



# Flowwww

Not just for clothes care



**POLITECNICO**  
MILANO 1863

"Flow"-Carefree  
Clothes Care System  
for New Generation

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# **ABSTRACT**

ENGLISH

Nowadays, light living is a growing trend among the new generation. Light living refers to a lifestyle that emphasizes simplicity, minimalism, and sustainability. It is important to study the impact of light lifestyle trends in design, how to meet young people's needs, and how to satisfy a light lifestyle. This paper investigates the trend of a light lifestyle and the change in the GenZ lifestyle. Meanwhile, the theme of "clothing" as an entry point to discover a new design opportunity. In the research phase, clothing care is essential to the new generation's life. Analyzing the cycle of clothing use in daily life, using questionnaires and interviews, identifies the new generation changing attitudes and behaviours towards clothing. It shows the needs and pain points of the new generation in clothing care.

The product research and development phase, based on a series of user experience studies and analysis of existing clothing care equipment designs, emphasizes that the

furniture-oriented appliances are in accordance with the light lifestyle and meet the needs of the new generation. It defines the bedroom as the ideal environment for clothing care. The development explored and integrated new available technologies to optimize the existing clothes care appliances to meet the new needs of light living.

The project develops using a twodiamond model approach, comprehensively evaluating the manufacturing, technology, and user experience aspects. New design tools: AI drawing provided a reasonable vision of product appearance and usage scenarios to assist in appearance design and modelling.

This paper introduces FLOW, a new clothing care product. It is more than a clothing care product. FLOW fits the home environment and can be a shelf, a clothes rack, or a light. As a light, it can bring pleasure and emotion to the user. These three different functions make FLOW furniture oriented. For clothes care, it can remove the odour of clothes and refresh it. The project provides an overview of the design and explores user experience through personas, scenarios, and journey maps. The visual elements, including mood boards, sketches, and 3D models, are included in the project, and intelligent interaction design is presented. Future research could explore innovative designs and technologies to enhance how people handle clothes and provide a more comfortable and pleasant user experience.

## ITALIANO

Oggi il light living è una tendenza in crescita tra le nuove generazioni. Per vita leggera si intende uno stile di vita che enfatizza la semplicità, il minimalismo e la sostenibilità. È importante studiare l'impatto delle tendenze dello stile di vita leggero nel design, come soddisfare le esigenze dei giovani e come soddisfare uno stile di vita leggero. Il presente lavoro analizza la tendenza di uno stile di vita leggero e il cambiamento nello stile di vita della GenZ. Nel frattempo, il tema dell'"abbigliamento" è il punto di partenza per scoprire una nuova opportunità di design. Nella fase di ricerca, la cura dell'abbigliamento è essenziale per la vita della nuova generazione. L'analisi del ciclo di utilizzo dell'abbigliamento nella vita quotidiana, attraverso questionari e interviste, identifica il cambiamento di atteggiamenti e comportamenti della nuova generazione nei confronti dell'abbigliamento. Mostra le esigenze e i punti dolenti della nuova generazione nella cura dell'abbigliamento.

La fase di ricerca e sviluppo del prodotto, basata su una serie di studi sull'esperienza dell'utente e sull'analisi dei design delle apparecchiature per la cura dell'abbigliamento esistenti, sottolinea che gli apparecchi orientati ai mobili sono in linea con lo stile di vita leggero e soddisfano le esigenze della nuova generazione. Definisce la camera da letto come l'ambiente ideale per la cura degli indumenti. Lo sviluppo ha esplorato e integrato le nuove tecnologie disponibili per ottimizzare gli apparecchi per la cura dei vestiti esistenti e soddisfare

le nuove esigenze di uno stile di vita leggero.

Il progetto si sviluppa utilizzando un approccio basato su un modello a due diamanti, valutando in modo completo gli aspetti produttivi, tecnologici e di esperienza dell'utente. Nuovi strumenti di progettazione: Il disegno dell'intelligenza artificiale ha fornito una visione ragionevole dell'aspetto del prodotto e degli scenari d'uso per aiutare la progettazione e la modellazione dell'aspetto.

Questo articolo presenta FLOW, un nuovo prodotto per la cura dell'abbigliamento. È più di un prodotto per la cura dei vestiti. FLOW si adatta all'ambiente domestico e può essere una mensola, un appendiabiti o una luce. Come luce, può portare piacere ed emozione all'utente. Queste tre diverse funzioni rendono FLOW orientato all'arredamento. Per la cura dei vestiti, può rimuovere l'odore degli abiti e rinfrescarli. Il progetto fornisce una panoramica del design ed esplora l'esperienza dell'utente attraverso personas, scenari e mappe di viaggio. Gli elementi visivi, tra cui moodboard, schizzi e modelli 3D, sono inclusi nel progetto e viene presentata una progettazione intelligente dell'interazione. La ricerca futura potrebbe esplorare design e tecnologie innovative per migliorare il modo in cui le persone maneggiano i vestiti e fornire un'esperienza utente più confortevole e piacevole.

# 01

## INTRODUCTION

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With the progress of society and the development of technology, the pace of global evolution has accelerated since the beginning of the 21st century. Novel concepts and phenomena continue to emerge while lifestyles and habits constantly change. It is necessary to consider how social changes affect the transformation of lifestyles and how they, in turn, affect our generation. At the same time, manufacturers and designers are committed to providing high-quality products to consumers and users. Therefore, it is necessary to analyze current social habits to design and produce products that can meet user needs and fit their lifestyles.

## 1.1 Starting Point

In recent years, global society has undergone rapid development and significant changes. Economic globalization, material diversification, the explosive generation and dissemination of information, and the COVID-19 pandemic have made modern life complex and uncertain. People's life pressures are gradually increasing, and their lifestyles, such as sustainable living, home office, and social life enrichment, are constantly changing (Nicola et al, 2020). At the same time, global environmental issues are also becoming more pressing, and people's environmental awareness and sustainable lifestyles are gaining attention. Modern people desire a healthy, comfortable, and sustainable way of life to cope

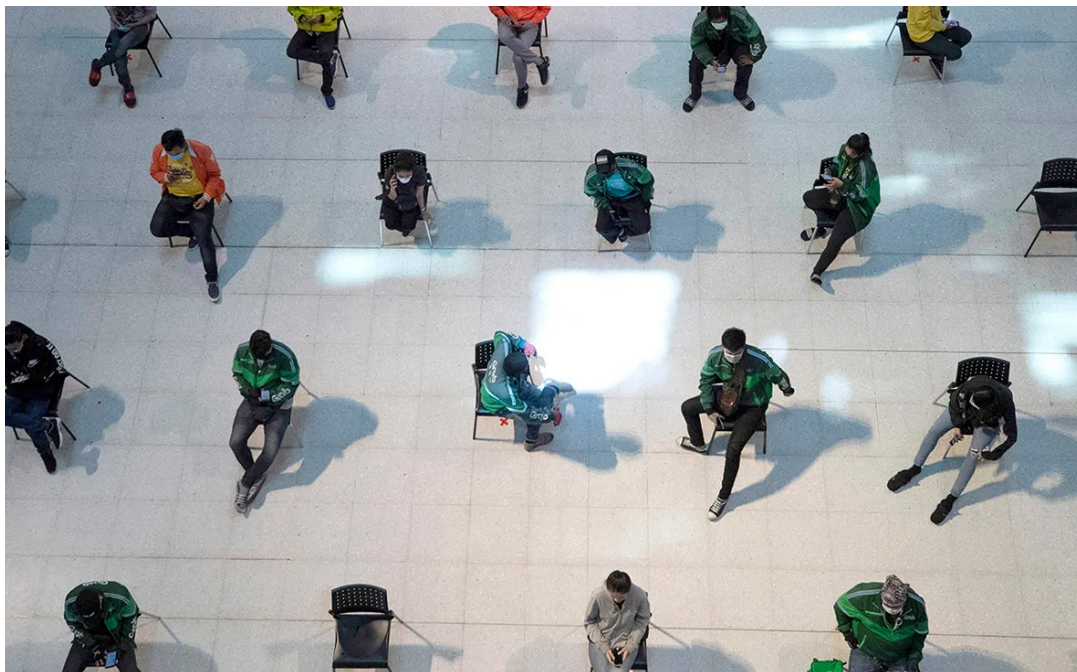


Figure 1 Social distant in Bangkok, Thailand

with complex social and ecological problems (Dunlap & York, 2008). The residential environment is closely related to people's needs. It has become an urgent problem to solve how to adapt to modern people's lifestyles while meeting their needs (Jackson, 2005).

As an essential part of the residential environment, the clothing care system plays a significant role in daily life. The design of modern clothing care products needs to adapt to changes in people's lifestyles and cleverly integrate into residential environments. The residential environment is a complex system consisting of various elements and systems. The home is a physical and social, cultural, economic, and psychological space that combines users' behavior, habits, feelings, and memories (Sadikoglu-Asan, 2022). The design of modern clothing care products needs to consider the relationships between the indoor environment, people, and objects, not just as a single object but as part of the indoor system, serving as a connection between people and the environment (Sadikoglu-Asan, 2022). Additionally, the clothing care system is essential to the clothing lifecycle. Proper clothing care can extend the life of clothes, allowing people to use clothing longer and sustainably.

However, in the daily routine, substantial segments of the population, including younger individuals, males, and higher-income groups, need more confidence and knowledge concerning clothing care<sup>1</sup>. A prevalent practice is casually placing used clothes on sofas or other fixed locations. When these clothes are to be worn again, they have often become odorous, damp, or wrinkled, necessitating washing to restore their appearance and smell. Despite increasing awareness to conserve water by reducing clothing washes, poor habits and inadequate clothing care knowledge generate a dissonance between ideals and reality. Statistics show that an organized living

space can inspire productivity and overall well-being<sup>2</sup>. Therefore, the design challenge is cultivating beneficial clothing care habits through a thoughtful product design that can adapt and enhance the user's lifestyle, thereby contributing to societal sustainability. This objective aligns with the design's ultimate goal of bearing social responsibility (Papanek& Fuller, 1972). Design for the real world..

Figure 2 Piles of used clothes in the house

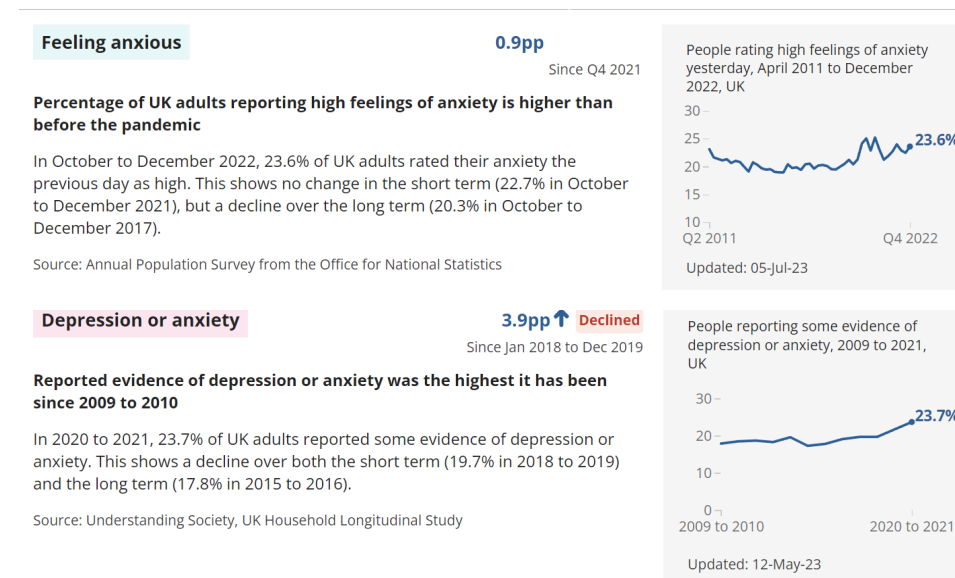


Figure 3 UK Measures of National Well-being Dashboard

## 1.2 The Trend in people's Life-behavior

The global pandemic has led to greater instability and complexity in society and increased uncertainty about the future. Individuals experience varying pressures and losses, including the loss of loved ones and employment opportunities due to COVID-19. The pandemic continues to exert effects, manifesting in economic downturns, inflation, elevated living costs, occupational shifts, and pervasive remote work, all contributing to societal impacts. Reports from the governments of the UK and the Netherlands highlight that young people confront substantial pressures<sup>3</sup>, indicated by a persistent



decline in their happiness levels from 2021 to 2022, notably in the areas of trust, quality of social life, health, and future financial prospects<sup>4</sup>.

In response to future uncertainties and multifarious pressures, society has started to responsibly contemplate prospective developments, instigating behavioral changes. Observable alterations include:

1. A greater inclination towards experimentation with new entities and products, with consumers demanding elevated experiences and displaying conspicuous hedonism.
2. An augmented sense of responsibility, with the public increasingly considering environmental issues and sustainability, while young individuals demonstrate a stronger propensity to purchase sustainable goods and services.
3. An increased focus on personal mental health and levels of happiness<sup>5</sup>, with enhanced emphasis on emotional value in life.
4. Greater attention to personal and public hygiene<sup>6</sup>. The pandemic has underscored the peril of the virus and the significance of self-protection, emphasizing behaviors like maintaining personal hygiene, indoor disinfection, and hand hygiene(Ivanova, 2022).



### 1.3 Rising need for Sustainable and Clothing care

In the post-pandemic era, more and more people are paying attention to the development of future society and are willing to take on corresponding responsibilities. This change is reflected in more people purchasing sustainable products and services. The concept of sustainability is not new; its origin can be traced back to the concept of sustainable development in the 1970s. Sustainable development was formally proposed for the first time at the United Nations Conference on the Human Environment in 1972<sup>7</sup>. This concept has become popular with the passage of time and the continuous progress of society. This also allows us to see the reflection of human beings on technological development and the destruction

of natural resources since the Industrial Revolution. This concept has also influenced the fashion and clothing industry, especially the textile industry, which has become a major source of environmental pollution due to its significant environmental impact(Chrobot, 2018). Measuring fashion: Environmental impact of the global apparel and footwear industries study. Full report and methodological considerations.. Therefore, paying attention to the sustainability of the clothing lifecycle is essential(Laitala, 2020).

