaces

Appendix I: Privacy notice consent form for usability testing

Appendix J: Usability testing details

Appendix A: Graduation Project Brief

TU Delft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF
To be filled in by the chair of the supervisory team.

chair Anton Jellema date 5 June 2020 signature

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

Master electives no. of EC accumulated in total: 30 EC

Of which, taking the conditional requirements into account, can be part of the exam programme 30 EC

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

(X) YES all 1st year master courses passed

( ) NO missing 1st year master courses are:

name C. van der Bunt date 08 - 06 - 2020 signature CB

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

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

Content: (X) APPROVED ( ) NOT APPROVED

Procedure: (X) APPROVED ( ) NOT APPROVED

Note BoE: adapt title, Philips IPL can be removed from the title. That will be clear enough. Only one company mentor is allowed.

comments

name A. Huwae date 23 6 - 2020 signature AH

TU Delft

Personal Project Brief - IDE Master Graduation

An improved design of . IPL hair removal device for generation Z project title

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

start date 11 - 05 - 2020 27 - 11 - 2020 end date

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

Royal Philips is a leading health technology company focused on improving people's health and enabling better outcomes across the health continuum from healthy living and prevention, to diagnosis, treatment and home care. Philips innovation site Eindhoven is focused on improving well being for consumers and creating awesome consumer experiences through real-life solutions, meanwhile bringing value to Philips. In Philips Beauty department, Philips has an intense pulsed light(IPL) hair removal device(figure 1), which can enable consumers to have prolonged smooth skin. It offers easy and pain-free hair removal treatments at home. There are four flexible attachments to fit and adapt human body figures such as underarms, bikini area, lower face, and large body areas. Moreover, users can use skin tone sensor(STS) to detect their skin type and the device will give preferred settings for the users. If consumers use the device every two weeks for the initial 4 to 5 treatments, consumers would see significant hair reduction. Afterwards, consumers are recommended to use it every 4 to 8 weeks if they see hairs grow back.

However, users encounter many problems when they use this product. The main problem is users lose their patience and trust during the initial treatments. According to Philips product research centre, users stop using this product after experiencing usability difficulties or feeling disappointed about the results(caused by inappropriate usage). Philips states that usability issues are the key factors which cause users lose patience or stop using the product. Therefore, Philips would like to improve the usability of this product, which might lead to a better user experience. There are some main usability issues. For example, user is not aware of which part of skin has been treated during treatments, holding the device in hands has some ergonomics issues, following long-term treatment schedule is not easy for users, the UI of this product is not clear enough for consumers to understand, and etc.

The second important thing is to keep in mind with generation Z who will become our future consumers. New generation consumers will come to the market soon, who are born between 1996-2012. They are very different from our current main consumers. They are embraced by new technologies and new adventures. With their open-minded thoughts, they are always eager to be creative and innovative. Therefore, the generation Z will be the future target users and the characteristics of the generation Z will be taken into consideration for the new design.

At the same time, relevant usability issue and enhance a better user experience which might lead to better treatment results. In this graduation project, relevant usability issues of Philips IPL device will analysed and improved, which may enhance user experience for Generation Z consumers with better end-treatment results.

All the usability directions of this product are open to be discovered from user research by using some tools of contextmapping, afterwards, ideation will be conducted. Meanwhile, Philips Value Proposition Creation(VPC) method (figure 2) can be applied to select the most relevant ideas both for Philips and users. VPC method is a product development process from Philips, which consider aspects of consumers, business, technology offers for product development. However, deeper understanding about the consumers is needed, thus, some tools from contextmapping will be used during qualitative user research. Afterwards relevant research results will be selected to be further developed into some concepts, and then final concept will be be chosen. In the end, an improved IPL device will be presented, which can lead to a better user experience and end results.

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introduction (continued): space for images

image / figure 1: Philips IPL Lumea

image / figure 2: Value Proposition Creation

PROBLEM DEFINITION **

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

For Philips intense pulsed light(IPL) hair removal device, we would like to offer an optimal user experience to our generation Z consumers. To come to an optimal user experience the following problems need to be overcome:

The Generation Z is not considered in mind with the current design, further analysis and research should be conducted to see if the needs of Generation Z can be included in the design.

This product has some usability problems.
- Users lose track on which part of their skin have been treated during the treatments.
- Users lose patience and trust during long treatment schedule and they misunderstand how often should they use the product.
- Users misunderstand the UI when they choose settings for their treatments.
- Using this product on lower legs is not easy for user to hold and operate.

At the moment, we need to explore what are the most relevant usability issues of this product for consumers and how it can lead to a better user experience.

ASSIGNMENT **

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

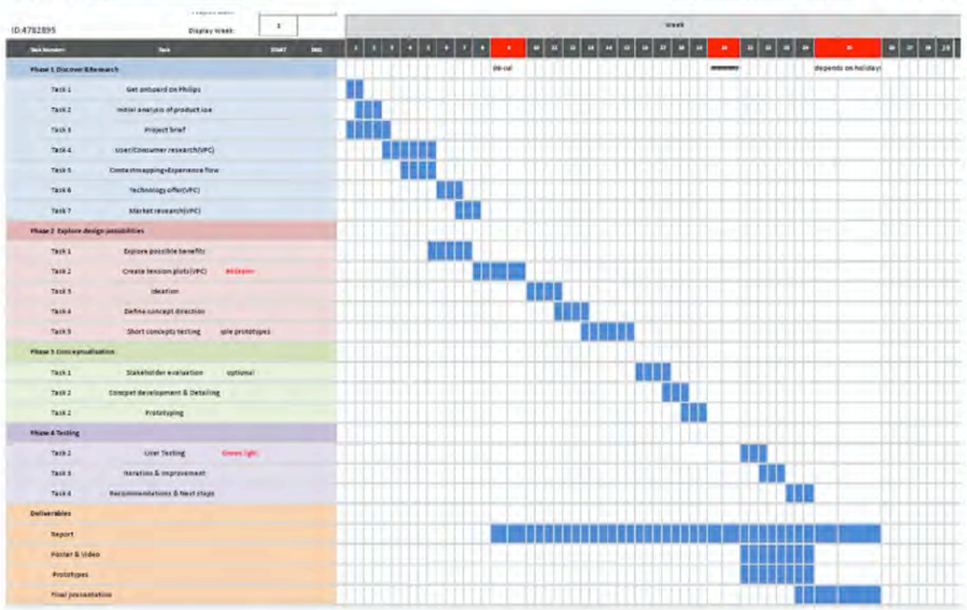
This project will be focusing on analysing the most relevant usability issue of Philips IPL device and improving the usability of this product with generation Z in mind as target group. In the end, it might lead to a better user experience for consumers with better end results.

1. Firstly, user research will be conducted with some tools of contextmapping, in order to understand generation Z deeper. What are the differences between generation Z and current consumers during their hair removal experience.
2. Current user experience will be analysed, from the first time use of the device until being committed to continuing to the end results. This will include the product itself. What are the most relevant usability issues for our consumers and what can bring our consumers a better user experience with better hair removal results?
3. Afterwards, relevant insights will be selected, which will lead to design opportunities(consumer tension). Ideation and direction selection will be done in combination with Philips value proposition creation method(VPC), which can have requirements from consumers, technology feasibility, and marketing opportunities.
4. Next, one design direction will be selected to further develop into design concepts. These concepts will be created based on the selected design direction and agile prototypes will be made for user testing. Later on, an improved final concept will be presented, and also some recommendations and reflections will be made.

PLANNING AND APPROACH **

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

start date 11 - 5 - 2020 27 - 11 - 2020 end date



This project has four phases:
1. Discover and Research: By using VPC method as a requirement tool, i will have a deep research about users. And then some inputs of technology offers and marketing opportunities from Philips research centre. Meanwhile, in order to understand consumers in a deeper qualitative way, some tools of contextmapping will be used in the qualitative user research as well. In the end, relevant insights should be found out.
2. Explore design possibilities: I will select some relevant insights, and then i will create design dilemma which is consumer tension. Next, i will find the most exciting tension plot(Design opportunity) for our concept direction. Then some concepts will be created based on the concept direction, and user testing will be carried out for deciding the most relevant concept for our users.
3. Conceptualisation: Create concept in details and make prototypes for user testing. Meanwhile, i will get different insights from different stakeholders(optional).
4. Testing: User testing for iteration, improvement and reflection.

Midterm meeting: Week 9
Green light meeting: Week 20
Graduation: Week 25
Note: this project is for 25 weeks, there are only 4 working days per week, but still it's 100 working days in total. However, due to the Covid-19 situation and summer holiday, this project might have some weeks delay.

MOTIVATION AND PERSONAL AMBITIONS

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

In the past, I was more like a design engineer because of my bachelor background. However, I found my interests in human interaction and emotion, and that's why I chose my master study at Design for interaction. I was doing my internship from my electives in Philips as well, during my internship, I saw how ideas are created and how can our design ideas can be realistically implemented in product to the market. As an interaction designer, I haven't got a chance to really implement my idea into a realistic product to the market. In this project, I would be able to dream ideas and then I would be also down to the earth to see how my ideas can be realistically considered by the business company. This is the part that during my education I didn't encounter with yet. Knowing and learning theories are what I am capable of, but using theories into a real world is what i'm very interested about for this project. Testing my ideas with real consumers and receiving insights from different stakeholders for my project are what i'm very interested in this project.