In recent years, although consumers have increased their spending on clothing, the lifespan of clothing has shortened(Doi, Howell, & Hirakawa, 2012). Additionally, considering the global population's continuous growth, clothing consumption is expected to increase gradually<sup>8</sup>, which may lead to further environmental damage and impact throughout the lifecycle of clothing<sup>9</sup>. Consumers generally need to gain knowledge and skills in clothing care, so helping users properly care for clothing has become particularly crucial.



Figure 6 Life Cycle Assessment in Fashion

Garment maintenance is necessary to preserve clothing and textiles' functionality and social acceptability. However, maintenance processes can have environmental repercussions due to their energy, water, and chemicals use(Harris, Roby, & Dibb, 2016). Sustainable clothing: Challenges, barriers and interventions for encouraging more sustainable consumer behaviour. International Journal of Consumer Studies, 40(3), 309–318. . Life Cycle Assessment (LCA) of Clothes research has indicated that the duration of use and maintenance phases exert a decisive influence on environmental impact assessments(Zamani, Sandin, & Peters, 2017). In many instances, garments' usage and maintenance stages significantly affect the environment. Furthermore, the activities and detergents consumers employ for garment care markedly influence the environment during the usage phase of textiles(Moazzem, 2021). Environmental impact of apparel supply chain and textile products. Environment, Development and Sustainability, 1–19.

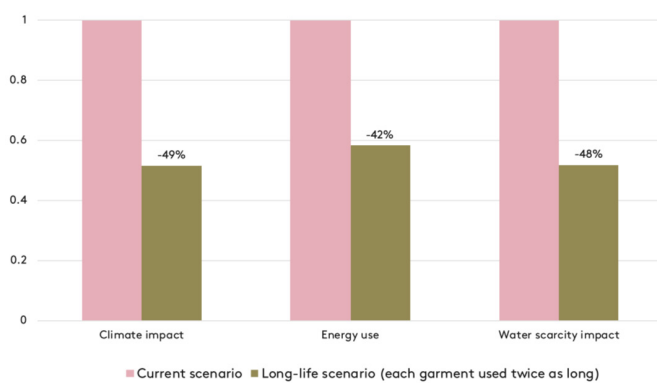


Figure 4 Environmental impact reductions if each garment of the national-level model

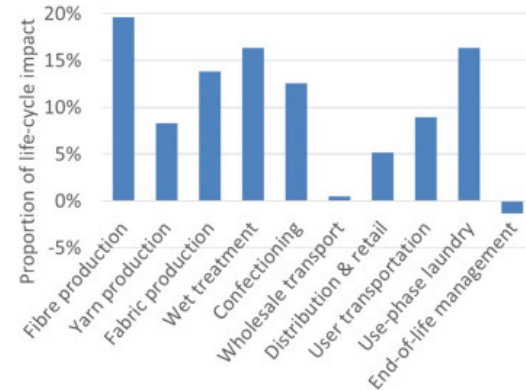


Figure 5 Energy consumption during garment life cycles data from

Sandin, G., Roos, S., Spak, B., Zamani, B., & Peters, G. (2019). Environmental assessment of Swedish clothing consumption— Six garments, Sustainable Futures. Mistra Future Fashion, 6.

Sandin, G., Roos, S., Spak, B., Zamani, B., & Peters, G. (2019). Environmental assessment of Swedish clothing consumption— Six garments, Sustainable Futures. Mistra Future Fashion, 6.

. Energy can be conserved by washing in cold water with suitable detergents, yet the chemicals commonly used in detergents and dry cleaning are toxic to both humans and aquatic ecosystems(McLaren, 2015).

Extending the lifespan of clothing can significantly reduce its negative impact on the environment throughout its lifecycle. When the lifespan of clothing is extended, the overall environmental impact cost is evenly distributed, reducing the environmental damage by more than 50%(Sandin, 2019). Proper and reasonable care of clothing by users is an effective way to increase the lifespan of clothing, which in turn helps to achieve sustainable development goals.

Consequently, this study concentrates on enhancing the environmental friendliness and efficiency of garment care processes and facilitating the adoption of sustainable behaviors(Beton, 2014).

# 02

## **LIGHT LIVING FOR HOME & CLOTHING**

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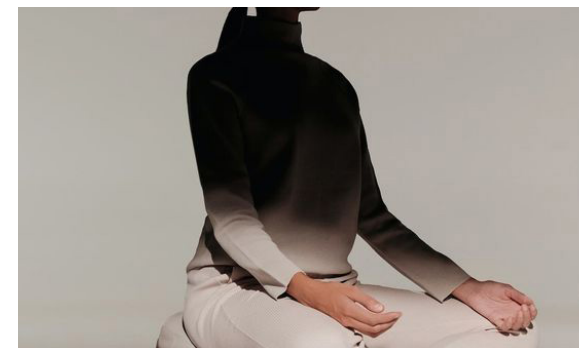
Living lighter entails being happy and healthy every day, in ways that enable everyone to prosper equitably while staying within sustainable ecological boundw

## 2.1 The Insights of Light living mood for people

This research paper is based on a postgraduate project in collaboration with the DeLonghi Group. The project explores and investigates changes in modern lifestyles in the current social environment, seeking to identify new values in contemporary living and propose the design of new home products that align with user needs and lifestyles.

What is 'light living'? Literally, 'light' is interpreted as not weighing much, as the Cambridge Dictionary<sup>10</sup> describes. In Chinese, 'light' often symbolizes objects with less weight. The term also implies simplicity, convenience, flexibility, ease, and portability in the context of living. AI artificial intelligence ChatGPT further clarifies that the "lighter living" trend is closely associated with modern lifestyle changes, particularly in travel and interior design. Essentially, it signifies more sustainable, minimalist, and eco-friendly lifestyle choices. By collating interpretations from various

sources, 'light living' is recognized as a metaphor that embodies various sustainable modern lifestyles. The report "Motivations for Lighter Living Action in BC"<sup>11</sup> it encompasses elements of minimalism, flexible living, sustainable development, and green lifestyle, among others. The emergence of the 'light living' concept reflects people's increasing focus on personal health, happiness, and emotional value. Against the backdrop of the post-pandemic era, the uncertain future and societal changes have motivated individuals to take control of their lives, experiment with new things, pay more attention to environmental protection, and shoulder greater responsibility for sustainable development. For instance, trends such as flexible remote working align with the 'light living' concept, adopting more flexible and convenient work forms. An eco-friendly lifestyle, choosing environmentally-friendly behaviors and habits in daily life, like cycling and recycling, also falls under this umbrella.



From a design perspective, based on the analysis of person-object-environment<sup>12</sup>, the 'light living' concept can be broken down into three aspects: 'lighter use' (people), 'lighter products' (objects), and 'lighter lifestyle' (environment).

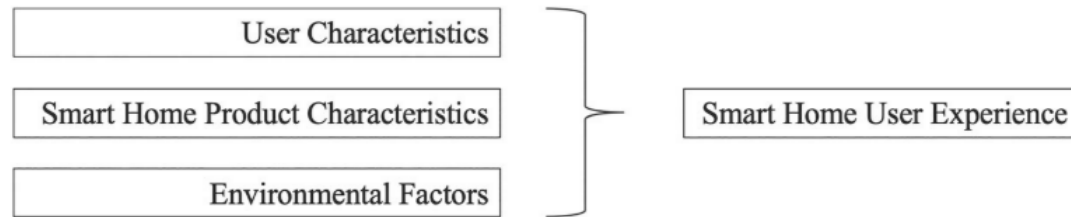


Figure 7 Factors for smart home user experience.

## 2.2 Case study relate to lighter living

A variety of products and services have emerged in the market that embodies the principles of lighter living. The following section explores five such examples, demonstrating how these innovations are enabling consumers to adopt more sustainable and minimalistic lifestyles.

### "Worn Wear"-Patagonia<sup>13</sup>



Figure 8 Factors for smart home user experience.

Patagonia, an outdoor clothing and gear brand, offers a program called "Worn Wear" that encourages consumers to trade in their used Patagonia items for store credit. These items are then cleaned, repaired, and resold, significantly extending the life of their products and promoting a circular economy. This model encourages consumers to engage in lighter living by reusing and recycling products, thereby reducing the environmental impact of the clothing industry.

### "Ergostone"-Heating Pad<sup>14</sup>

Figure 9 "Ergostone"-Heating Pad



Ergostone, a sustainable wellness product, uses soapstone, a mining by-product, to create a heating pad with unique thermal-retention properties. The pad can be heated or cooled and used as a hot or cold compress, and also doubles as a relaxation weight to help reduce stress and anxiety.

### Wall Organizer & Mess-Free Planter<sup>15</sup>

Figure 10 Wall Organizer & Mess-Free Planter



Fahredin Kosumi's Wall Organizer and Mess-Free Planter is a multi-functional organizational wall accessory that combines office organization with greenery, making it a space-saving and functional design piece for those working from home.

### "TAC"-Air Purifier<sup>16</sup>

Figure 11 "TAC"-Air Purifier



The TAC air purifier provides custom air cleaning with unique filters dedicated to specific types of allergens or pollutants, allowing users to layer filters for their unique space and needs. It is also designed to be visually appealing.

### "Table for Living"-Ikea's Concept Kitchen<sup>17</sup>

Figure 12 "Table for Living"-Ikea's Concept Kitchen



"table for living" with a smart light that observes ingredients and projects information onto the table to assist with meal preparation. The smart light can suggest ingredient combinations and turn the table surface into a burner. The table also has induction technology for charging mobile devices and keeping food warm or cool.

## 2.3 New lifestyle for Clothing care

The preceding chapter explored the continual evolution and changes in human lifestyles, particularly emphasizing "lighter living". Such a lifestyle is chiefly characterized by its pursuit of minimalism, adaptability, convenience, environmental friendliness, and sustainability. These emerging ways of living reshape relevant processes and practices in garment care.

### **Eco-Friendly**

Firstly, an increased emphasis on environmental issues among certain groups makes them prefer purchasing fewer items of higher quality. This behaviour aligns with sustainability principles as it lowers the overall demand for garment production, reducing its environmental impact (Moazzem, 2021). A preference for durable clothing can help reduce the frequency and volume of purchases, further lessening environmental stress<sup>18</sup>. This shift elevates the importance of garment care and maintenance, as these clothes must withstand the test of time and last as long as possible, echoing the previously discussed notion of extending product lifespan to reduce environmental impacts (Harris, Roby, & Dibb, 2016). However, high-quality clothes require more meticulous care methods, stimulating demand for professional garment care (Remy, 2016).

### **Flexible & Adaptability**

Secondly, the quickening pace of life has influenced garment care practices, with a growing need for flexible and adaptability. People are leaning towards owning fewer, easier-to-maintain clothes<sup>19</sup>, such as those that are easy to clean, wrinkle-resistant, and require no ironing, spurring innovation among clothing manufacturers<sup>20</sup>. However, these garments still lack social and aesthetic attributes in their design and are primarily found in intimate or formal wear (such as trousers and T-shirts). In addition, technological advancements have enabled time-saving in garment care, with products like portable washing machines and compact clothing steamers becoming increasingly popular due to their space and energy efficiency. Simultaneously, connected and intelligent products have enhanced the user experience.

### **Health & Hygiene**

Post-pandemic, the heightened focus on personal health has influenced garment care processes. Studies show that people started paying more attention to proper handwashing during and after the pandemic, reflecting an increased emphasis on personal hygiene that extends to disinfection and sterilization of clothing, incredibly intimate wear such as underwear, T-shirts, shirts, trousers, etc<sup>21</sup>.

## Well-being

The uncertainty and anxiety about the future and a decreased sense of happiness in the post-pandemic era drive people to seek more comfortable and quality lifestyles<sup>22</sup>. When choosing household appliances, people favour products that offer comprehensive features, high practicality, and additional value. Many brands and companies have started taking action to provide garment care products, which will be discussed in depth in the subsequent chapters<sup>23</sup>.

Figure 13 AIR 3-Heater



*Air3<sup>24</sup> is not just a functional electric heater, but a redefinition of the relationship between home appliances and home life. It takes the carrying basket as a prototype and is designed for bathroom use, providing heating, clothes drying, sterilization, and towel drying. Its portable design offers a safe and comfortable living environment and represents a new direction in design thinking.*

Figure 14 Panasonic Shoe Deodorizer MS-DS100



*The Panasonic Shoe Deodorizer MS-DS100<sup>26</sup> uses nanoe X ion technology to eliminate odors in shoes caused by foot sweat and bacteria. The device generates hydroxyl radicals and diffuses them from six outlets to remove odors from the entire interior of the shoe.*

Figure 15 Samsung-Less Microfiber Filter



*Samsung has launched the Less Microfiber Filter<sup>25</sup>, which promises to capture up to 98% of microplastics to prevent them from entering wastewater. The filter can be installed on top of any standard washing machine and only needs to be cleaned once a month. This is an important first step in addressing the microplastics issue and a significant move by a major home appliance manufacturer to acknowledge and address the problem.*



# 03

## RESEARCH OF GARMENT CARE AND BRAND STUDING

Living lighter entails being happy and healthy every day, in ways that enable everyone to prosper equitably while staying within sustainable ecological bound

### 3.1 The History of Garment care system development and Future Trend

Firstly, garment care represents a broad concept, encompassing a variety of elements. Garment care can be categorized into two notions depending on its range of application, namely, broad and narrow senses. Considering from the perspective of a garment's lifecycle, garment care in its broader sense includes all actions from the point a user purchases a garment until it is finally recycled, discarded, or sold. This comprises wearing, cleaning and drying, organizing, storing, and maintaining (Vezzoli, 1998). However, in the narrower sense, garment care primarily focuses on garment preservation, maintenance, and storage.

As for the broader sense of garment care, it has a long history. Ever since humans began to wear clothes, methods such as handwashing with clean water and air drying have been used for garment care (Hughes-Riley, 2018). With the advent of the industrial revolution and the progress of human civilization, humans have started to design products with advanced technology to handle various household chores (Hughes-Riley, 2018). Subsequently, the paper will discuss the washing machine, dryer, electric iron, and steam iron, in chronological order of their development.

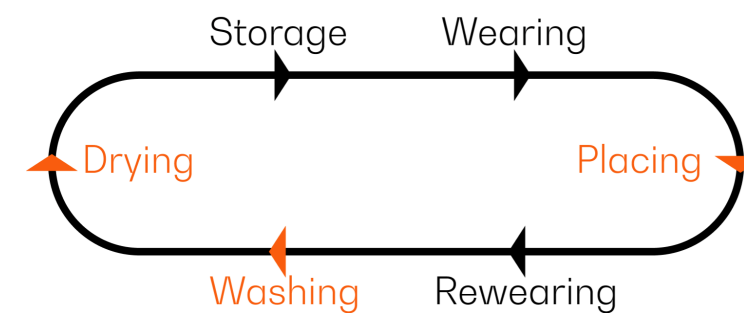


Figure 16 Garment care system

## WASHING SATGE

The history of washing machines dates back to 1910 when the invention of the electric washing machine in the United States replaced manual labor with electric power. Enhancements followed with the incorporation of timers and controllers<sup>27</sup>. By the 1950s, washing machines emerged that unified washing, spinning, and drying, thereby integrating all stages of garment cleaning.

The advancement of technology in the contemporary era facilitated the automation and intellectualization of washing machines. This technology enabled full automation of all washing processes and catered to various clothing types via preset programs. With the dawn of the 21st century and the proliferation of the internet, the development of the Internet of Things (IoT), and miniaturization of technologies, washing machines became more comprehensive and intelligent.

This comprehensiveness manifests in several ways:

1. Adapting to various types of clothing and washing requirements, with all-in-one washer-dryers executing all cleaning steps;
2. Focusing on ecological preservation, modern washing machines drastically reduce energy consumption, elevate cleaning efficiency, and curtail the use of chemical detergents and water;
3. Implementing further specialized features, such as noise and vibration control, sterilization, pet care washing, automatic door opening, etc., aimed at optimizing washing machine products and satisfying user needs.

Intelligence is evident in the enhancement of user

Wash Machine



interaction and experience. The utilization of IoT, smart chips, and AI analysis optimizes user experience by minimizing operational steps and aligning with contemporary lifestyle trends.



## DRYING SATGE

The clothing dryer, a device explicitly engineered for clothing drying, was developed in response to diverse and fluctuating climatic conditions worldwide and to fulfill the need for rapid drying. Typically, the drying procedure commences immediately following the washing process. It is noteworthy that standalone dryers, specifically designed for garment drying, were introduced much later than washing machines. They initially formed part of washer-dryer units, with independent drying products appearing subsequently. As such, standalone dryers often mirror the design and appearance of washing machines.

With the proliferation of home appliances in developing countries, the market has seen the emergence of affordable, compact, vertical drying racks. These convenient, economical products have further evolved into collapsible dryers, which are suitable for travel, space-efficient, and offer flexible usage.

Modern dryers primarily utilize three drying technologies:

1. Air-cooling drying systems, typically employing PET heaters in their heating modules;
2. Water-cooling drying systems, characterized by their use of cooling water during the drying process;
3. Heat pump drying systems, a comparatively mature solution in the market. Regardless of the employed system, the fundamental principle of a dryer involves drying clothes by heating air.

In future developments, cabinet dryers are expected

### Clothing Dryer

to gravitate towards more eco-friendly, efficient, and energy-saving designs, enhancing intelligent functionalities, much like their washing machine counterparts, to enrich user experience.



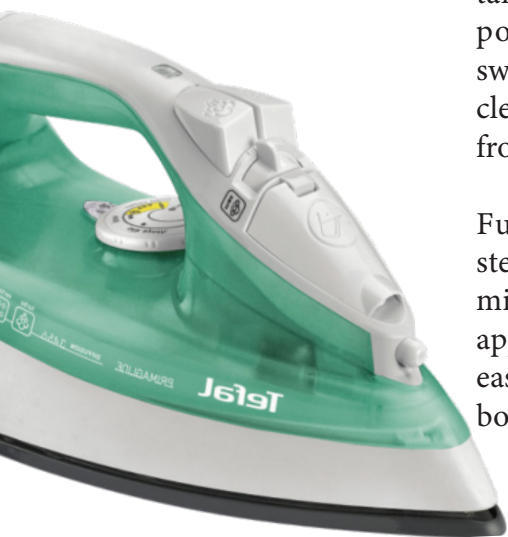
## CARING SATGE

Electric irons and garment steamers, first introduced at the close of the 20th century, were primarily aimed at maintaining garments and restoring their pristine state. Post-drying, these devices deploy high-temperature steam to diminish clothing wrinkles, thus rendering the attire more presentable and sophisticated, aligning with the social needs of consumers.

In 1924, the United States witnessed the advent of practical electric irons, and steam electric irons were invented two years later, in 1926. From this point forward, steam electric irons dominated the market. Vertical steam irons, introduced mid-20th century, demonstrated superior ironing results across diverse fabrics, such as wool, cotton, silk, linen, and cloth. Initially, these devices found primary usage among upscale clothing stores and affluent households.

As technology progressed, electric irons and garment steamers have adopted increasingly comprehensive functions for garment care. However, their principal objective of wrinkle removal remains, with user involvement necessary throughout operation. Presently, both devices come equipped with smart chips enabling tailored care for different types of clothing, optimizing power, enhancing efficiency, and completing tasks swiftly. Additional features encompass disinfection, self-cleaning, noise reduction, vertical ironing, scale removal from water tanks, and wireless ironing.

Future trajectories for electric irons and garment steamers suggest a movement towards portability and miniaturization. For instance, handheld versions of these appliances are now available. These lightweight devices, easy to store without the necessity for additional ironing boards, are especially suited for travel.



### Irons And Garment Steamers





### 3.2 Literature research about clothes & clothes care

With the continuous advancement of washing and drying technology, washing machines and all-in-one washer-dryers have become indispensable household appliances. The cleaning and drying of clothes have been fully automated and intelligently operated.

However, most stages of garment care still require manual intervention, and this stage significantly affects the wear and lifespan of the clothing. Over the past decade, as society has progressed and living standards have risen, there has been an increase in the diversity of daily activities and social interactions. The advancement in productivity gave rise to the concept of "fast fashion." Driven by internet social media, consumers place greater emphasis on fashion trends (Joy, 2012). Compared to the beginning of the century, the number of garments people purchase has increased (Moazzem, 2021), raising the question of how to manage and care for a vast amount of clothing.

Consequently, the consumer demand for appliances shifted from "cleaning clothes" to "caring for clothes." There are many challenges in garment care, such as potential fabric damage from manual ironing and the inconvenience of sending clothes to dry cleaners.

Some renowned companies have recognized this trend, like Toshiba, which launched the LG Styler in 2012<sup>28</sup>—a household appliance dedicated to garment care and distinct from traditional irons and steamers. The LG Styler offers four main features: wrinkle removal, drying,

sterilization, and odour removal. Consumers hang the garment inside and select the desired program when in use. Following this, competitive products like Samsung's AirDresser and Rowenta's Care For You were introduced. These products primarily use steam and external force on the garments to achieve the desired effects. High-temperature steam can "soften" the clothing fibres, while external forces, achieved through vibration and airflow,



Figure 17 LG Styler

Concurrently, an increasing array of products is being introduced to address the specific needs of garment care, ranging from sterilization and disinfection, portable garment care, odor removal and deodorization, to comprehensive care systems akin to the LG Styler. The emergence of these diverse product categories caters to varying consumer demands. Collecting and synthesizing the distinct features of the above products gives insights regarding future trends and design directions in garment care. The following section will analyze various garment care products available in the current market.

### **Clothes and Fibers**

In clothing care, the garment stands paramount, representing one of daily life's most frequently consumed and utilized items. Throughout human history, garments have played a significant role in societal development and serve as symbols bridging material and culture civilizations. With a history spanning several millennia, the evolution of clothing has transitioned from merely fulfilling basic survival needs to becoming an indispensable element in societies. Early humans used leaves and branches for protection, eventually turning to animal hides. The subsequent introduction of plant fibers led to the creation of insulating and protective fabrics, such as cotton, linen, and silk (Sanders, Grunden, & Dunn, 2021). Following the industrial revolution, the adoption of new materials revolutionized fabric and clothing advancements. Synthetic fibers entered the public purview in the 19th century, with the first semi-synthetic fiber invented in the same era. The emergence and application of synthetic fibers, advancements in

dyeing techniques, and the large-scale industrialization of textile technologies collectively enhanced garment production efficiency, reducing clothing costs (Morgan, 1981). This affordability transformed fashion from a luxury exclusive to the elite into a commodity accessible to many. Synthetic fibers introduced revolutionary shifts in the textile industry from their inception. By 2021, polyester commanded a 54% share in global fiber production, solidifying its position as the most widely produced fiber<sup>29</sup>. Meanwhile, cotton's market share decreased from 27% in 2019/20 to 24% in 2020/21<sup>30</sup>. In 2021, global wool fiber production stabilized at around one million tons, accounting for approximately 3% of the market<sup>31</sup>.

Global fiber production (kilograms per person)<sup>2</sup>

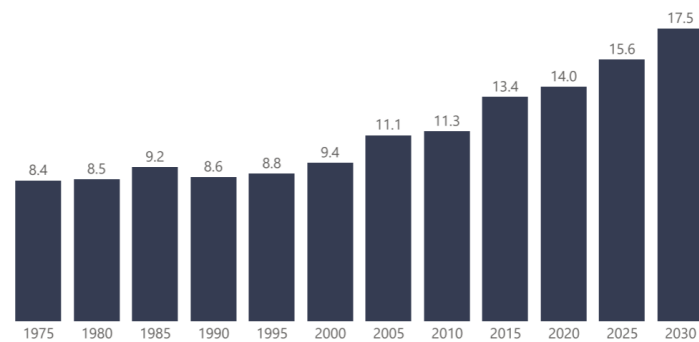


Figure 18 Textile Exchange based on UN data and global data compilations, from Sanders, D., Grunden, A., & Dunn, R. R. (2021). A review of clothing microbiology: The history of clothing and the role of microbes in textiles.

Global fiber production (million tonnes)<sup>1</sup>

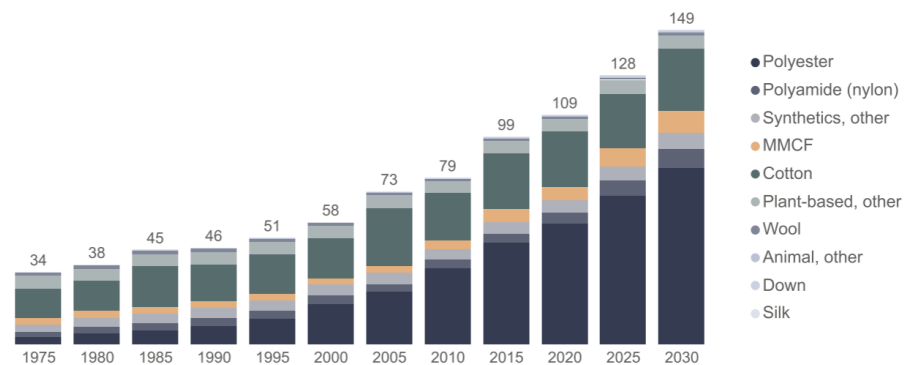


Figure 19 Textile Exchange based on data from ICAC, FAO, IWTO, Mohair South Africa, inserco, CIRFS, IVC, Maia Research, and its own modelling

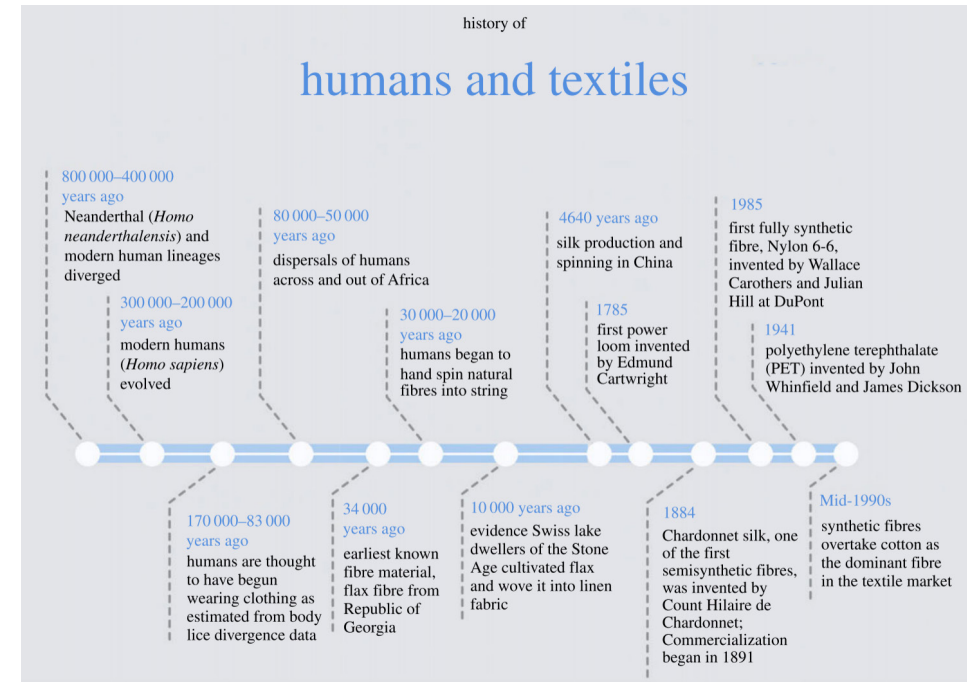


Figure 20 A brief timeline of the evolution of textiles throughout human history. from <https://textileexchange.org/knowledge-center/reports/preferred-fiber-and-materials/>

### Material Attributes and Functions of Clothing:

Clothing primarily shields the wearer from direct contact with the natural environment, thereby minimizing skin irritation and harm<sup>32</sup>.

#### 1. Physical protection:

Garments defend against potential damages from environmental factors like sunlight, rain, wind, and snow—offering insulation in the cold and protection against direct ultraviolet radiation. Additionally, they mitigate mechanical impacts, such as scratches or abrasions.

#### 2. Chemical protection:

Specific attire prevents exposure to chemicals, acids, and other hazardous substances.

### **3. Biological protection:**

Garments protect wearers from harmful organisms or pollutants, exemplified in healthcare environments, and reduce insect bites.

Presently, the most representative products of clothing's material functions are concentrated in specialized protective attire and specific applications, including medical protective clothing, diving suits, swimwear, military uniforms, and space suits. These garments, through their unique materials and craftsmanship, cater to the diverse requirements of individuals across varied environments.

## **Socio-cultural Attributes and Functions of Clothing:**

Beyond mere material functions, clothing in human societies, as it evolves, increasingly assumes significant social and cultural roles.