Moreover, being a translator for consumers and then create solutions for them are also very interesting for me. Improving the product usability is one part of this project and creating optimal user experience to reach certain emotional needs is another part. This project can give me the chance to create both physical and mental user interaction requirements.

Furthermore, this project has a new target group which is generation Z(1996-2012). It gives me inspiration and excitement that i can design something for the future instead of only focusing on current consumers. I should be innovative, creative and be ready for the future change.

Last but not the least, working at an international company and learning at large organisation are very interesting for me also good for my career development. I would be humble and modest to learn how a professional company make product development, and at the same time i can build up my knowledge while seeing the real outside world.

FINAL COMMENTS

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

Appendix B: Cognitive Walkthrough Session

Unpacking & Read user manual | Pre-treatment | Skin tone detection & Settings selection | Treat lower legs | Treat armpits | Charging

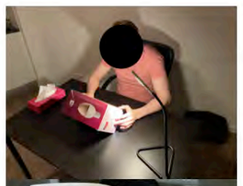
Treat lips area | Clean and store | Plan the next treatment

24yrs, Master student

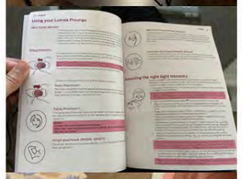
24yrs, Master student

Unpacking & Read user manual | Pre-treatment | Skin tone detection & Settings selection | Treat lower legs | Charging | Treat armpits

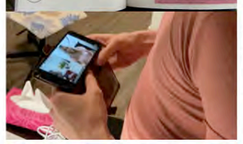
Box:
4 attachments,
One IPL device
A charger
A pouch
An user manual



1. Read information from package.

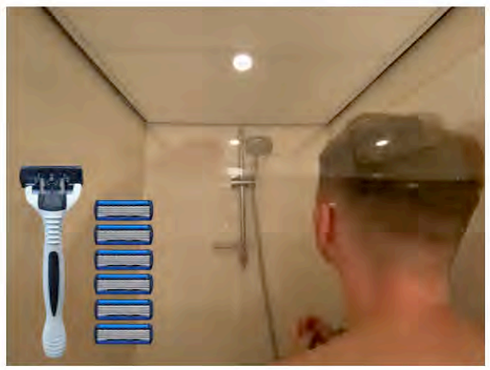


2. Read user manual.
User read few warnings and then skipped it



3. User quit user manual and checked with Youtube videos. (Gen Z)

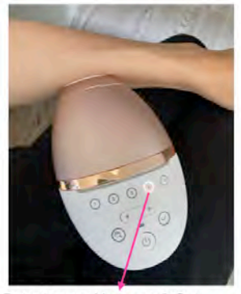
Unpacking & Read user manual | **Pre-treatment** | Skin tone detection & Settings selection | Treat lower legs | Charging | Treat armpits



User started to shave the body according to the instructions from user manual.

1. "But i shaved two days ago, do i need to shave this part again?"
2. "It took me an hour to take a shower and shave my body."

Unpacking & Read user manual | Pre-treatment | **Skin tone detection & Settings selection** | Treat lower legs | Charging | Treat armpits



Detect your skin tones & Get suggested settings

Skin contact sensor

User misunderstood that this is setting 5, not your skin tone is type 5.

"Do i scan my skin for different body part and when should i do it?"

Unpacking & Read user manual | Pre-treatment | **Skin tone detection & Settings selection** | Treat lower legs | Charging | Treat armpits

User couldn't change setting if they finished skin tone scanning. User needs to re-do skin tone scan in order to change settings.

After changing the setting, user intended to confirm setting by clicking ✅ button, but it didn't work.

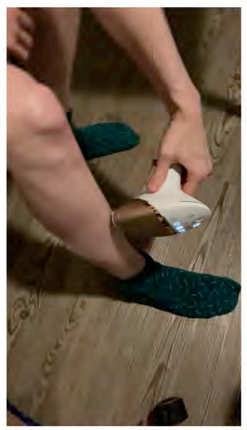
"i don't think it detect my skin tone correctly"

The skin tone detection is not matching logically with setting numbers.

User clicked number 5 to confirm setting, but you can only click ✅ button to confirm.

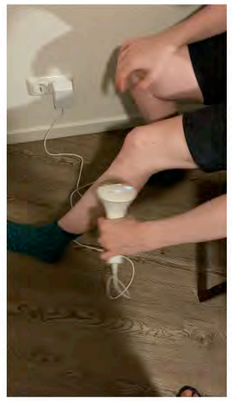
Unpacking & Read user manual | Pre-treatment | Skin tone detection & Settings selection | **Treat lower legs** | Charging | Treat armpits

1. User lack of visuals while detecting their leg skin tone.
2. User's wrist is uncomfortable because of the strains. User needs to keep 90° angle in order to have good skin contact with the device.



1. It is not easy to have a good skin contact with the device on the bone of the leg.
2. No clue about where has been flashed and where should be treated.
3. It takes at least 10 mins for one leg, and the batter is out.
4. Some hairs remain on legs, which were burnt during flashing and it smells.

Unpacking & Read user manual — Pre-treatment — Skin tone detection & Settings selection — Treat lower legs — **Charging** — Treat armpits



Function:

1. Use it corded.

2. Slide and flash (keep pressing flashing button in order to have quicker treatment) But user don't know these functions at all.

Treatment is interrupted because of no good skin contact.

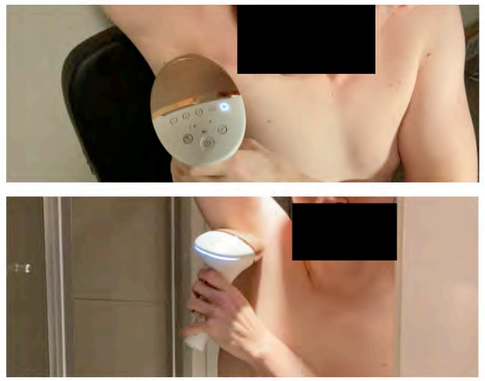
User feel more muscle sore because of pressing flashing button continuously while treating lower legs.

The light is bright, it is annoying for others who is in the same room.

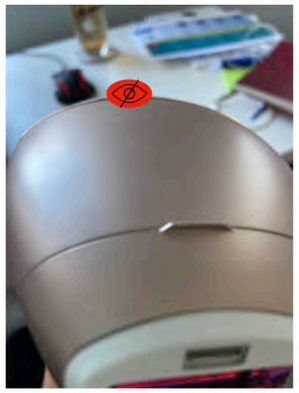
You can charge it and use it at the same time.

User doesn't know it before.

Unpacking & Read user manual — Pre-treatment — Skin tone detection & Settings selection — Treat lower legs — Charging — **Treat armpits**



- User has trouble with good skin contact.
- No clue where to flash
- But it gets better when user uses it in front of the mirror.
- User feels painful while using it on armpits, but the suggested setting is still "5". (lose trust)



- Ineffective visual communication
- User can't see interface easily while using it on armpits.

Treat lips area — Clean and Store — Plan the next treatment

User doesn't recognise the icon on the attachment for the first time.

The direction that user sees the icon is reversed.

The icons in general are not clear, users looked at the box to understand which attachment to use.

1. User can't see "ready" light anymore when uses it on face.
2. The setting changes to "1" automatically after changing attachment.
3. The light is pretty bright for user while uses it on face.

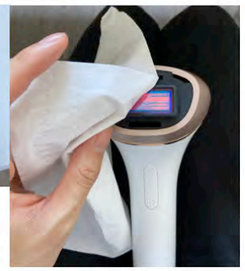
Treat lips area — Clean and Store — Plan the next treatment

User wears a pair of sunglasses for protecting eyes.

The light is still too bright, because the

Treat lips area — **Clean and Store** — Plan the next treatment

User cleaned the device but user found out some attachments miss filter windows.



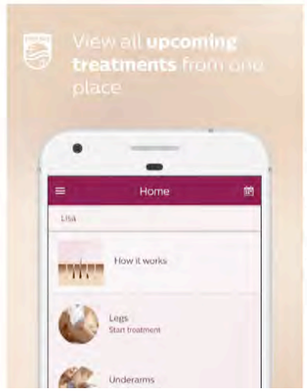
How well should i clean it? Can i clean it with water?

User manual was not clear for it

User can't put the device in the pouch.

User thought maybe it can be detached and then put into pouch. The box is put above closet.

Treat lips area — Clean and Store — **Plan the next treatment**



App: (Out of project scope)

- More explanation of using the device.
- Customised treatment agenda.

Appendix C: Privacy Notice Consent Form for User Interviews

<dd-Mmm-yyyy>

<STUDY ID><PROJECT><STUDY TITLE>

PARTICIPANT NR: _____

Acknowledgement of Participation

Acknowledgement of Participation

<Name of the study as communicated to participants>

Participant

√ I have read the information for participants in this study, I understand it and the researcher in charge has answered all my questions about the study.

√ I have had sufficient time to consider my participation in this study and I am aware that participation in this study is entirely voluntary.

√ I am aware that I may decide, at any time, not to participate or to end my participation, without being required to explain my reasons.

√ I understand and give my consent that the researcher in charge and other parties involved in this research project will gather use and process personal data for this study. Personal data may include < *ethnicity data, the taking of photos, making video recordings, or audio taping interviews.*> I understand that data allowing for identification of my identity (for example my name and address) will be deleted from the research data and will be replaced by a code. Access to the key between that code and my identity details is restricted to the researcher in charge and his manager. That key may only be displayed to regulatory authorities and/or ethical committees for reporting purposes, or to the independent physician consultant in the event that such is rendered necessary on medical grounds. My personal data will be kept on file for a reasonable period and for a maximum of 2 years after the study ends, and will subsequently be deleted, with the exception of (i) video material and photographs, and (ii) legal obligations to which Philips is subject.

√ I consent to the use of my personal data for other research and development purposes.

√ I am aware of my right to view the personal information that is gathered about me and to have any and all inaccuracies corrected.

<dd-Mmm-yyyy>

<STUDY ID><PROJECT><STUDY TITLE>

PARTICIPANT NR: _____

Acknowledgement of Participation

By signing this statement, I agree to the conditions under which I will participate in the study:

_____	_____	_____
Name	Signature*	Date

Researcher in charge or his/her appointed representative

I have discussed the substance of this consent form, answered any possible questions and signed it in the participant's presence.

Zhou Zhou	Zhou Zhou	03-07-2020
Name	Signature	Date

<dd-Mmm-yyyy>

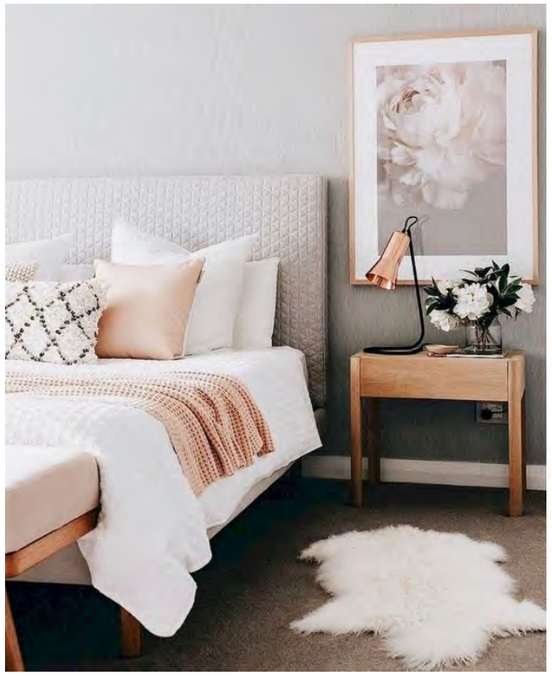
<STUDY ID><PROJECT><STUDY TITLE>

PARTICIPANT NR: _____

Acknowledgement of Participation

√ I understand that information concerning this study, for example products, brochures, descriptions of the study, prototypes, user manuals and instructions, as well as information about myself that is created during the study, such as measurement results and users, constitutes confidential information belonging to Philips. I hereby confirm that I will treat that information confidentially and use it exclusively for purposes connected to this study and that I will not disclose that information to third parties in any manner whatsoever, including by social media.

Appendix D: Sensitising Booklet



Sensitising Booklet

Personal care consumer study

TU Delft & Philips product research centre

July 2020

Zhou Zhou

Hi I'm Zhou Zhou, an industrial designer/researcher who likes to focus on user experience and interaction. I like modern dance and traditional Chinese dance during my free time. Sometimes I do some personal care activities, for instance, I have an electrical toothbrush at home which I like it very much.

In this booklet, I would like to invite you to share your personal care experience with me, and hope we can have a fun journey! There are no right/wrong answers, all insights are very welcome. Feel free to express your opinions here.

Thank you for your participation and see you in the interview later!

Kind regards
Zhou Zhou

Hi, may I know you a bit more?

- Name:
- Age:
- Gender:
- Profession:
- How many people do you live together:
- Could you please describe what does personal care mean for you?
- From scare 1-5, how important personal care is for you?

Not important 1 2 3 4 5 Very important

Personal Care

Would you like to **point it out/type** what kind of personal care do you do for your body?
(e.g. grooming, skin tanning, nails, hairs…)

Personal Care

Would you like to take a photo of three favourite personal care products which you own?

Personal Care Routine

Could you please track and record your personal care routine for **a week,** and write them down in this table?
For example: you can write "I polished my nails in a salon and I felt fresh."

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Morning 							
Emotion							
Afternoon 							
Emotion							
Evening 							
Emotion							

Could you please imagine your ideal environment to do your personal care?

You can draw, write, take photos or any other ways to express your ideas

Thanks for your participation!

See you in the interview!
Do you have any other comments?

Appendix E: User Interview Questions

Interview Introduction

Welcome and thank you for being willing to share your experience with me during this interview. My name is Zhou Zhou and I am doing product research at Philips Beauty where I am pursuing my master thesis.

I would like to ensure that there are no right or wrong answers during this interview. We are looking for your honest opinions and insights on what you experienced. We could learn a lot from hearing about your experiences so please share as much as you can.

In the coming hour I would like to discuss your sensitising booklet firstly and then some specific questions about what would you do to keep your skin smooth and clean.

General Questions:

- Firstly, I would like to talk about your sensitising booklet. How do you think about the little booklet? How's the experience of filling it in?

(ask questions about their background: study, single/married, hobbies, etc. To understand their personalities/characteristics)

- Could you please describe what does personal care mean for you? You chose scale number xx, why?

- I see you've pointed out the parts you do your personal care, could you explain it to me how do you do them? And why do you do them?

- You've showed three photos of your favourite personal care product, could you please tell me why do you choose them? What makes it interesting/important for you? And what do you think can be improved?

- Nice that you recorded your weekly personal care routine, can you describe why you do xxx at xxx and how do you feel about it?

Grooming experience:

Now I would like to talk about how do you keep your skin smooth and clean, or what kind of care do you do for your skin(body/facial)?

Could you please tell me how do you keep your skin clean and smooth? What do you do for it? What tools do you use?

1.Could you please tell me how do you keep your skin clean and smooth?

a.What do you do for it?

b.Where do you do it?

c.Which tools? How do you feel about using these tools?

d.Why do you do it?

e.When do you do it? (days, weeks, winter/summer, daytime/evening)

f.What do you do before and after?

g.Could you describe your feelings during the skin care/grooming experience?

h.How does the treatment go?

i.How did you feel about it? How is the experience?

a.You have created your ideal personal care environment in the booklet, can you explain it to me?

b.Does it fit your grooming/skin care situation?

c.If not, could you imagine what is the ideal situation for your grooming experience?

a.Would you like to give some ideas for your ideal grooming experience?

b.Be brave to create ideas

Optional questions

a.Have you ever heard of IPL hair removal device?

b.Have you used it? How do you feel about it?

c.What do you think about this technology?

d.What attract you the most and what are your concerns?

e.Have you ever considered buy it, why?

f.How would IPL fit your personal care routine? Time, money, efforts, energy…

g.Subscription vs Purchase? Why? Why not?

Ending:

Here comes to the end of our interview. Thank you very much for participating in this interview. All your input is very valuable for us and helps us a lot in the development of products. Do you have any questions or something to add?

Who are you?
Prepared questions

- What does personalisation mean for you?
- A personalised function you liked in a product/ service?
- Why do you like it?

Lisa

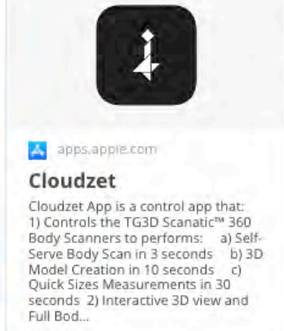
personalisation means for me that the product or service can adapt to my needs.

a function that I **don't** need is change of colour. that doesn't help me.

if it's about self care (sports, well-being, beauty), I need to be motivated to continue. If I can set goals or have something interactive, like a streak, that counts as personalisation for me. **I want to reach my own goals.**

If I look at a product (groceries) online that I want to buy, I want to know if it's available in a specific supermarket (on my way home). This is also personalisation for me.

Winnie
personlisation means I can cater to my own needs.
It associates using my own data or being able to adjust in my control
Spotify: I can set my own playlist, my sleeping time, also search for my own preferred songs.
CloudFit personal avatar:
https://images.app.goo.gl/1pTNgs3Woi1vjZzr9
I use this for clothe buying. It has my digitalised body and measures so I can decide which size of outfit is suitable for me.
I would like the product to remember my preference, yet still allow me to have a certain control.
I am concerned by privacy.



Inge

Personalization for me means that a product or service speaks to me personally. It works for me, it's not just functioning.

A personalized service I like is Netflix --> allows me to watch what I like without having to constantly give active input

Google Pictures gives me personal highlights of past years, which I really like because it's something extra they didn't have to do

Congxin
Personalisation means I can personalised the service based on my own preferences, like locations or times. Also a one-to-one service is a major part in personalised service as well. I think I'll feel better if location is isolated from others.

Nail painting

I can have it as I want, and I can have it revised as many times as I want.

What kind of personalisation do you expect in IPL journey?

Before the IPL journey starts

I wish someone can give detailed instructions on the usages. And trustworthy comments and reviews.

Knowing the science behind this device (i.e. how exactly it removes the hair) makes me feel more reassured.