### **1. Privacy:**

In numerous cultures and religions, garments cover body parts deemed private.

### **2. Identity:**

Attire can signal an individual's profession, cultural background, religious beliefs, or social status. For instance, uniforms immediately identify someone as a

particular profession or organization member.

### **3. Fashion and self-expression:**

Through attire, individuals can convey personal style, preferences, or even moods.

### **4. Social norms and cultural customs:**

Different societies or communities may perceive appropriate or attractive clothing differently.

### **5. Psychological and emotional well-being:**

Wearing certain types of clothing can impact an individual's confidence, self-esteem, and overall mood.

Within the socio-cultural dimensions, clothing acts predominantly as a tangible representation of societal and cultural norms (Entwistle, 2023). Individuals select attire to align with and fulfill diverse socio-cultural purposes. For instance, formal events necessitate the wearing of formal attire, office settings typically require business suits, and weddings involve bridal gowns. Leisure activities allow wearers to exhibit their individuality through clothing choices.

With economic and societal advancements leading to elevated production capacities, individuals possess more wealth. Viewing from Maslow's hierarchy of needs, consumers' choice in clothing has evolved (Wahba, & Bridwell, 1976). Initially, the emphasis was primarily on basic functionalities and features like quality, fit, comfort, and warmth. Now, the focus encompasses clothing style, aesthetics, material, color, brand alignment, and whether attire can cater to emotional



and psychological satisfactions, like expressing individuality. Ultimately, clothing's potential to deliver social value, such as enhancing self-confidence and taste in social settings, becomes paramount.

Consequently, the socio-cultural roles clothing embodies have significantly propelled the growth of fast fashion and consumer spending. The desire to acquire and own various attire styles meets societal expectations and standards. Although clothing ownership is rising, garments inevitably experience wear and tear during usage. Therefore, maintaining them to restore their original function and appearance is essential, such as mending tears or scratches, odor removal, wrinkle reduction, and providing specialized care for unique fabrics(Fletcher, 2012). This underscores the growing need for professional garment care, elucidating the expanding market for garment care services.

**In Summary:**

By analyzing the relationship between clothing, fabric, and the evolution of garment care appliances, connections between consumer needs and garment care products and services become evident. Modern society witnesses increased garment retention, reflecting the shift in people's perceptions of clothing value and attributes. Consumers prioritize garment care and usage. The variety of fabric types, styles, and colors in fashion design and manufacturing has notably intensified the challenges associated with garment maintenance and use.

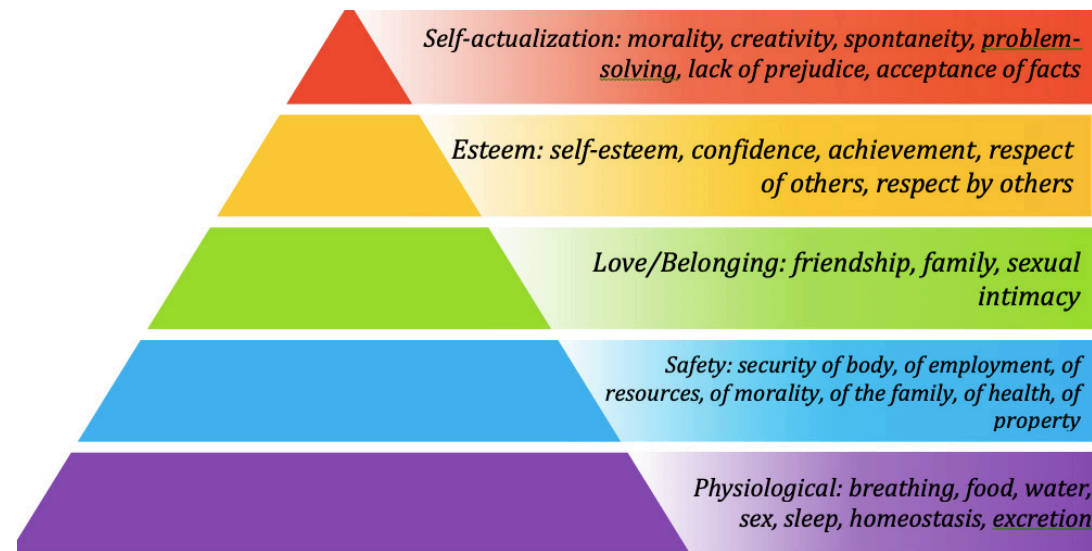


Figure 21 Maslow's hierarchy of needs

### 3.3 Clothes Care market research and analyze

A comprehensive collection and organization of these products were undertaken to gain deeper insights into existing garment care products on the market and guide product design and research. To entail analyzing brands, functions, technologies, features, strengths, and weaknesses. Product positioning was conceptualized using frameworks like the Blue Ocean and Red Ocean strategies and SWOT analysis.

#### 3.3.1 Case study of Competitors' product



Product dimensions: 445 x 1850 x 585mm  
Clothing capacity: 3 jackets + 1 pants

#### LG-Styler

Function: Swinging dust removal, steam sterilization, dehumidification and drying, intelligent care, reducing clothing damage

The LG Styler, a cutting-edge garment care system, utilizes steam technology to mitigate wrinkles, odors, and bacteria, maintaining clothing in optimal condition. This system, designed with an elegant wardrobe-like exterior, provides storage for garments and offers diverse drying options and a dynamic hanger feature, ensuring gentle treatment of attire. It encompasses an array of cycles tailored for various fabric types,

including refresh, sanitize, gentle dry, and unique care modes. A distinct Moving Hanger Action is incorporated, which agitates the garments during the cycle, amplifying the steam effect and diminishing wrinkles. Moreover, the LG Styler is equipped with an Aroma Kit, allowing for the infusion of pleasant fragrances into garments.



Product dimensions: 445 x 1850 x 632mm  
Clothing Capacity: 3 jackets + 3 pants.

## Samsung-AirDresser

Function & Feature: Swinging dust removal, steam sterilization, dehumidification and drying, intelligent care, reducing clothing damage.

The Samsung Airdresser is an intelligent clothes care machine that uses Jet Steam technology to release potent steam jets onto fabrics. This process effectively eliminates viruses, bacteria, and odors, making it an innovative appliance that refreshes and disinfects clothes without washing. With its deodorizing filter, heat pump drying system, and dust filter, the Samsung Airdresser is a convenient and effective clothing care system. It offers up to 24 cycles for different fabrics,

including wool, linen, down, and delicate items. Users can select the cycle that best suits their needs: a 20-minute quick refresh or thorough steam disinfection. In addition to its functionality, the Samsung Airdresser also boasts a stylish and sleek design that blends seamlessly with any home decor. It comes in various colors and finishes, such as gold mirror, white glass, and brown glass, and has a spacious interior that can accommodate up to six pieces of clothing at once.



Product Size: 800 x 324 x 925mm  
Clothing Capacity: 3 clothing

## Rowenta-Care For You

Function & Feature: Swinging dust removal, steam sterilization, dehumidification and drying, intelligent care, reducing clothing damage.

The Rowenta Care For You is an automated ironing system that employs steam for effective wrinkle removal, sanitization, and garment drying. This system offers a streamlined solution for daily garment care. This appliance is equipped with an intelligent sensor that discerns fabric type and quantity, calibrating the steam emission accordingly. It can process up to three garments within 10 minutes, optimizing time

and energy usage. Additionally, it revitalizes and deodorizes garments, neutralizing odors and bacteria. Designed for versatility, the Rowenta Care For You is compatible with a broad range of fabrics, encompassing delicate materials like silk and wool and children's toys and cushions. The mild drying mechanism curtails potential fabric damage or shrinkage. A detachable water reservoir simplifies both refilling and maintenance.



Product dimensions: 1300 x 406x 762mm  
Clothing Capacity: 2 clothes.

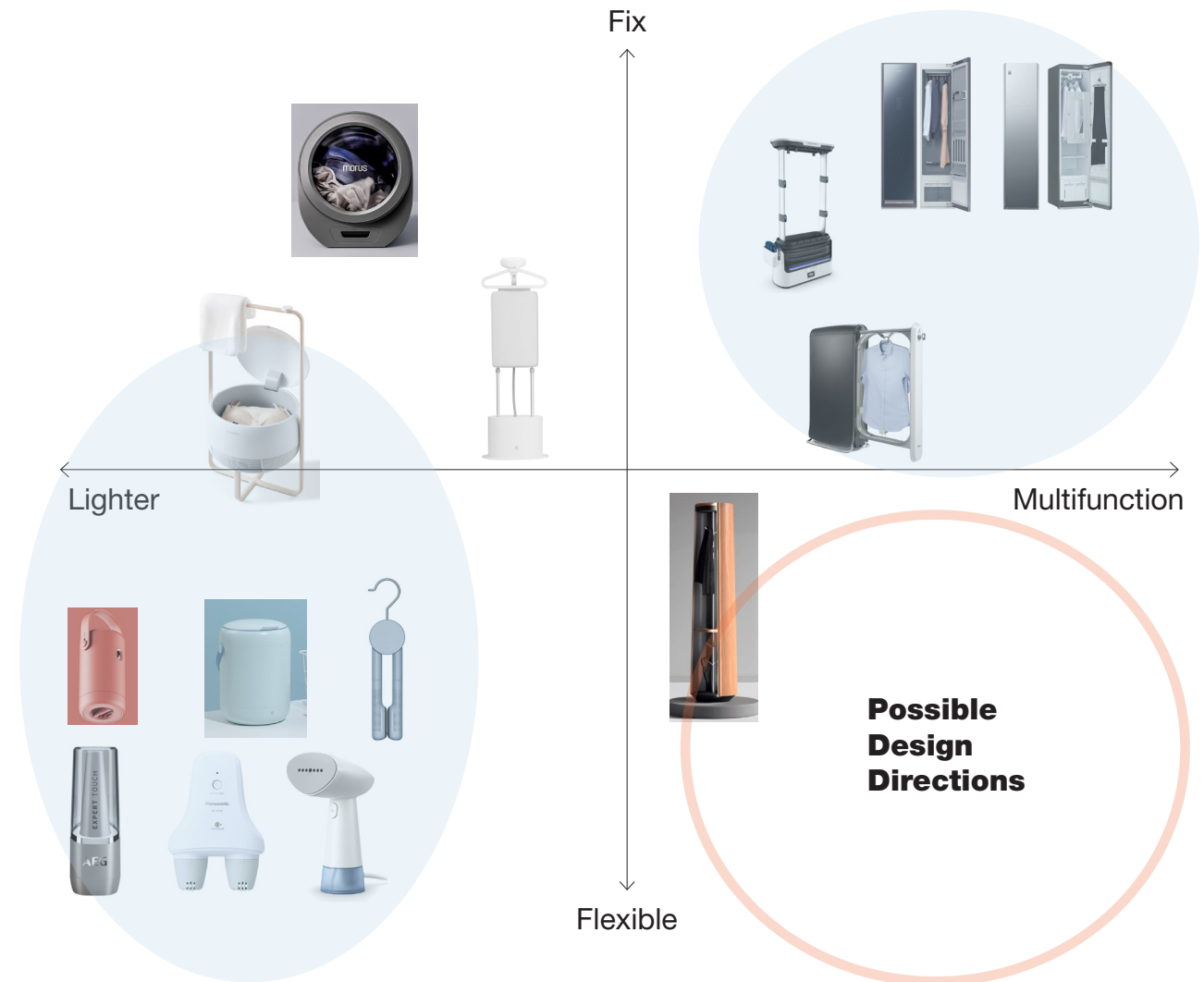
## Whirlpool-Swash

Function: De-wrinkle, Neutralizes odors and leaves clothes smelling clean, Extends the life of garments, Restores the fit of clothes that's lost after wear.

Whirlpool's Swash is a groundbreaking appliance that redefines the concept of laundry and clothing care. It is not quite a washing machine, nor a dry cleaner; instead, Swash sits in a unique category of its own. This compact device is designed to refresh, de-wrinkle, and restore clothes in as little as 10 minutes, extending their life and reducing the need for frequent washes. Swash's proprietary design uses a combination of heat and a specialized solution to

rejuvenate fabrics, ensuring your clothes maintain their shape, feel, and color. Its slim profile allows it to fit seamlessly into any living space, making it perfect for urban dwellers or those seeking a quick freshening up of garments. While it won't replace the need for a full wash or dry cleaning, Swash offers a convenient and eco-friendly solution for those in-between moments, saving time, energy, and reducing wear and tear on your favorite clothes.

## 3.3.2 Market Researches



Through analysis of the various types of clothing care products and their positioning in the market, we have found that the existing clothing care products mainly fall into two categories: flexible-single function and fixed-multi function, with a lack of products in the flexible-multi function quadrant. This direction may be the future product positioning for our design project.

### **3.3.3 Technology Principles and case study**

A comprehensive study of existing clothing care products found that their primary functions include ironing wrinkles, disinfection and sterilization, drying clothes, and odor removal. The intelligent clothing care machine integrates these functions, offering a systematic solution. A deeper understanding of this intelligent clothing care machine will facilitate a more comprehensive grasp of the steps and principles of clothing care, thus guiding design (Park, Lee, & Kim, 2023). The operation of this care machine typically divides into three stages: steam shaping, low-temperature drying, and odor removal and sterilization<sup>33</sup>. Different materials require different care temperatures and time settings. The following elaborates on these steps:

#### **1.1 Steam Shaping Stage:**

An electrode-type steam generator produces high-temperature steam<sup>34</sup>, which thoroughly mixes with the air inside the chamber, controlling the chamber's temperature between 50°-58° (Liang, 2016). This achieves contactless automatic ironing, wrinkle management, and auto-shaping effects. The steam evenly wraps around the clothes, penetrating the fabric fibers, removing odors, and restoring the clothing to its original state. The entire process is fully automated, and the system adjusts the shaping time based on the type of clothing. Moreover, mid-temperature steam has sterilization and clothing-cleaning effects.

#### **1.2 Low-temperature Drying Stage:**

During this stage, the steam generator is turned off, and the heat pump condensation system initiates, performing gentle drying at 45°-60°. A fan mixes the air in the chamber, and through the heat pump condensation system, water vapor is transformed into droplets and collected in the condensation tank. This condensation drying method is both quick and effective in removing odors.