I would like people with similar skin/hair to show me if the device worked for them

I wish a friend recommended it to me, so I can trust it is worth the money

I would like to have a youtube use video (with a person similar to my skin tone) so I can learn and see how the product's function before using the product.

If I don't have much hair, would this device still be suitable for me?

The first time with IPL

I would like to have a pick-up salon of IPL device for the first time-use workshop

I would like this because I need to make sure I use it correctly. Especially for the first time. If you do it wrong in the beginning, you will always do it wrong.

It would be nice to have a personalized treatment plan based on my own body/preferences

I would like to have a skin checkup or consultation during first use to know if this is the right treatment for me.

I would like to know the cycle process and someone to accompany me to see if I'm using it in the right way. I also want to know which part of my body should be treated more frequently than the other parts.

I would like the device to tell me what parts i have already treated and what parts i missed

I agree with this, I am concerned if I will neglect some parts and notice it few days later.

Second use with IPL

I want the result to be visible already.

I want to understand the product by now. If I need to get the manual again, it's clearly too complicated.

I can imagine using this on my armpits or legs, but for more sensitive areas (i..e bikini lines, close to genital..) I don't feel really safe with the strong flashing lights.

Living with IPL

I would prefer to use the IPL in salons, since it's rather more difficult to use on my own and I can enjoy while the treatment being professionally done.

During using: I would like to know when my hair needs to be better removed instead of waiting until I smell the burn.

I want to know what to do when i'm not getting the results i want

I would like to document my own hair removal journey, including pictures so I can see my own results

perhaps soft sound feedback, makes me feel more like a treatment rather then a serious device.. (now feel like doing a medical treatment almost...)

I would like to use it in my own room and treat hair removal as a routine rather than a schedule that I need to specially pay attention to.

I want to have a specific day when to do it. Otherwise I might forget to use it.

I want the product to tell me how long one session is gonna take. I personalise the product and then it knows: "Lisa is always doing legs & arm pits. She has used it often, so now she can do it quicker. Therefore: 20 minutes." Then I know that I can still do it quickly before I have an appointment

End result of IPL

No hair ever again

before/after? I would like to have a satisfying feeling, perhaps a longer period of time without hair would give me such feeling.

I want to rent the device and return after I don't need.

Gradual decrease of hair growth to none. But I know the cycle only persists for 6 months.

Missing spots

I want the result to be visible already.

the device has to tell me which part I flashed already.
The window is so small, how can I possible cover every part of the skin?

A laser projector to tell me where has flashed.

A UV light with some gel to tell me where has flashed.

Maybe give an indication of the amount of flashes that were done? to let me know if my treatment style is consistent/if I'm giving the right amount of flashes

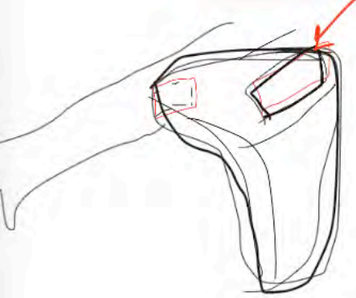
I would like the device to tell me what parts i have already treated and what parts i missed

I would like to have some protections on the device in case I forget to shave first and then burn myself... Maybe a reminder is good too.

I agree with this, I am concerned if i will neglect some parts and notice it few days later.

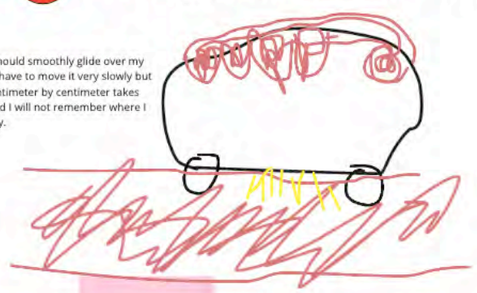
connect to an app that I can adjust the level of the laser. It will be good if I can actually view how my skin looks like when the laser is working.

Maybe have a window to see what parts am I doing and what are the parts.



Moving the device on skin

The device should smoothly glide over my skin. I might have to move it very slowly but moving it centimeter by centimeter takes sooo long and I will not remember where I had it already.



If there was some kind of softness or flexibility in the part of the device that should make contact with the skin, this would make maintaining contact easier.

If the front part is soft silicon, probably it can adapt to different parts of my body easily without needing to change heads and really stick tightly to my skin.

It would be nice if the device had some flexibility in the sense that I could hold it comfortably from different angles.

Personal guidance and support

I want to know what to do when i'm not getting the results i want

I wish someone can give detailed instructions on the usages. And trustworthy comments and reviews.

I would like to have a pick-up salon of IPL device for the first time-use workshop

I would like this because I need to make sure I use it correctly. Especially for the first time. If you do it wrong in the beginning, you will always do it wrong.

I would like to know the cycle process and someone to accompany me to see if I'm using it in the right way. I also want to know which part of my body should be treated more frequently than the other parts.

I would like to have a skin checkup or consultation during first use to know if this is the right treatment for me.

Knowing the science behind this device (i.e. how exactly it removes the hair) makes the feel more reassured.

Personalised Treatment schedule

Connect to the app to remember my last treatment settings + treatment areas

To record the process and what body parts I've done so far.

I want to have a specific date/time to do it. Otherwise I might forget to use it.

I want the product to tell me how long one session is gonna take. I personalize the product and then it knows. "Like it always does legs & arms (yes. She has used it other, so now she can do it quicker. Therefore, 20 minutes." Then I know that I can still do it quickly before I have an appointment.

It would be nice to have a personalized treatment plan based on my own body/preferences

I would like to use it in my own room and treat hair removal as a routine rather than a schedule that I need to specially pay attention to.

I would like to document my own hair removal journey, including pictures so I can see my own results

The app is more like a scheduling plan or personal journey to me. I would not desire to use the app and device simultaneously, will become even more complicate.

Motivation to continue

perhaps soft sound feedback, makes me feel more like a treatment rather then a serious device.. (now feel like doing a medical treatment almost...)

"We could eliminate these many roots already! Good job, the other ones will go in the next sessions!"

Sound feedback would be nice to feel more like an enjoyable self-care treatment experience. I can imagine when I'm using this, I want to put on some soft jazz music and feel like in a salon.

Advice from social media / friends/families

I wish a friend recommended it to me, so I can trust it is worth the money

I would like to have a youtube use video (with a person similar to my skin tone) so I can learn and see how the product's function before using the product.

I would like people with similar skin/hair to show me if the device worked for them

New User Interface

Personalised light intensity setting

I mainly want the device to have a screen. It needs to tell me more about what it's doing. Right now the buttons look the same as my hairdryer.

A slide button to adjust my light intensity level

Can the device detect the density of my hair roots and adjust setting level?

The device should clearly explain what skintone in detected, what it recommends and then ask what you would like to do. It needs to be clearer.

During using I would like to know when my hair needs to be better removed instead of waiting until I smell the burn.

is it possible not have so much steps (click detect -> select intensity -> confirm intensity -> wait for it to flash), can it automatically detect? before flashing

I can imagine using this on my armpits or legs, but for more sensitive areas (i..e bikini lines, close to genital..) I don't feel really safe with the strong flashing lights.

not numbers, but perhaps easier understanding scale or a screen interface that gives more clear visual feedback.

If you could personalise your IPL device, what would you like to have on the device itself?
Please give at least 3 ideas in different directions.

To record the process and what body parts I've done so far.

connect to an app that i can adjust the level of the laser. It will be good if I can actually view how my skin looks like when the laser is working.

The app is more like a scheduling plan or personal journey to me. I would not desire to use the app and device simultaneously, will become even more complicate.

I would like to have some protections on the device in case I forget to shave first and then burn myself... Maybe a reminder is good too.

A slide button to adjust my light intensity level

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A laser projector to tell me where has flashed.

A UV light with some cream to tell me where has flashed.

Connect to the app to remember my last treatment settings + treatment areas

Maybe give an indication of the amount of flashes that were done? to let me know if my treatment style is consistent/if I'm giving the right amount of flashes

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Inge van de Wetering

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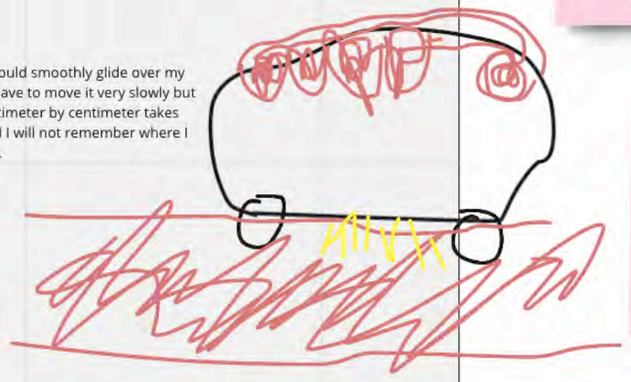

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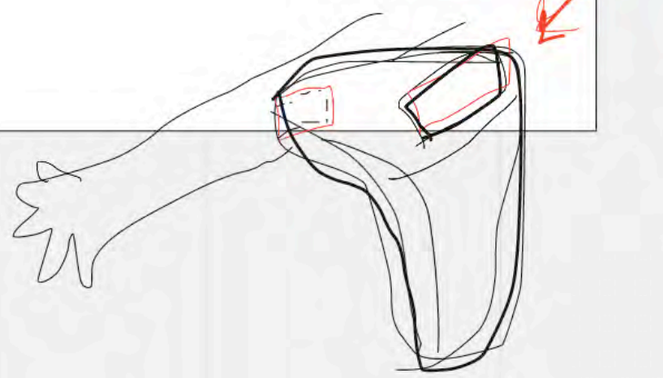
Can the device detect the density of my hair roots and adjust setting level?

It would be nice if the device had some flexibility in the sense that I could hold it comfortably from different angles.

is it possible not have so much steps (click detect -> select intensity -> confirm intensity -> wait for it to flash), can it automatically detect? before flashing

Maybe have a window to see what parts am I doing and what are the parts.



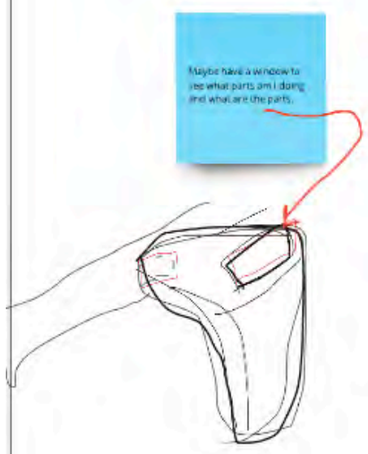
Let's cluster our ideas together!
What are the top 3 ideas you like?

Missing spots

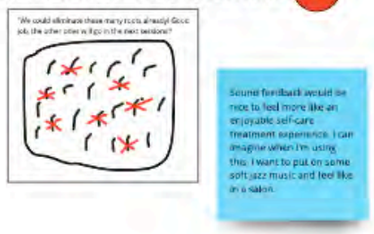
Moving the device

Personal guidance and support

Personalised Treatment schedule

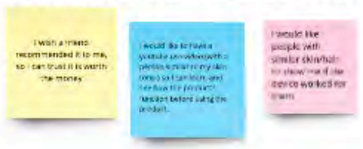


Motivation to continue



New User Interface

Advice from social media / friends/families

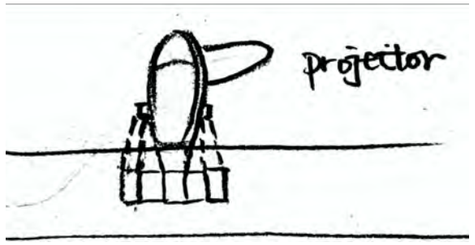


Personalised lighting setting

Appendix G: Ideas from Ideation

1.Projector on the device

A mini projector can be added on the device to show the user where to release the next flash.

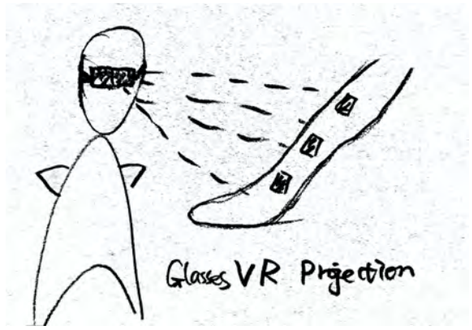


Idea Selection Decision:

A mini projector is at high cost and the navigation is not clear for the users. The users still do not fully know how the whole treatment goes, but they only know where the next spot is. Thus, the users might still lose track of the treatment. This idea will not be selected.

2. VR Glasses

A VR glasses connected with the device can show the user on the glasses where to flash and where has been flashed.

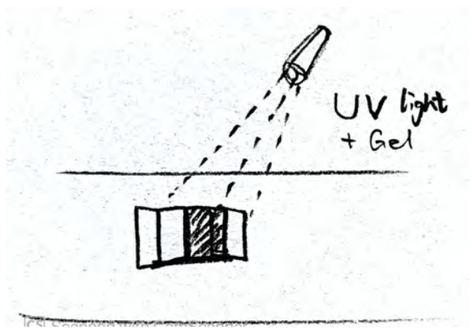


Idea Selection Decision:

This idea will not be selected. Generation Z users prefer easy usage of the product(chapter 3.5.1), a simple and comfortable product is more preferred than complex technology. An extra VR glasses will add the complexity of the usage and the users will need to find more space for storing it. Thus, this idea will not be selected.

3. UV light

A coloured gel can be used on the treatment area. After the treatment, the user can use a UV light(like a bank note detector) to scan where have been flashed.



Idea Selection Decision:

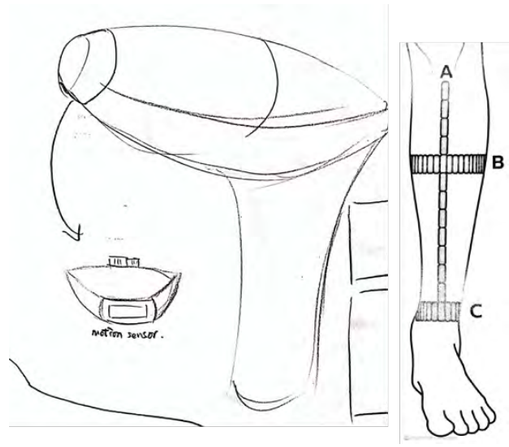
When conducting IPL treatment, it suggests that keep the skin dry and clean. However, it is uncertain if the gel is safe for IPL treatment and how effective the colour can change. Moreover, the users need to clean the gel after the IPL treatment which add extra steps for the users. Thus, this idea will not be selected.

4. Sensors:

IMU sensor: This IMU sensor is the combination of accelerometer and gyroscope, which can measure translational accelerations and rotational speed (Wikipedia, 2020).

IR mouse sensor: The IR mouse sensor can measure and detect infrared radiation(Jost, 2019).

This idea will firstly ask the user to measure their treatment area, in order to calculate how many flashes the user needs for this area. For instance, on the lower leg, the user needs to measure the radius of the ankle (C) and wide middle part of the lower leg (B), and the length of their lower leg (A). Next, the sensor can detect the movements of the user, which is possible to give guidance and feedback to the users during the treatment.

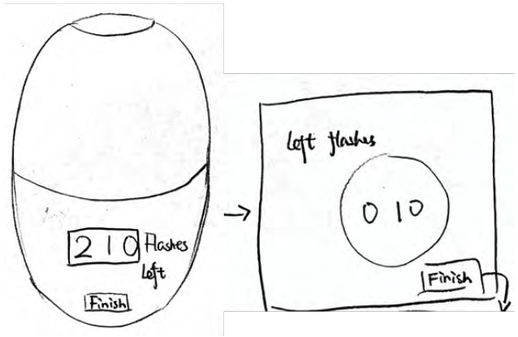


Idea Selection Decision:

This idea will be selected and Philips is already developing related technology for it. IMU and IR sensors are both possible for providing personal guidance. However, the limitation is that the users need to keep good skin contact all the time. Thus, the later design should be tested if the users can keep good skin contact during the whole treatment. Otherwise, the design should provide the users an easy way to keep the device on the skin.

5. Indication for total amount of flashes

With the new sensors, the device will calculate the total amount of flashes that user needs to apply on lower leg area. When the user starts treatment, the device will count down how many flashes user has left.

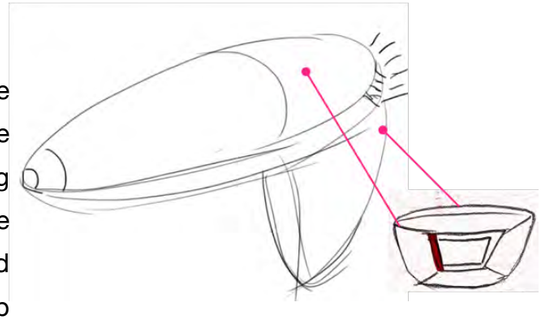


Idea Selection Decision:

The idea 5 is good for the users who only need a little and quick guidance, which they can still have their freedom. For other users, it is not easy for them to follow how many flashes to apply on a specific area when they are doing treatment on a large surface. Users will get lost with 350 flashes if they see this number at the beginning. Thus, this idea will not be selected.

6. Skin contact guidance

With the new sensors, the device can tell the user via screen and light which part of the attachment does not have good skin contact. If the left side of the attachment does not have good skin contact, the red light on the left side of the attachment icon will be light on. The user can see this icon indicating light on the screen and on the back of the handle. It can help the user do the treatment with less interruption and have a better skin contact.



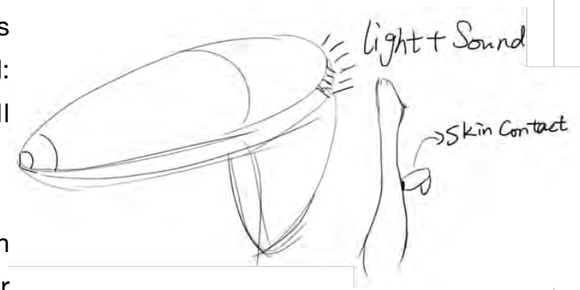
Idea Selection Decision:

The idea 6 is a good match for giving guidance to the users about keeping skin contact. From the product use analysis chapter 2, the user had difficulty with keeping good skin contact during the treatment. One of the reasons is that the user did not know how to keep good skin contact. This idea can guide the user to better keep good skin contact. However, this idea is combined with the personal guidance idea, the users might have too much information to watch. Thus, the current “ready to flash” light will remain, but the colour will change to green for a better understanding. There will be no feedback of skin contact on the screen and the attachment remains the same at the moment.