#### **1.3 Odor Removal and Sterilization Stage:**

The machine activates the ultraviolet sterilization system after the clothes are dried. Ultraviolet rays have efficient sterilization and decomposition capabilities. During operation, it also produces trace amounts of ozone, which further aids in sterilization and odor removal. After a series of treatments, most harmful bacteria and microbes can be effectively eliminated. Additionally, the machine has a built-in aroma box that ensures a lasting fragrance on the clothes.

### **Case Study on the Technology Principles of Clothing Care Products: LG Styler**

The LG Styler<sup>35</sup> is a clothing care product that uses advanced technology to refresh and sanitize clothing items. The product uses steam and heat to remove

wrinkles, odors, and allergens from clothes, without the need for washing or dry cleaning<sup>36</sup>.

The technology behind the LG Styler is based on the principle of steam cleaning<sup>37</sup>. Steam is a powerful cleaning agent that can penetrate deep into the fabric fibers, loosening dirt and bacteria. The LG Styler uses a highly specialized steam generator that produces steam at high pressure and high temperature, ensuring effective cleaning and sanitization.

In addition to steam cleaning, the LG Styler also uses heat to dry and dehumidify clothes. The product is equipped with a heat pump that circulates warm air within the cabinet, ensuring that clothes are dried quickly and efficiently. The heat pump also removes excess moisture from the air, helping to prevent mold and mildew growth, which further aids in sterilization and odor removal. After a series of treatments, most harmful bacteria and microbes can be effectively eliminated. Additionally, the machine has a built-in aroma box that ensures a lasting fragrance on the

**Step-01: Important precaution**

Fabric care labels that can be used with the			
Category	Label	Meaning	Styler
Drying labels		Normal	○
		Permanent press / Wrinkle resistant	○
		Gentle / Delicate	○
		Do not tumble dry	○
		Do not dry	✗
		Line / Hang dry	○
		Drip dry	○
		Dry flat	○

Figure 22 LG Styler Usage Process- Important Precaution

The initial step involves examining the care labels on garments to determine their compatibility with subsequent care procedures. This step is crucial, as improper care can damage the clothing, and different garments have distinct care requirements. However, this step requires manual identification and has yet to integrate technology to enhance user experience.

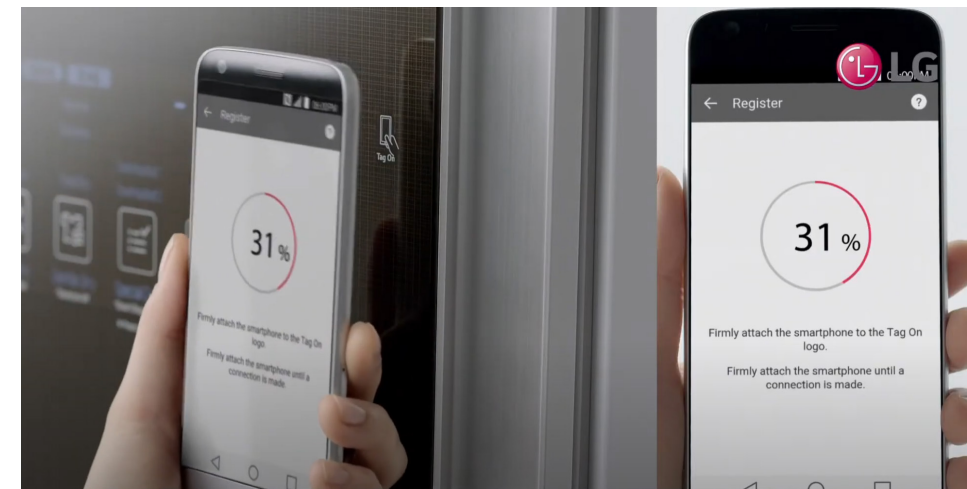


Figure 23 LG Styler Usage Process-NFC

The subsequent step involves selecting the appropriate care mode. Using NFC technology on smartphones, an application establishes a connection with the product. Depending on the type of clothing and season, users select the appropriate care mode on the app and can remotely control the garment care machine. This step utilizes the Internet of Things (IoT) and NFC technologies<sup>39</sup>. IoT refers to a network of interconnected objects, from industrial machines to wearable devices, that collect data via embedded sensors and act upon this data. NFC is a short-range, high-frequency wireless communication technology that allows for touchless point-to-point data transfer between electronic devices.



Figure 24 LG Styler Usage Process-Function selection

The final step is the "Refresh" process: checking the tank's water level and ensuring the fragrances are added to the aroma box. Once the garments are arranged inside the machine, the "Refresh" function is selected. Leveraging LG's proprietary TrueSteam technology, the machine provides steam care to remove wrinkles and disinfect, followed by a low-temperature drying phase using a heat pump. TrueSteam stands out as a vital technology, meeting requirements for wrinkle removal, disinfection, and odor reduction. In LG's design, a steam generator heats water to 100°C, hot enough to eliminate 99.9% of allergens and residues left by dead allergens. Steam can mitigate or eliminate smoke, sweat, and food odors adhering to fabrics and knits. Odor-reducing technology relies on fragrances dispersed throughout the garment by steam. Lastly, the low-temperature drying technology dries garments with 45-60 warm air, minimizing damage.

### 3.4 Technology Research about Clothes Care

Analyzing current and potential future technologies applicable to garment care processes is essential. Understanding the principles behind these technologies and how they achieve their functions is crucial. Utilizing advanced technologies can enhance the user experience and improve garment care efficacy.



### 3.4.1 **Wrinkle Removal Technology**

Traditionally, the removal of wrinkles from clothing was achieved through steam ironing, where the combined effects of high-temperature steam and the pressing force applied to the garment ensured the desired outcome.

To understand how to remove wrinkles from clothes, we need to understand the principle behind it, the development of wrinkles in clothing arises from the disturbance and misalignment of fabric fibers<sup>40</sup>. To restore these fibers to their original state, techniques often employ heat, moisture, pressure, or a combination of these elements (Yuexin, 2020). The following elucidates these techniques:

**Heat:**

Applying heat to fabric softens its fibers, facilitating their return to their original alignment. Conventional irons utilize a heated plate to directly relax and realign fibers, while steam irons, merging heat and moisture, offer enhanced wrinkle removal.

**Moisture:**

Moisture aids in relaxing fibers. A damp fabric is more amenable to reshaping, thereby easing wrinkle removal.

**Pressure:**

Exerting pressure assists in realigning the fabric fibers. Ironing not only introduces heat but also applies pressure to smoothen wrinkles. Some delicate fabrics might benefit from pressing between two surfaces, as in the case of a fabric press.

**Chemical Relaxation:**

Commercially available products, such as fabric relaxers and wrinkle releasers, contain chemicals that facilitate fiber relaxation.

**Tension:**

Suspended garments, post-washing or drying, can leverage gravity to minimize wrinkles.

**Fabric Composition:**

Different fabrics possess distinct wrinkle susceptibilities and removal responses. While natural fibers like cotton are prone to wrinkles, they can be easily smoothed out with ironing. In contrast, synthetic fibers, such as polyester, resist wrinkling but risk damage under excessive heat.

High-temperature steam can "soften" fabric fibers; hence, intelligent garment care machines continue to employ a combination of "thermal energy and external force" for wrinkle removal. Thermal energy derives from the collaborative efforts of the water circulation and heating systems. This heating system transforms liquid water into steam, distributed within the garment care machine chamber to soften the fabric fibers. Commonly used heating mechanisms include physical and chemical methods. Physical heating encompasses techniques such as electric, solar, and combustion heating. Due to the lack of stability and safety concerns associated with chemical heating when applied to household appliances, physical heating methods are preferred. As utilized in garment care machines, the modern vertical ironing system involves the simultaneous effects of heat, moisture, and the garment's weight (or added weight). This process results in the deformation of the garment's surface when suspended vertically. The

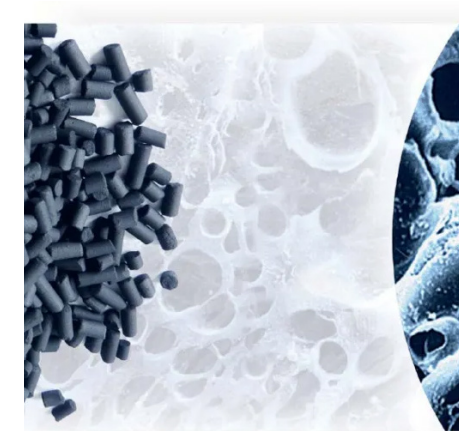


heat carried by the steam produced by the generator, when transferred to the fabric surface, affects the fibers internally. This thermal action alters the thermodynamic state of the fabric, causing fiber deformation and achieving the ironing effect.

### 3.4.2 **Odor Removal Technology**

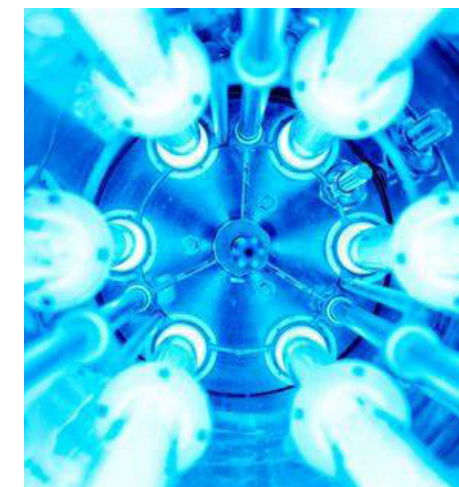
Odors permeate everyday experiences. Molecules from odoriferous sources disperse, with some entering the nasal cavity to stimulate olfactory cells, subsequently leading to olfactory perception. Studies have established a direct connection between the olfactory system and the ancient limbic system in the brain, the latter being associated with emotions(Sharma, 2019). The relationship between olfaction and emotion is significant, with scents purportedly influencing approximately 75% of emotional responses<sup>41</sup>. It is posited that scents hold a pivotal place in emotional memory. In 2013, a scientific consensus highlighted ten essential dimensions of olfaction(Castro, Ramanathan, & Chennubhotla, 2013). Notably, certain odors, especially offensive ones, evoke strong aversions. Following the pandemic, there has been an amplified focus on health and hygiene, prompting closer examination of odors associated with daily products. The primary sources of malodors include body and environmental emissions. Efforts to mitigate

these malodors in clothing led to the identification of several techniques, as detailed in literature reviews. For garments, the main deodorization strategies comprise adsorption, chemical and biological degradation, and odor masking(Wang, 2020). The subsequent section delves into these techniques.



#### **Activated Carbon Adsorption**

Activated carbon is a widely used deodorizing material. This porous substance has a large specific surface area, strong adsorption and catalytic properties<sup>42</sup>. Its acid, alkali, heat resistance, and easy regeneration make it widely used, and its high safety further increases its attractiveness. Activated carbon is not only effective in controlling indoor formaldehyde pollution, but also has adsorption effects on various pollutants such as formaldehyde, benzene, TVOC, and can also absorb odors and moisture(Brasquet, & Le Cloirec, 1997).



#### **UV Light**

Ultraviolet (UV) disinfection technology effectively neutralizes bacteria and viruses (Ma, 2023). This method involves irradiating the surface of target objects with UV light, leading to the deactivation of bacteria and viruses and ensuring disinfection. This technique is commonly adopted in hospitals, laboratories, and food processing facilities<sup>43</sup>. The market also offers a variety of household UV disinfection devices, including UV disinfection cases for smartphones and domestic air purifiers.

### Aroma

Aromatherapy is a common method for deodorizing. It is a method of improving air quality by volatilizing aromatic substances. It can eliminate odors and improve air quality by using essential oils or other aromatic substances<sup>44</sup>.



### Heat Steam Deodorization

High-temperature steam sterilization represents an efficacious method for eradicating microbes<sup>45</sup>. Compared to other techniques, a distinct advantage of steam sterilization is eliminating the need for chemicals or other disinfectants, rendering it an environmentally safe approach. Steam sterilization also offers versatility in sterilizing various items, from medical and laboratory equipment to other general articles. This method can eradicate many microbes, including bacteria, viruses, and fungi. However, one limitation is its potential to damage certain materials, such as plastics and other thermally sensitive substances.



### 3.4.3 Sterilization Technology

Given that traditional disinfection methods are insufficient to meet product safety, utility, and convenience demands, it becomes imperative to develop secure and efficient disinfection practices and their related products. Such innovations enhance individuals' lifestyles and elevate health awareness and deliver a more intelligent, healthier, and safer living experience. Extensive literature analysis revealed prevailing disinfection methodologies. Compared to traditional methods, modern disinfection technologies possess significant developmental potential, leaning towards efficiency, intelligence, sustainability, and health. In textiles, primary disinfection techniques comprise high-temperature steam disinfection, ozone disinfection, ultraviolet light disinfection, pasteurization, and negative ion sterilization.

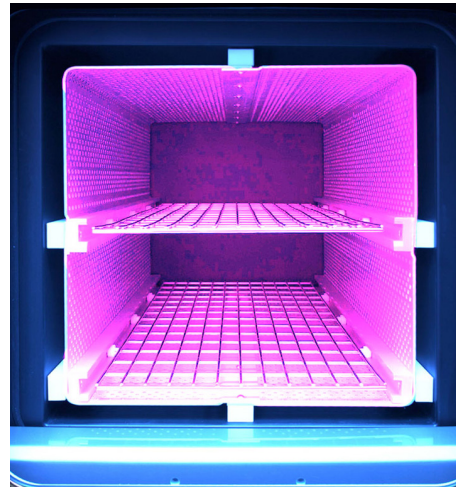
### UV LIGHT



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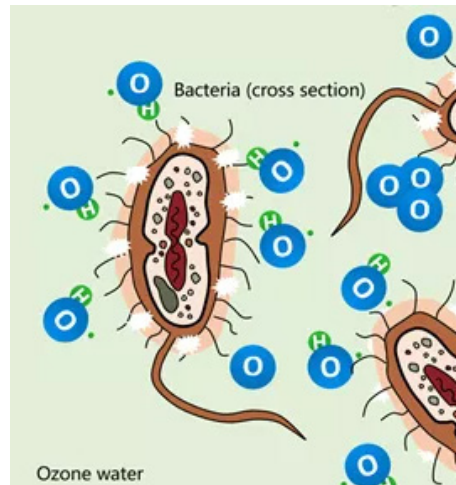
### Plasma

Plasma sterilization is a type of sterilization that uses ionized gas to kill microorganisms. It has been recognized as an effective method for sterilization and disinfection. Plasma sterilization can be used in three ways: 1. plasma is directly generated at the site of application, 2. plasma is generated at a remote site and transferred to the target site, and 3. plasma-treated solutions are used for disinfection. For example, there are plasma air purifiers that can be used to purify the air in your home.