7. Sound feedback

Type 1. Once the user has good skin contact, the light will be on and the sound is also on: “bing”.

Type 2. After the user starts the treatment, when there is no good skin contact, a gentle sound will be played: “bing~bing~bing”. Until the skin contact is well maintained.

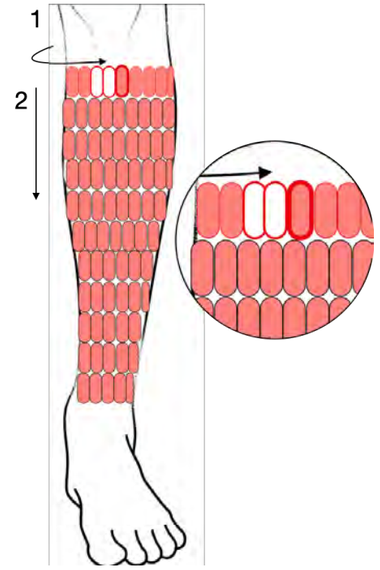


Idea Selection Decision:

When the users can not see the interface at certain positions, the sound feedback could be a good way for them to receive feedback. However, the way how sound feedback works can be seen in the combination of idea 9.

8. Guidance on circular direction:

The idea is about providing guidance on the lower leg in a circular direction. The user will use a motion/mouse sensor to measure the treatment area first, and then the user can start treatment from the top of the lower leg to the bottom in a circular direction(figure x). The device will inform the user how many flashes need to apply on the first row. After the first row, the user can start with the second row. When the user moves the device to the second row, the sensor will indicate the user how far to move. For instance, the device can say: “please move 2cm downwards to start your second row." When the user has moved 2cm, the sensor tell user: “you have moved 2cm.” However, in order to have a precise track of the treatment process, the user should keep the device on the skin all the time.



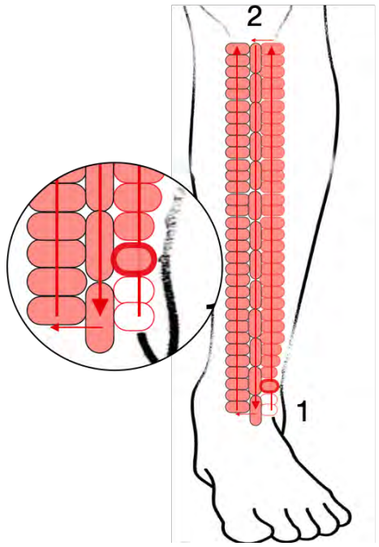
Idea Selection Decision:

The idea 8 has a clear guidance for the users where and how to flash. But most of users have different treatment behaviours, which is to flash from the bottom to the top of their lower legs. Doing treatment in a circular direction is not user friendly. Thus, this idea is not selected.

9. Guidance on vertical direction:

The idea is about providing guidance on the lower leg in a vertical direction.The user will use a motion/mouse sensor to measure the treatment area first, and then the user can start treatment from the bottom to the top of the lower leg(figure x). The device will inform the user how many flashes they need to apply on the first line. After the first line, the user can start with the second line. When the user moves the device to the second line, the motion sensor can indicate users how far to move. For instance, the device can say: “please move 2cm to your left to start your second line treatment." When the user has moved 2cm, the sensor can tell the user: “you have moved 2cm.” Moreover, when the user moves to the shin bone area, the motion sensor can indicate the user to rotate the device with 90 degree in order to have a better skin contact for the shin bone area.

However, in order to have a precise track of the treatment process, the user should keep the device on the skin during the treatment.



Idea Selection Decision:

The idea 9 is a better match with the design requirements. It guides users to know where and how to flash, it indicates the users how many flashes per line, and it has the same treatment behaviours like the most users have(from the bottom to the top on the lower leg). Therefore, the design concept on the guidance part will use this idea.

Moreover, because the users need to keep constant skin contact during a complete single line, thus, a sound feedback will be added to remind the users if they lose skin contact on the line.

10. Auto-detect Skin Tone(figure x):

The device can automatically detect the user’s skin tone and automatically chooses suitable light intensity settings for the user. During the treatment, the device can continue to detect your skin tone. If the user moves to a darker skin area, the light intensity will be automatically adjusted.

Idea Selection Decision:

This idea is suitable for the users who prefer a fast way of auto-choosing suitable light intensity settings. The device can do it for the users and the users have the control to adjust it. This idea will be selected in the final design.

11. Gentle Function:

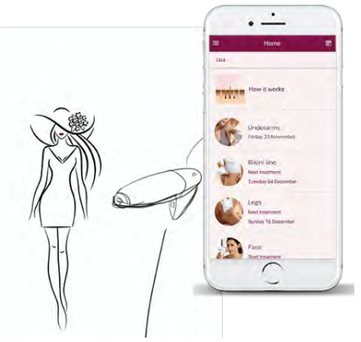
Whenever the user feels the light intensity is too strong, the user can always press the gentle button to lower down the light intensity during the treatment.

Idea Selection Decision:

This idea will not be selected, as most users like to know the skin tone and light intensity settings, thus, a clear indication and precise adjustment on light intensity are preferred.

12. Connected App for flexible treatment schedule(figure x):

If the user chooses different modes on the device with different light intensity, the IPL Lumea App can adjust treatment schedule according to the user's choice.

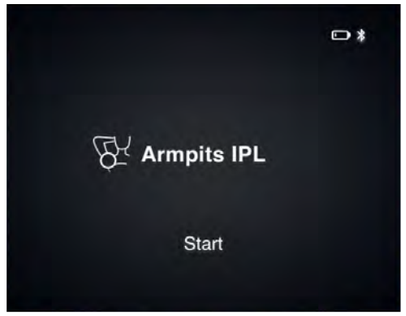


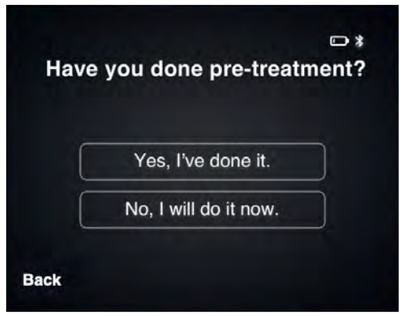
Idea Selection Decision:

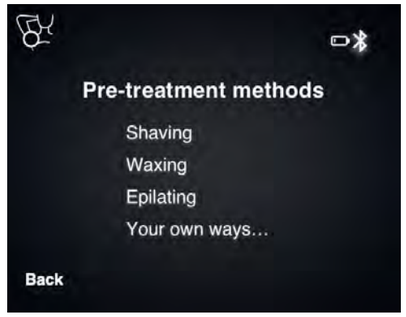
This idea will be selected, because the generation Z users are highly digital solution oriented(chapter 1.2.2), a connected product with an App can attract them and allow them to easily manage treatment schedule.

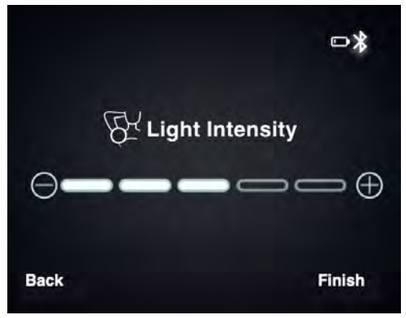
Appendix H: Digital Interfaces

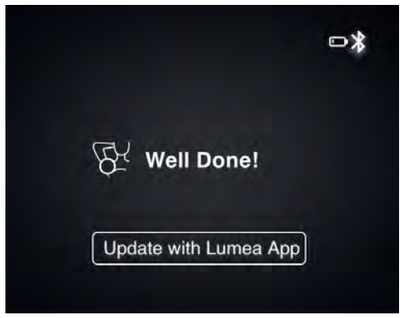
Armpits attachment



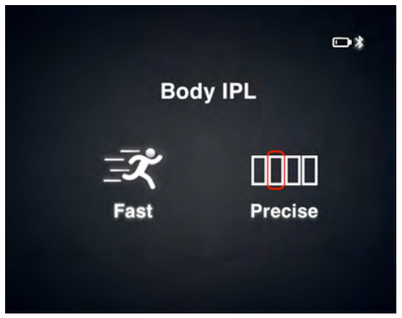


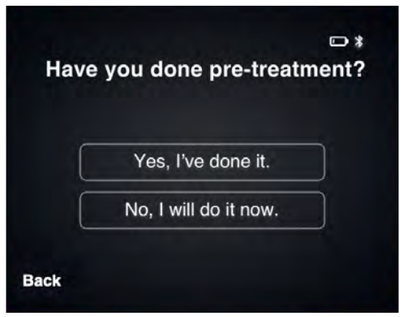


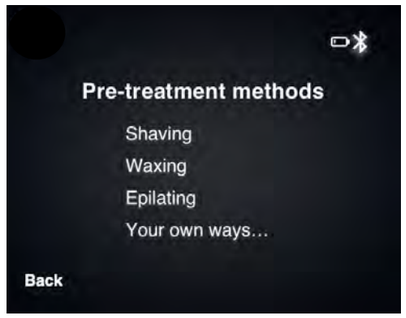


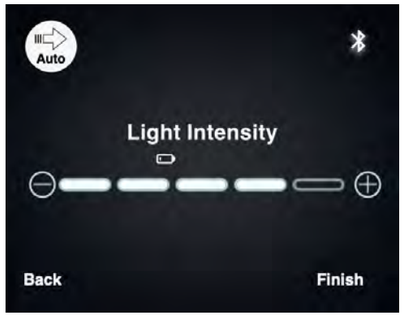


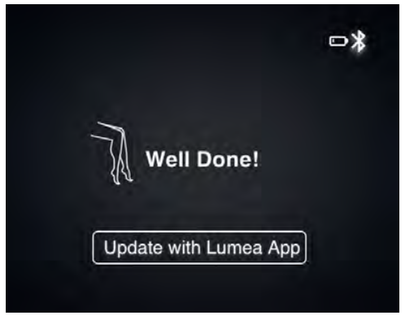
Fast mode











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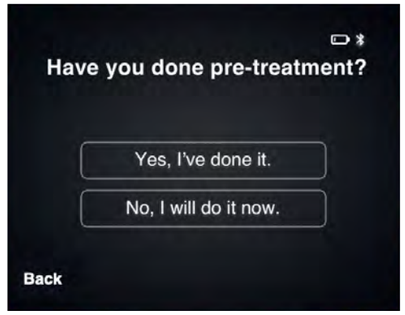