### Ozone

Ozone disinfection is a method of disinfection that uses ozone gas to kill microorganisms. Ozone disinfection can be used in many applications, such as water treatment, air purification, and surface disinfection. There are many home-use products that use ozone disinfection technology. For example, there are ozone air purifiers that can be used to purify the air in your home. There are also ozone generators that can be used to disinfect surfaces and other items.



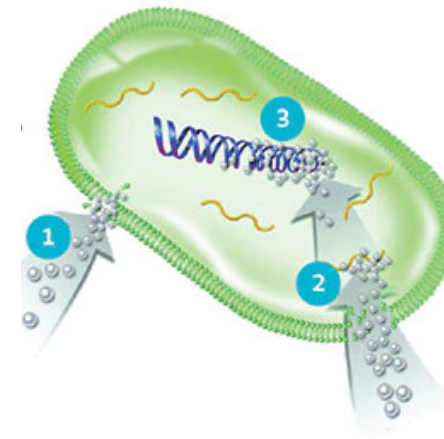
### High-temperature steam

High-temperature steam sterilization represents an efficacious method for eradicating microbes. Compared to other techniques, a distinct advantage of steam sterilization is eliminating the need for chemicals or other disinfectants, rendering it an environmentally safe approach. Steam sterilization also offers versatility in sterilizing various items, from medical and laboratory equipment to other general articles. This method can eradicate many microbes, including bacteria, viruses, and fungi. However, one limitation is its potential to damage certain materials, such as plastics and other thermally sensitive substances.



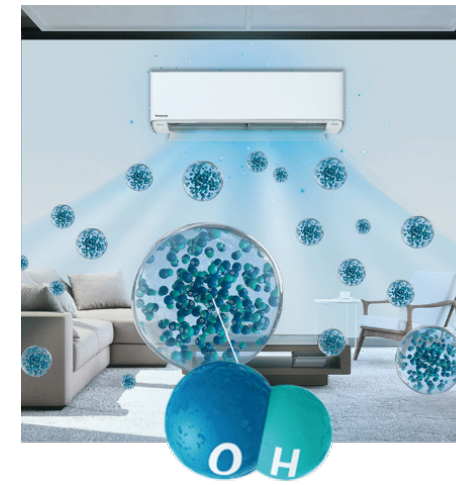
### Silver Ion Sterilization

Silver ion sterilization is a method that employs silver ions to eradicate microbes. Renowned for their antibacterial properties, silver ions can eliminate various microbes, encompassing bacteria, viruses, and fungi. Numerous household products incorporate silver ion sterilization technology. For instance, silver ion water filters serve to purify domestic water, and silver ion air purifiers aim at cleansing indoor air.



### Negative Ion Disinfection

Negative ion disinfection is an auxiliary sterilization method that has some disinfection effect but is not pure. Negative ions can purify the disinfection cabinet, remove odors, and clean the air. The principle of negative ion disinfection is to adsorb various viruses and bacteria, change their structure or transfer energy, and activate oxygen molecules in the air, so negative ions are formed. Daily household products that use negative ion disinfection include air purifiers, humidifiers.



### 3.5 Study Of Delonghi Group & Delonghi

The project involves collaboration with the DeLonghi brand. DeLonghi stands as a renowned multinational home appliance brand with a storied history. To align with DeLonghi's brand values and product strategy while comprehensively meeting brand needs<sup>46</sup>, a thorough analysis of DeLonghi's cultural context, product positioning, strategy, design ethos, and target audience is imperative (Norman, 2004). Based on this in-depth analysis, clothing care products that resonate with DeLonghi's unique characteristics and culture have been developed, ensuring they embody the brand's core ethos and foster a close connection with the target consumers.

Figure 25 Delonghi Group Portfolio | De' Longhi Group—Corporate Website. (n.d.). Retrieved September 9, 2023, from <https://www.delonghigroup.com/en/brand/portfolio>



#### Introducing Delonghi Group:

The DeLonghi Group, a multinational conglomerate headquartered in Treviso, Italy, was established in 1902. Operating in over 120 global markets, the group boasts a diverse portfolio of brands, including DeLonghi from Italy, Kenwood from the UK, and Braun's household appliances. Spanning a range of sectors, the group's products encompass coffee machines, kitchen appliances, heating devices, air conditioning/air purification, and cleaning/ironing. The group employs over 10,000 individuals<sup>47</sup>. Originating as a small industrial parts manufacturing workshop, the DeLonghi family business was founded in 1950. By 1955, the company had transitioned into producing heating elements. Following the establishment and expansion of its own household

appliance brand, the group strategically acquired brands like Kenwood from the UK and Braun from Germany, consolidating its status as a multinational entity.

#### Brief Development History of Delonghi Products

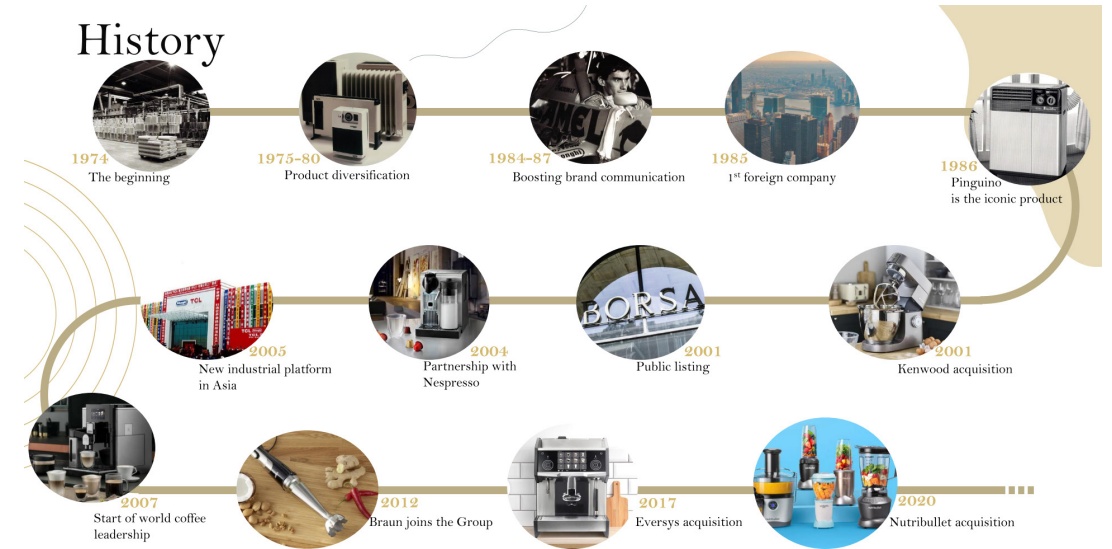


Figure 26 History of Delonghi Product

#### Value and Vision of Delonghi Group

From DeLonghi's official 2022 group brief, the following three phrases can be extracted<sup>48</sup>:

- Worldwide, everyday, by your side
- A desirable object, an emotion, an authentic experience
- To be lived, to be shared
- Our values - Everyday Markers

These phrases effectively articulate the culture of the DeLonghi Group and encapsulate the group's vision and values. Additionally, the DeLonghi Group's

official website elucidates its brand values and vision, highlighting seven core values<sup>49</sup>:

**HERITAGE, PASSION, RESPECT, TEAMWORK, COMPETENCE, COURAGE, AMBITION.**

Together, these seven terms and the three slogans represent the group's overarching values and vision.

The DeLonghi Group places significant emphasis on sustainability, prioritizing the well-being and health of its employees and consumers. Viewed from a product perspective, these offerings are designed to enhance people's lives while adhering to sustainable production and manufacturing practices. In its operations, the group strives for responsible and efficient utilization of energy resources, promoting a circular economy and waste reuse to proactively address climate change challenges. These actions embody the group's sustainability objectives and characteristics.



Figure 27 Value of DeLonghi Group

### Introducing Brand of DeLonghi:

**The values and vision of DeLonghi: A product from DeLonghi elevates ordinary activities, transforming them into special moments.**

DeLonghi offers consumers an innovative blend of style and performance as a global brand. Established in 1974 initially as an electric radiator brand, DeLonghi introduced iconic products like Pinguino, Tasciugo, Sfornatutto, and Rot-Fryer. Over time, the product range expanded across all its regions. Today, DeLonghi specializes in innovative appliances for comfort, home cleaning, and the kitchen. Within the latter segment, coffee machines have become central to the brand, positioning the DeLonghi Group as one of the global leaders in this domain.

Under the DeLonghi brand, there are three main product categories: coffee, kitchen cooking, and comfort. The coffee machine is the brand's most representative and well-known product and holds the distinction of being the world's leading espresso coffee maker.



Coffee



Kitchen Cooking



Comfort & Care

## The Connection between Projects and Brands

Analysis and categorization of the current product lines under the Delonghi brand reveals these products' positioning, core values, and distinct characteristics. This provides an overview of Delonghi's product strategy.

COFFEE MACHINES

### Automatic Espresso Machines



Magnifica S Smart    Dinamica Plus    Eletta Explore    PrimaDonna Elite

### Manual Coffee Machine with Coffee Beans



La Specialista Arte    La Specialista Arte Evo    La Specialista Prestigio    La Specialista Maestro

### Manual Espresso Machines



Dedicata Style    Dedicata Arte

### Nespresso Machines



Granlattissima, White    Lattissima One    Essenza Mini

### Portable air conditioner



Comfort compatto  
Per camere fino a 85 m<sup>2</sup>    Più spazio, più freschezza  
Per camere fino a 100 m<sup>2</sup>    Freschezza extra-large  
Per camere fino a 120 m<sup>2</sup>

### Dehumidifier



Tasciugo AriaDry Multi    Tasciugo AriaDry Multi

### Cordless Electric Vacuum Cleaner



Colombina Evo    Colombina Evo

### Fan Heater



Capsule    Capsule Desk Loop    Capsule Fit, bianco

### Convactor



SlimStyle    Slimstyle    HSX2320F

COMFORT & CARE

An analysis of Delonghi's product categories, particularly in coffee machines and comfort care, reveals the prominence of the coffee machine sector within the brand's offerings. Even though it is a distinct product category, it spans multiple user scenarios and product variations, signifying Delonghi's longstanding commitment and market leadership in this domain. The company's product management exhibits sophistication, ranging from high-end automated systems to user-friendly capsule coffee machines. The design of their elite automatic coffee machines employs a silver-grey metallic tone complemented by black. These design choices, anchored in the ethos of form following function, adopt straight lines and geometric shapes as primary elements, exuding precision, order, and resilience. Overall, the product communicates professionalism, technological sophistication, elegance, and a contemporary-retro charm. The design prioritizes user interaction by thoroughly examining user journeys in coffee preparation and consumption.

Conversely, the capsule coffee machines accentuate a pared-down design emphasizing simplicity and compactness. The material and color palette chiefly comprises classic shades of black and white plastics punctuated by vibrant colors such as red. The design prioritizes user-friendliness, emphasizing the machine's swift brewing feature, thus offering an experience characterized by sleek modernity, space efficiency, and versatility.

Upon examining Delonghi's product design and strategy in the coffee machine domain, the market segment emerges as notably competitive, characterized by the presence of several contenders, resulting in the term of the "Red Ocean" situation. This environment showcases complex consumer expectations and prevalent price

competitions. Nevertheless, Delonghi maintains a significant market share in this domain.

Contrastingly, in the comfort care segment, Delonghi's emphasis is less pronounced than in its coffee machine and kitchen appliance sectors. The product distribution seems fragmented with insufficient segmentation based on user needs. The primary focus in this category lies on air comfort solutions (both heating and cooling) and home cleaning<sup>50</sup>. Plastics are the dominant material, and the color scheme largely revolves around shades of black, grey, and white. The delineation of product value and vision in this segment is somewhat ambiguous, with features often resembling those of competitors. This segment, however, presents potential avenues for innovation. By prioritizing user experience, it becomes feasible to explore fresh product values and visions, recognize and cater to emerging needs, and pioneer novel product and market categories.

### **Blue-Ocean Strategy<sup>51</sup>:**

#### **Path 1: Analyze substitutive sectors**

**Which are the alternatives to satisfy a need?**

*Delonghi's mission and vision emphasize enhancing daily activities and moments through its products. The objective extends beyond solving immediate problems—it seeks to redefine lifestyles. To stay in line with Delonghi's ethos in the comfort care realm, there is a necessity to develop novel product solutions catering to user needs.*

#### **Path 2: Analyze the strategic clusters**

**Which are the main competitive factors?**

*The prevailing product designs and functions emphasize user facilitation, with machinery becoming progressively adept. Take coffee machines, for instance—they assist users in preparing a range of coffees with precision. However, the connection between users and products seems underemphasized,*

resulting in products that often stand apart from users' daily lives.

**Path 3: Analyse the customer purchase process**

**Which are the main actors that take part to the purchase process?**

Within the appliance industry, the emphasis for consumers is dual-fold: product design and the associated user experience.

**Path 4: Analyze the complementary products**

**Which are the complementary products related to the core offering?**

Delonghi's comfort care range primarily addresses air comfort and cleanliness. Considering garment care—a sector intrinsically linked with atmospheric humidity and temperature—LG's STYLE garment care appliance offers humidity modification capabilities. Such innovations often overlap in function. From a behavioral standpoint, the everyday use of air heaters or conditioners emerges for garment drying and deodorization tasks.

**Path 5: Analyze the product or service meaning**

**Which is the meaning of the product-service in the consumer life?**

In the home appliance industry, the value of a product extends beyond problem-solving—it aims to provide emotional satisfaction and enrich user experiences. This philosophy mirrors Delonghi's brand ideals. Prioritizing user experience remains crucial, ensuring products offer consistent positive and engaging interactions while diminishing negative experiences.

**Path 6: Analyze the changing trends**

**Which are the main changing trend directly or indirectly related with the sector?**

The contemporary societal tempo is brisk. Amid escalating global unpredictability, sustainability and engagement in enriching routines have become more central. In the fashion sphere, the rise of fast fashion results in increased garment acquisitions. Addressing the maintenance of this expanding clothing volume is paramount. Thus, routine garment upkeep, encompassing sanitization and odor removal, paired with sustainable practices, is fundamental, hinting at potential market niches.

Incorporating analyses of contemporary societal behaviors and research on garment care, new market needs, and opportunities surface. These shifts are congruent with Delonghi's organizational objectives, indicating a responsive stance towards evolving garment care requisites.

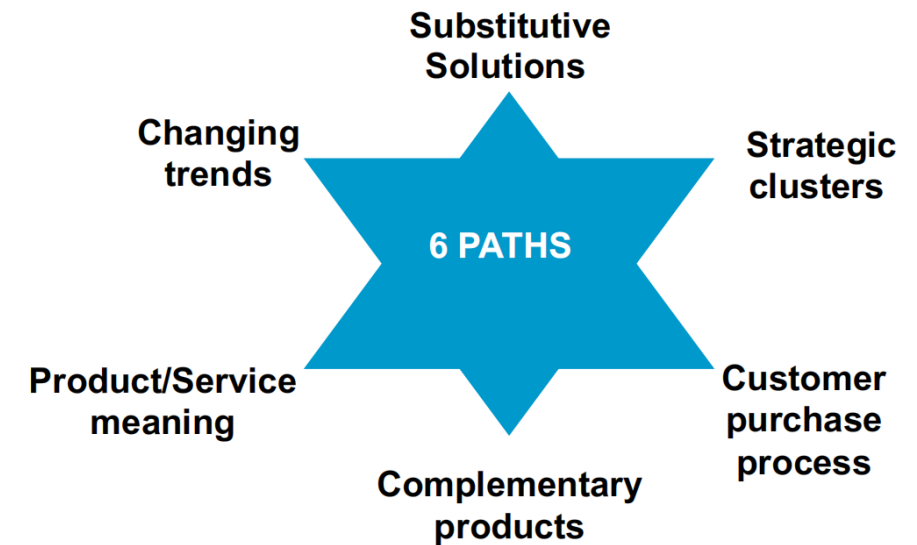


Figure 28 The way how to create blue ocean



# 04

## **NEW VALUE FOR CLOTHING CARE AND USER RESEARCH**

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### **4.1 User Research for New Generation**

In design processes, analyzing user requirements is fundamental and important. Designers must prioritize user research because users hold a central role in foundational research and design. Product design aims to cater to users, implying a close connection between the product's entire lifecycle and the users. When examining clothing care project designs, it is necessary to consider users' behaviors in clothing care and their perspectives on the clothing lifecycle. Through interviews and literature reviews, this section investigates users' interactions with clothing in daily life, their clothing care needs, hierarchical requirements, and design considerations. Users' attitudes towards clothing are equally significant as they influence their treatment methods. Answers to these questions are collated from interviews and then statistically analyzed through charts, guiding future research on clothing care.

## ***User Research: Interview***

To gain a comprehensive understanding of the clothing-care process and to explore user attitudes and requirements towards clothing, this study employs experiential research methods to analyze the potential user base. Through in-depth interviews, the research aims to uncover habitual behaviors and attitudes toward routine clothing care among users. This approach facilitates the direct acquisition of user needs and establishes a linkage between the product and its prospective users, addressing their primary concerns in clothing care.

In-depth interviews are a prevalent qualitative research tool predominantly used for gathering data on user needs, experiences, sentiments, and perspectives. Semi-structured interviews allow researchers to explore user needs through a method that blends flexibility with structure. For the specific objectives of this study, the semi-structured interviews were formulated based on preliminary survey results.

### **Interview 1: Zhang Female/Age: 24 Occupation: Financial Industry Analyst**

**Q1: What type of clothing is prevalent in your household, and what is the average cost of a piece of clothing?**

A1: In my closet, I mainly have professional clothing like suits, shirts, and formal dresses because that's what I need for work. I also have some casual clothes like undershirts, jeans, and simple T-shirts which I wear on weekends or after work. As for the price, I pay more attention to quality and brand. A formal suit costs around 1500-3000 yuan. For casual clothes, I may choose some more affordable brands. If averaged out, I think my clothes are probably around 800-1000 yuan per piece.

**Q2: Where do you usually store the clothes you wear? What problems do you encounter when wearing clothes on a daily basis? Do you reuse clothes after wearing them?**

For clothes that I usually wear, if they are not too dirty or sweaty, I will hang them up to ventilate and put them back in the wardrobe. If there are obvious stains or if I feel they need to be cleaned, I will put them in the laundry basket and wait for washing. As for the clothes I have worn, if I only wear them for a short time and there are no major stains or odors, I will choose to wear them again. But if I wear them all day, especially in summer, I usually choose to wash them before wearing them again.

**Q3: How often do you participate in social gatherings? Do you pay attention to matching your clothing and accessories when attending parties?**

I go to some work-related events like meeting customers, team dinners, and business events with partners because of my job. I have to dress nicely and look professional. On weekends, I hang out with friends and we might have dinner, watch movies, or travel together. When I go to parties, I try to wear clothes that match well. For work events, I wear more formal clothes like suits or dresses to make sure I look professional and elegant. For casual gatherings with friends, I wear clothes that are appropriate for the event but still look decent and tasteful. If my clothes don't have any stains or smells after the party, I might not wash them right away. But if I'm in a restaurant or a place where there might be smells, I ventilate my clothes first before deciding whether to wash them. If my clothes have any stains or obvious sweat smells, I put them in the laundry basket right away to wash them.

**Q4: How often do you wash your clothes? What are your washing habits?**

I usually wash my clothes once a week. First, I separate dark and light-colored clothes to prevent dyeing. I also wash particularly dirty or special clothes separately. For delicate or easily deformed clothes, I hand wash them. For most other clothes, I use a washing machine and select the right washing mode. If I'm busy or don't have many clothes, I may wait until I have enough to wash before doing so. But I

don't wait more than two weeks because bacteria and odors can build up and make cleaning harder. So I try to wash my clothes regularly to keep them and my house clean.

**Q5: Do you encounter problems with clothes having odors in your daily wear? If so, what are some possible types of odors you might encounter?**

Yeah, it's pretty common to run into funky smells on your clothes from everyday wear. Here are some of the usual suspects:  
Sweat: Especially during the summer when you're sweating like crazy, your clothes can start to pick up that sweat stink. If you don't wash them soon enough, the smell will only get worse.  
Dampness: If you store your clothes in a damp place or don't dry them properly after washing, they'll start to smell musty.  
Food: Sometimes when you're cooking or eating out, your clothes will take on the smell of the food, especially if it's something really flavorful like grilled meat, fish, or fried food.

**Q6: How do you usually take care of your clothes? Do you pay attention to the care labels on your clothes? Do you use clothing care products?**

When it comes to clothing care, I haven't really paid much attention to it. I usually decide whether to wash based on how dirty the clothes look. As for those care labels, I occasionally take a look, especially when the clothes are something I really like or are expensive. However, most of the time, I just throw them into the washing machine and choose the regular mode for washing.

**Q7: Have you ever used home appliances for caring for your clothing?**

My family has a steamer for ironing clothes. It's very convenient, especially for clothes that are easy or difficult to iron flat. Sometimes I use it when I buy clothes or keep them for a long time and they get wrinkled. During the rainy season or winter, some friends have mentioned using clothes dryers to quickly dry clothes without worrying about dampness or mildew. Although my family hasn't purchased one yet.

**Q8: Do you believe that clothing care labels are important? Are you aware of the information that these labels provide?**

Well, to be honest, I didn't pay much attention to clothing care labels before. But after washing a piece of clothing I really liked and ruining it, I started paying more attention to these labels. The icons and text on clothing care labels do provide information on how to properly clean and care for clothing. However, some of the icons can be a bit difficult to understand, and I admit that I don't fully know the specific meaning of each one.

## Interview 2: Xiao Male/Age: 28 Occupation: Freelancer, Photographer

**Q1: What type of clothing is prevalent in your household, and what is the average cost of a piece of clothing?**

The clothes I have at home are mostly casual and for sports. I prefer to dress this way because it's more comfortable for me. I don't really care about brands, so I usually buy my clothes at department stores or online. Normally, I spend around 200 to 400 yuan for each item of clothing. But for special events, I may buy one or two more expensive pieces of clothing.

**Q2: Do you purchase Street fashion or luxury clothing?**

Sometimes I buy street fashion clothes to look good when I'm with friends or going to events. However, I'm not really passionate about it. I mostly buy them when I see a style I really like or when I think they're a good deal. I've only bought one or two pieces of luxury clothing, mostly when they were on sale or for special occasions.

**Q3: Do street fashion clothes require special maintenance or are they usually treated casually?**

For street fashion clothes, I do pay more attention to maintenance. After all, they are relatively expensive and often have unique styles, so I don't want them to wear out or fade so quickly. I will wash them according to the instructions on the tag, avoid using high temperature drying or direct sunlight, and even choose to hand wash some special materials. But for my other daily clothes, I may not be so careful. Most of them are directly machine-washed and then hung on the balcony. Of course, even with hypebeast clothes, I still wear them casually. Comfort is the most important thing, haha.

**Q4: Do you find it troublesome to keep up with street fashion clothing?**

Sometimes it can be a bit troublesome, especially when certain clothes require hand washing or specific washing temperatures, and cannot be put in the dryer. It does take more effort compared to my other daily clothes. But considering the price of these clothes and my love for them, I am willing to take the time to maintain them properly.

To be honest, even though it's a hassle, every time I finish washing and organizing them and put them back on, seeing the clothes still looking fresh and bright, I feel that the time and effort are worth it.

**Q5: Where do you usually store the clothes you wear? What problems do you encounter when wearing clothes on a daily basis?**

Sometimes when I come home from work or going out, especially when I'm a little tired, I have a habit of just throwing my clothes on the sofa or bed. However, usually before going to bed or the next day, I will tidy them up either by hanging them up or putting them in the laundry basket. But it's true, I'm not the kind of person who always tidies up immediately every time, sometimes I do feel lazy to deal

with it.

**Q6: How often do you participate in social gatherings?**

It's not too little. I usually attend 7 to 10 gatherings per month, which may be dinners with friends, or gatherings with classmates, or company team-building activities. Sometimes it's also social events related to business or work. So overall, I still enjoy socializing.

**Q7: How often do you do your laundry?**

I usually wash my clothes once or twice a week, depending on my activities and the weather. During summer, I might wash them more frequently because I sweat a lot and clothes get dirty easily. Sometimes I accumulate a pile of clothes before doing laundry, especially in winter when the clothes are thicker and one or two pieces can fill up the washing machine. However, I usually don't accumulate for too long because leaving dirty clothes in the laundry basket for too long is not very hygienic, and some stains are harder to wash after a long time.

**Q8: What are the consequences of hoarding clothes?**

There are quite a few problems with hoarding clothes. Firstly, if they are left stacked up for too long, they start to smell musty, especially in the summer when sweating a lot. If the clothes are not cleaned in time, the smell is really unpleasant. Sometimes there may be a problem with small insects. I have found a few small bugs in the laundry basket before, which scared me and made me throw all my clothes in the washing machine. Also, if some clothes have stains or something on them and are left untreated for too long, they become difficult to clean later on. This is especially true for my white or light-colored clothes, as the stains are really obvious. To be honest, having too many clothes piled up makes it difficult to wash them all at once, and when hanging them out to dry, it's also inconvenient to find a place to hang them one by one.

**Q9: How do you usually take care of your clothes? Do you pay attention to the care labels on your clothes?**

Well, to be honest, although I buy a lot of fashionable clothes, I don't really pay much attention to their care. Most of the time, I just throw them in the washing machine, sometimes mixing dark and light colors together. But for really expensive or favorite clothes, I still hand wash them, afraid of damaging them. As for care labels, I occasionally take a glance, especially for clothes made of special fabrics or those that I think are more delicate. I would check what the label says and try to wash them according to the instructions.

**Q10: Have you ever used home appliances for garment care?**

For home appliances, I have used a steam iron. Some of my trendy clothes tend to wrinkle after washing and I'm not good at using a regular iron, so I find the steam iron convenient. I just hang up the clothes and steam them, and the wrinkles disappear. It's quite easy to use. In addition, I have seen a disinfection machine at a friend's house before. It is designed specifically for disinfecting clothes, and my friend said it can kill bacteria and eliminate odors. However, I haven't personally tried it yet. I just find it an interesting product.

## Interview 3: Paola Female/Age: 22 Occupation: University student

**Q1: Do you buy luxury or street fashion clothing?**

Luxury and trendy clothing? Actually, I don't really pursue brands. When I buy clothes, I mainly look at their design and texture. If I really like them and find them very unique, I will consider buying them. But to be honest, as a college student, my budget is limited, so I don't often buy luxury brands. As for street fashion brands, I occasionally buy one or two pieces, but it's more because of their design, not because they are trendy.

**Q2: Do you know how to take care of luxury clothing? Do you have a habit of caring for your clothes or do you tend to be more careless?**

I try to be careful with my luxury clothes, after all I spent a lot of money on them and I hope to wear them for a long time. But I don't really know the professional care methods, I usually just follow the labels on the clothes when washing them. Actually, I don't have any special care habits, most of the time I am quite casual, just avoiding using hot water and not mixing with dark-colored clothes, these basic common sense. If there are any special care products or methods, I really don't know.

**Q3: Where do you usually store the clothes you wear?**

Most of the time, I hang the clothes I wear on hangers or put them directly back in the closet. If the clothes are not very dirty or have only been worn for a short time, such as T-shirts or jackets worn for only a few hours, I don't wash them every time. However, sometimes I may put them on a chair or bed because I'm in a hurry or lazy. But if they stay there for a long time, the clothes may become a bit wrinkled, or there may be a slight odor due to the humidity in the house. Therefore, sometimes I need to air them out or spray some perfume. However, I try to avoid putting clothes in a mess, because it's really inconvenient to search through a pile of clothes every time I need to find something.

**Q4: Do you ever encounter clothes with unpleasant odors in your daily wear? If so, what types of odors might you encounter?**

Sometimes, yes, especially when I sweat a lot in summer. After doing sports or spending a whole day outside, my clothes might have sweat odor. Also, if I store clothes before they dry completely, they might have a damp smell, somewhat like mold. Another case is when clothes are left in the laundry basket unwashed for a long time, they might have a bit of an odor, possibly a mixture of various smells. If I smell sweat or damp mold odor on my clothes, I definitely won't continue wearing them. It feels uncomfortable and it's not good to wear them outside, as I'm afraid others might also notice the smell.