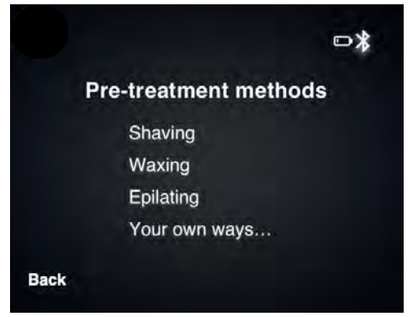

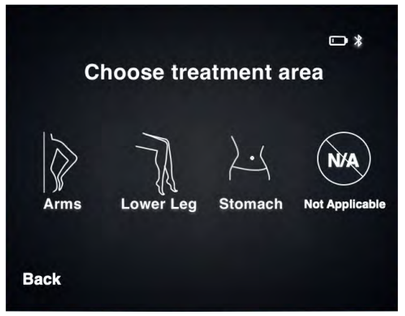

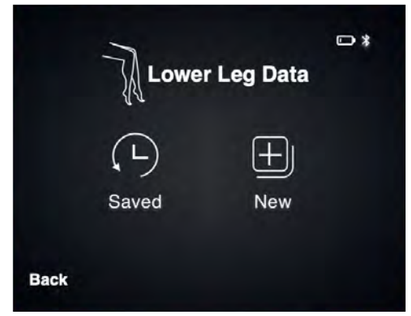

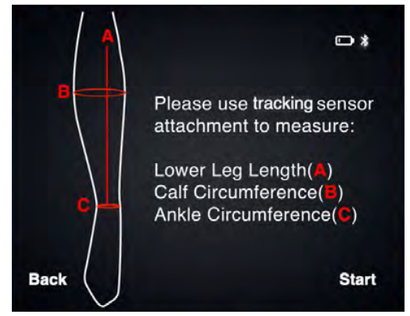

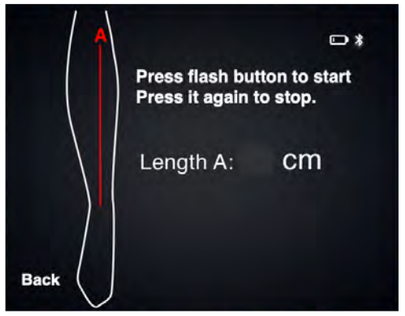

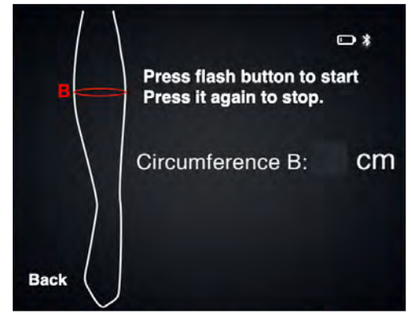

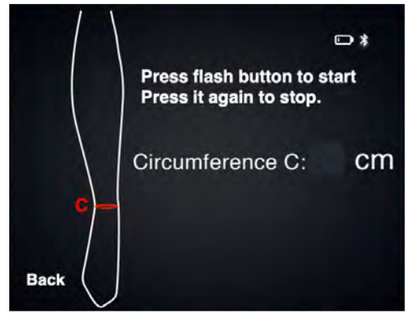

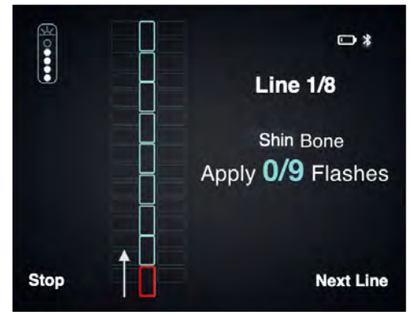

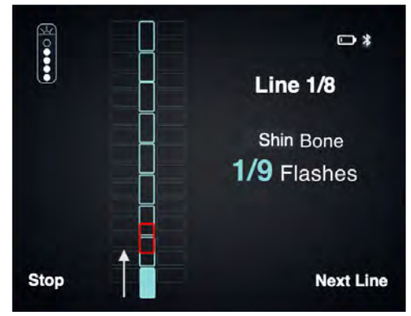

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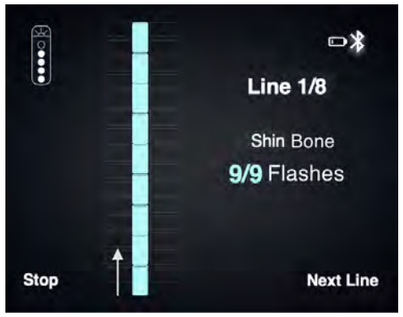

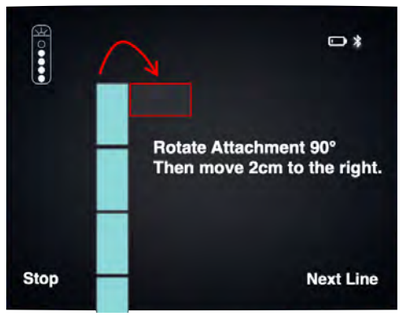

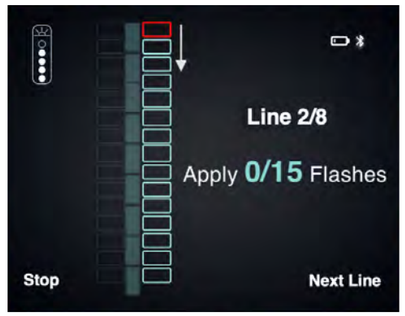

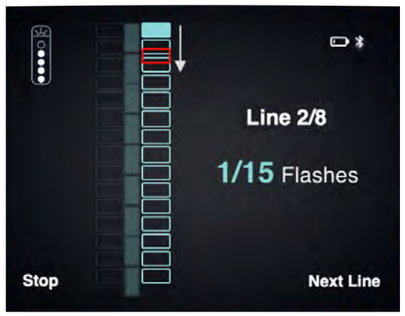

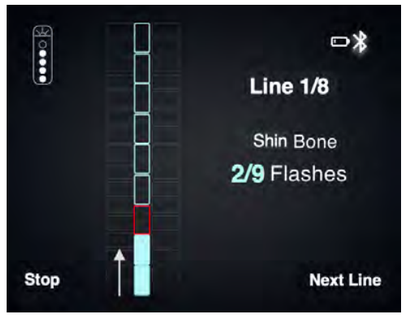

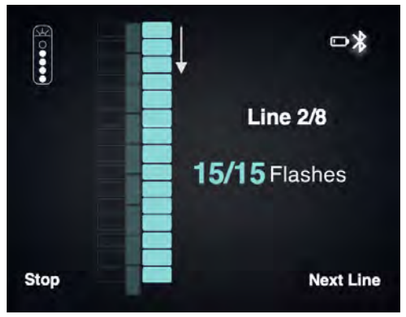

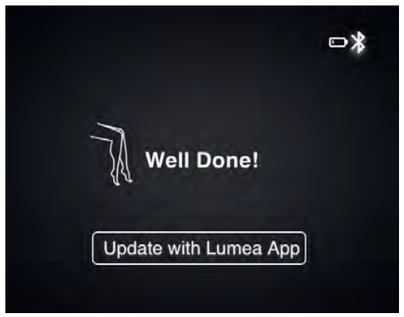

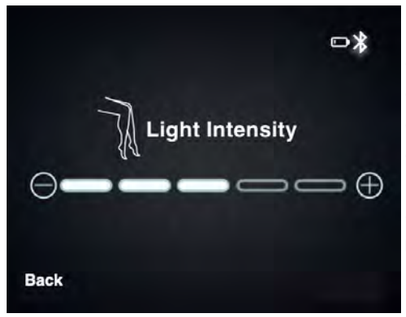

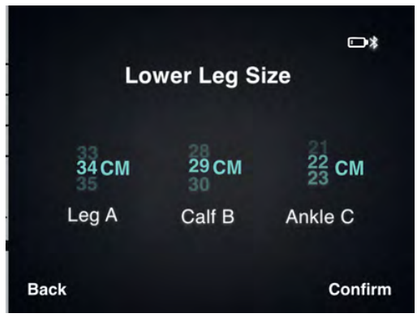

Appendix I: Privacy Notice Consent Form for Usability Testing

<04-12-2020>

Personal care study for IPL graduation project
PARTICIPANT NR: ___1_____

Acknowledgement of Participation

Acknowledgement of Participation
IPL generation Z usability testing

Participant

√ I have read the information for participants in this study, I understand it and the researcher in charge has answered all my questions about the study.

√ I have had sufficient time to consider my participation in this study and I am aware that participation in this study is entirely voluntary.

√ I am aware that I may decide, at any time, not to participate or to end my participation, without being required to explain my reasons.

√ I understand and give my consent that the researcher in charge and other parties involved in this research project will gather use and process personal data for this study. Personal data may include < *ethnicity data, the taking of photos, making video recordings, audio taping interviews, or screen recording.*> I understand that data allowing for identification of my identity (for example my name and address) will be deleted from the research data and will be replaced by a code. Access to the key between that code and my identity details is restricted to the researcher in charge and his manager. That key may only be displayed to regulatory authorities and/or ethical committees for reporting purposes, or to the independent physician consultant in the event that such is rendered necessary on medical grounds. My personal data will be kept on file for a reasonable period and for a maximum of 2 years after the study ends, and will subsequently be deleted, with the exception of (i) video material and photographs, and (ii) legal obligations to which Philips is subject.

√ I consent to the use of my personal data for other research and development purposes.

√ I am aware of my right to view the personal information that is gathered about me and to have any and all inaccuracies corrected.

PHILIPS

Information for Participants
<Doc ID>

<04-12-2020>

Personal care study for IPL graduation project
PARTICIPANT NR: ___1_____

Acknowledgement of Participation

√ I understand that information concerning this study, for example products, brochures, descriptions of the study, prototypes, user manuals and instructions, as well as information about myself that is created during the study, such as measurement results and users, constitutes confidential information belonging to Philips. I hereby confirm that I will treat that information confidentially and use it exclusively for purposes connected to this study and that I will not disclose that information to third parties in any manner whatsoever, including by social media.

PHILIPS

Information for Participants
<Doc ID>

<04-12-2020>

Personal care study for IPL graduation project
PARTICIPANT NR: ___1_____

Acknowledgement of Participation

By signing this statement, I agree to the conditions under which I will participate in the study:

_____	_____	_____
Name	Signature*	Date

Researcher in charge or his/her appointed representative

I have discussed the substance of this consent form, answered any possible questions and signed it in the participant's presence.

Zhou Zhou	周洲	04-12-2020
Name	Signature	Date

Appendix J: Usability Testing Details

Usability Testing Plan

Design goal:
By designing an Effective Communication on the IPL device, a more Personal Guidance on the IPL device will be created in order to reach A Sense of Achievement.

Research goal:
The scope of the usability testing is about testing the design goal via the digital screen. There are three elements will be evaluated, the effective communication of the screen, the personal guidance from the screen, and the confidence on building sense of achievement after using the personal guidance of the screen. This testing is for qualitative research.

Research questions:
1. Is the communication of the digital user interface clear for the user?
2. Can user understand the personal guidance from the screen?
3. Does the personal guidance from the screen help the user to do a correct treatment?
4. Which measurement method does the user prefer, tape or motion sensor?
5. Does the user understand the tape measurement and the motion sensor measurement?
6. With the personal guidance interfaces, does the user feel more confident to reach their hair-free goal?

Schedule & Location:
The usability testing will be conducted both online and in-person. Location: Eindhoven, the Netherlands. The testing will be held between 7th Dec to 17th Dec 2020.

Sessions:
Before the testing, participants will need to sign the consent and privacy notice form.
Each session will last for one hour, and there will be 15mins between for the break. For the online session, participants will need a Philips IPL Lumea device for the testing, and they will follow instructions via a shared screen. For face-face testing, Covid-19 measures should be applied (disinfect equipment and mouth masks). All participants will do the testing tasks first and then fill in a questionnaire for evaluation.

Equipment:
Philips IPL Lumea Device, a laptop, an iPhone and disinfection stuff. The sessions will be recorded by photos and videos for later evaluation sessions.

Participants:
Number of participants: 8
Age: 18-25
Gender: Both female and male
Requirements: Participants should be interested in hair removal activities and have already heard about IPL technology, or already have a IPL device.

Scenarios:
Participants will be invited to watch the CAD model of the new designed IPL device. Short explanation of the design will be given. The participants will be given a Philips IPL Lumea device for the testing but they will be asked to imagine this Lumea device as the new designed IPL device (with screen) which they can see from the CAD model. They will conduct IPL treatment by Lumea device, and they will look at the screen via their laptops or phones.

Task 1
Imagine you are going to do a IPL treatment on your armpits by using the new Philips IPL device. Please choose the attachment and watch the digital screen when you conduct your treatment.
Task 2
Please use the body attachment for conducting a lower leg treatment. Please choose the fast mode for your lower leg treatment. (You will be informed when you need to stop the treatment)
Task 3(Motion sensor measurement)
Please choose the precise mode for your lower leg treatment and follow the instructions on the screen.
Task 4(Tape measurement)
Please choose the precise mode for your lower leg treatment and follow the instructions on the screen.
Task 5
Please hold the 3D printed model and use it on your armpits, lower leg, bikini line, arms, and upper lip. Press the black flash button one time. (participants who conduct online testing will not do this task)

Metrics:
Task 1:

For participants	For moderator
1. In which scale do you find it's easy to have the right light intensity setting?	Observe if the participant has problem with understanding the auto light intensity feature, Moderator rates the severity of the problem.

Task 2:

For participants	For moderator
1. How easy is it for you to understand the fast mode concept? Not easy 1-5 very easy	Observe the participant, rate the severity of the problem.
2. Have you recognised the "Auto" button? Do you understand it? If not, would you be able to understand for the next time?	Having a discussion about the "Auto" button, ask if they understand it, why they don't understand, what could be easy for them, what would they do if they do not understand it, and write it down.

Task 3

For participants	For moderator
1. How easy is it for you to follow motion sensor measurement instruction? 1(Not easy)-5(Very easy)	Moderator rates severity of the problem
2. How easy is it for you to follow the guidance from the screen to conduct IPL treatment on your lower leg? 1(Not easy)-5(Very easy)	Moderator rates severity of the problem 1. Understanding the guidance 2. Full skin contact during the whole treatment.
3. How true do you think that this personal guidance helps you to conduct a correct IPL treatment? Not true1-5very true	Moderator rates severity of the problem
4. How confident do you feel to reach your hair-free goal after using this personal guidance? Not confident1-5Very confident	Moderator rates severity of the problem

5. In which scale do you agree that this guidance is personally guiding you during the treatment.	Observe the participant, rate the severity of the problem.

Task 4

For participants	For moderator
1. How easy is it for you to follow tape measurement instruction? 1(Not easy)-5(Very easy)	Moderator rates severity of the problem
2. Do you prefer to have motion sensor measurement or tape measurement? And why?	Have a discussion with the participants, write down the reasons.

Task 5

For participants	For moderator
1. How comfortable do you feel when you use the device on your hands?	Moderator rates severity of the problem
2. Evaluation on comfort on lips, armpits, lower leg, belly, and arms.	Observe if the participant is able to keep good skin contact on these body parts, rate the severity of the skin contact. Refer the design requirement of comfort chapter.

Overall question:

For participants	For moderator
1. Could you give reasons why it's (not) appealing for you?	Have a discussion and write down reasons
2. Do you understand the icons on the interface? Which one do you feel confused?	Have a discussion and write down reasons

Roles:
Instructor and moderator: Zhou Zhou

Reference:
Usability.gov https://www.usability.gov/how-to-and-tools/methods/planning-usability-testing.html

Questions for IPL Usability Testing

Participant Number:

Task 1

1. In which scale do you find it's easy to have the right light intensity setting?

Not easy at all 1 2 3 4 5 Very easy

Task 2

1. How easy is it for you to understand the fast mode concept?

Not easy at all 1 2 3 4 5 Very easy

2. Have you recognised the "Auto" button? Do you understand it? If not, would you be able to understand for the next time?

Task 3

1. How easy is it for you to follow motion sensor measurement instruction?

Not easy at all 1 2 3 4 5 Very easy

2. How easy is it for you to follow the guidance from the screen to conduct IPL treatment on your lower leg?

Not easy at all 1 2 3 4 5 Very easy

3. How true do you think it is that this personal guidance helps you to conduct a correct IPL treatment?

Not true at all 1 2 3 4 5 Very true

4. How confident do you feel to reach your hair-free goal after using this personal guidance?

Not confident at all 1 2 3 4 5 Very confident

5. In which scale do you agree that this guidance is personally guiding you during the treatment.

Not agree at all 1 2 3 4 5 Totally agree

Task 4

1. How easy is it for you to follow tape measurement instruction?

Not easy at all 1 2 3 4 5 Very easy

2. Do you prefer to have motion sensor measurement or tape measurement? And why?

Overall Questions

1. How comfortable do you feel when you use the device on your hands?

Not comfortable at all 1 2 3 4 5 Very comfortable

2. Could you give reasons why it's (not) appealing for you?

3. Do you understand the icons on the interface? Which one do you feel confused?