**Q5: How do you usually take care of your clothes? Do you pay attention to the clothing care labels? Do you use clothing care products?**

I try to pay attention to the care labels on my clothes, especially when I buy new clothes. But to be honest, some of the labels on clothes

I don't quite understand, like those small patterns, so sometimes I search online for how to take care of them.

**Q6: Have you ever used any home appliances for clothing care? Can you use them?**

Have I ever used home appliances for clothing care? I have a steam iron at home, and I use it when there are wrinkles on clothes. But I don't have other appliances like clothes dryers or clothes disinfection cabinets at home. I think it's good to use these products if conditions permit, after all, they can better maintain clothes.

**Q7: Do you understand the content of care labels?**

Well, I think it's quite important, especially for clothes that are slightly more expensive or made of special materials. When I buy clothes, sometimes I look at those care labels because I don't want to bring them home and ruin them by washing them incorrectly. But to be honest, some of the symbols on the labels I really don't understand what they mean, I have to use my phone to check every time.

**Q8: Does the space in school dormitories affect your choices when buying household appliances?**

Of course it does. School dormitories have limited space and are shared with roommates, so I can't buy too big household appliances. Small appliances like rice cookers and hair dryers are okay, but I don't consider large items like air purifiers and clothing care machines. Also, there are rules in the dormitory, and some appliances cannot be brought in. So before buying, I will consider the size and whether it is convenient to carry

## ***User Research: Insign and Anlysis***

At this stage, further organize, filter, and summarize the interview results of previous users, and dig out the value. The first step is to summarize the problems based on the research results and then categorize them into potential issues that may affect the project phase.

### ***1. Purchasing Behavior and Consumption Concepts:***

Economic factors, to a certain extent, influence consumers' purchasing behaviors, especially under budget constraints. Consumers are increasingly focusing on the practicality, comfort, and material of clothing rather than just the brand. Research indicates that individuals like Paola and Li tend to choose based on personal preferences rather than brand influence. This reveals the interplay between self-identification and brand effect.

### ***2. Awareness and Practices in Clothing Care:***

Although all respondents expressed concern about clothing care, their practical skills varied. For example, while Paola wishes to properly maintain her luxury items, she lacks expertise in care knowledge. Respondents have a basic understanding of correct washing and maintenance methods, but their depth of knowledge is limited. Clothing care labels are often overlooked, and one key reason is inconsistent standards and difficulties in interpreting information.

### ***3. Household Appliances and Living Environment:***

Home space considerations, such as area and type of residence, influence consumers' decisions to purchase household appliances.

### ***4. Situational Awareness and Clothing Care Needs:***

A common issue identified in the research was the problem of odors in clothing due to them not being fully dried or stored for extended periods. Respondents displayed high sensitivity towards

the cleanliness and smell of their garments, implying a strong demand for targeted solutions. For young consumers with a fast-paced lifestyle or unwillingness to invest time, they might seek simplified and efficient clothing care methods. Odors in clothing not only cause discomfort to consumers but might also affect their confidence and social interactions, due to concerns that others may notice. Young consumers express significant interest in products that provide an emotional experience.

## 4.2 The clothing care for New Generation

Presently, based on research, clothing care products on the market can be categorized into three main types:

- 1.The cabinet-style intelligent automatic clothing care machines, such as the LG-style
- 2.Traditional clothing care products, including garment steamers and irons,
- 3.Specialized, small-scale clothing care items, like lint removers, scent diffusers, and mite eliminators

The industry trend is leaning towards cabinet-style intelligent automatic machines, which combine the features of both traditional and specialized clothing care products, embodying a synergy of professionalism and intelligence. The future clothing care market is projected to increasingly focus on identifying and refining user needs while enhancing personalized user experiences. Research findings suggest that many needs of younger users still need to be addressed.

These young individuals, amidst their fast-paced lifestyles, seek swifter, more efficient, lighter, and tailored clothing care product experiences.

### Modern Lifestyles:

Contemporary youth lifestyles have evolved. With richer material and cultural experiences, they regularly engage in diverse social events like concerts, dinners, and outdoor adventures. Suitable attire that reflects individual values and traits is essential for these occasions. However, such clothing is prone to pollutants, including bacteria, dust, and sweat, which, if untreated, may result in undesirable odors. Influences from fast fashion, street styles, and digital media drive the youth to amass extensive wardrobes, underscoring the need for efficient clothing care solutions, particularly those offering rapid drying and odor elimination.



### Fast-paced life and mental stress:

The fast-paced lifestyle has led the younger generation to develop some unhealthy habits, particularly in clothing care. For example, casually piling up worn clothes can cause wrinkles and odors, making them difficult to wear again. In recent years, the pandemic has not only caused public anxiety but also intensified uncertainty about the future, putting young people under greater pressure. In terms of clothing care, they seek efficient and immediate solutions to meet their practical needs and psychological expectations. Helping young people transform their unhealthy lifestyles is important(An, 2020).



### Lack of clothing care awareness and skills:

The fast-paced lifestyle has led the younger generation to develop

unhealthy habits, particularly in clothing care. For example, casually piling up worn clothes can cause wrinkles and odors, making them difficult to wear again. In recent years, the pandemic has caused public anxiety and intensified uncertainty about the future, putting young people under more significant pressure. They seek efficient and immediate solutions to meet their practical needs and psychological expectations in terms of clothing care. Helping young people transform their unhealthy lifestyles is crucial.



**Focus on personal health and hygiene:**

Young people are paying more attention to their personal health and striving to reduce risks associated with diseases and pollution. They frequently use disinfectant products to clean items in their daily lives. Additionally, they pay more attention to the hygiene status of clothing, as clothing in direct contact with the skin may increase the risk of disease. To reduce contamination risks, they adopt various disinfection and sterilization methods for their clothing care.



**Rising Sustainability Awareness:**

Furthermore, young people have become more mindful of the potential impact their daily behavior can have on the environment. As a result, they tend to adopt products and lifestyles that support sustainable development. This group prefers to buy second-hand

clothing, reduce the frequency of washing, and strive to extend the lifespan of their clothing. By limiting water usage during washing and implementing appropriate clothing maintenance strategies, it is possible to effectively extend the lifespan of clothing.

This trend reflects the changing habits of young people in the current era and the new demands they present in the field of clothing care.

**Modern Lifestyles**

- Possessing numerous clothing items
- Having a large amount of accessories
- Engaging in social and outdoor activities

**HOW MIGHT WE?**

- Temporary storage for worn clothing
- Storage for accessories
- Convenient and focused clothing refresh functions (drying, deodorizing, and disinfecting)

**Fast-paced life and mental stress**

- Limited time to care for clothes
- Stockpiling of worn clothing
- Daily emotional well-being
- Managing life stresses

**HOW MIGHT WE?**

- Fast clothing refresh (time and interaction)
- Products provide emotional value (appearance and use)

**Clothing care Awareness & Skills**

- Inadequate clothing care skills
- Insufficient knowledge of clothing care methods
- Difficulty in identifying and understanding care labels

**HOW MIGHT WE?**

- Smart clothing care label recognition?
- Smart selection of clothing care mode?
- Reducing the use of washing machines

**Personal Health & Hygiene**

- Emphasizing personal hygiene and health
- Sanitizing daily items
- Ensuring clothing hygiene and odor control

**HOW MIGHT WE?**

- Sterilization and deodorization of clothing
- Disinfection and sterilization of personal items

**Sustainability Awareness**

- Awareness of energy conservation
- Prolonging clothing durability

**HOW MIGHT WE?**

- Reduce the frequency of washing clothes

## 4.3 The New Value and Opportunity of clothing care

In the pursuit of comprehending user behavior and requirements, both interviews and surveys served as research tools. The pivotal challenge encompasses the seamless assimilation of user data and research outcomes into the design framework of products. Additionally, pinpointing the evolving significance of clothing care tailored for the youth remains a query. Insights from Don Norman's user experience levels (Norman, 2004), as elaborated in "Emotional Design," prove enlightening. This framework delineates three distinct experience strata: visceral, behavioral, and reflective, each heralding innovative dimensions for product design. With this theoretical foundation, a product's user experience is demarcated into three planes<sup>52</sup>:

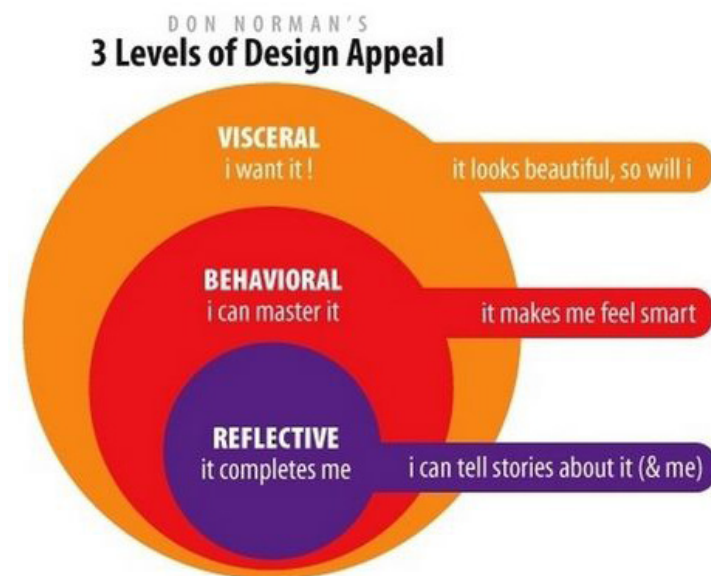


Figure 29 Don Norman's user experience levels

### **Intuitive Experience (Visceral Level):**

Centered on users' initial perceptions of a product, this level predominantly surfaces in the product's interactional design. The product's external presentation and primary reception are pivotal in enticing users to delve deeper.

### **Process Experience (Behavioral Level):**

This domain relates to the interface dynamics between users and products, enveloping the structural and framework aspects. Here, principal assessment criteria are attributes like operational fluidity, user comfort, user-friendly interface, and clarity. Furthermore, addressing the tangible needs of users is paramount in determining the merit of this experience.

### **Story Telling Experience (Reflective Level):**

Anchored in the reflective evaluation post comprehensive product interaction, this experience emphasizes the design's breadth and strategic facets. Should a product align with this level's benchmarks, it etches a profound memory, augmenting the affinity between the product and its users. As such, curating an exemplary end-to-end experience epitomizes the zenith of emotional design.

The core of optimizing product ideas lies in in-depth analysis of emotional factors in user experience design, and thus meeting customers' implicit needs (Norman, 2004). To truly convey emotional care to users, it is crucial to pay attention to their implicit needs. The improvement of product functionality can be based on users' explicit needs.

From this perspective, discussions of new product value can revolve around three core dimensions: user experience, lifestyle, and the product itself.

### 4.3.1 ***A lighter user experience from Fast and Multiple way using***

#### **Process Experience (Behavioral Level)**

User experience is pivotal throughout a product's lifecycle. The contemporary rapid lifestyle necessitates products that provide young users an efficient and seamless experience. Due to their substantial size and weight, a considerable portion of present-day clothing care products occupy significant indoor spaces. This poses challenges for young individuals predominantly living in rented properties or university dormitories, especially given these accommodations' limited and often congested nature. While many current products boast integrated clothing care features with automation and intelligence, they still demand users to adapt settings according to specific needs. Inappropriate settings could lead to potential garment damage. These products must genuinely address the primary needs of younger users, presenting intricate operation sequences in the process. Young adults typically prefer uncomplicated care for everyday apparel, including items like vests, T-shirts, and various pants, whereas formal wear sees less frequent use.

Customizing clothing care devices based on prevalent attire types worn by this demographic emerges as a promising design avenue. Determining automatic care settings contingent on fabric types and care prerequisites presents another valuable design prospect.

### 4.3.2 ***A lighter lifestyle from Passive and Active using***

#### **Story Telling Experience (Reflective Level) Process Experience (Behavioral Level)**

In design, influencing or guiding users through products to cultivate positive habits and lifestyles stands as a pivotal objective and is also a designer's responsibility. This is closely tied to the reflective level of user experience. Many young individuals need to gain awareness of clothing care and pile them up carelessly. Addressing this demographic, there is a need to encourage them to pay better attention to the condition of their clothes and assist them in drying, disinfecting, and organizing their garments. Optimizing and guiding young people's clothing care habits can lead them to embrace a healthy, sustainable, and emotionally positive lifestyle. Product functionalities and experiences can bring emotional value to young individuals, enhancing their way of life. Here, we introduce the relationship model of the three elements: "Product-Environment-Person":

#### ***Relationship between users and clothing care:***

Clothing care products should offer features and interactions that meet the demands of young people, delivering an efficient experience for users.

#### ***Relationship between environment and clothing care products:***

Products should be designed to integrate seamlessly into home settings in terms of appearance and form. A tangible and informational exchange exists between home environments and products, such as whole-house intelligence and functional interactions. The product and the environment collectively craft a comfortable, efficient, and relaxed user experience.

#### ***Relationship between users and environment:***

Users exist within an environment, able to actively interact with it or passively receive information and services it offers. Products within this setting have two states: in-use and not-in-use. Even



non-operational products should proactively offer services to users, amplifying their value.

In the "Person-Product-Environment" system, delivering an exemplary experience for users is paramount, guiding them towards cultivating superior lifestyle habits.

### 4.3.3 **A lighter product from Specific new need-cloths refresh**

#### **Intuitive Experience (Visceral Level)**

When evaluating lighter products, the primary consideration is whether the product design and functionalities align with user preferences and requirements. This aspect is intrinsically linked to the intuitive dimension of user experience. The aesthetic design of garment care products should integrate seamlessly with domestic settings while resonating with the tastes of a younger audience. Functionally, these products ought to address the practical needs of daily living for young individuals, prioritizing attributes such as rapid drying, wrinkle elimination, daily odor and germ neutralization, volume and weight efficiency, operational flexibility, and user-friendliness, instead of seeking to make the product an all-encompassing solution.

**Efficient clothing drying**

+

**Daily Disinfection**

+

**Clothing Deodorization**

## 4.4 **A new scenario of a clothing care system: Fast refresh and Furniture-oriented**

Based on prior user insights, novel value propositions have emerged within the garment care domain. This section delves into strategies for assimilating these identified values into product design. One can evaluate garment care product design through the "User-Product-Environment" framework and "User Emotional Experience." A product's value is intrinsically linked to its user and the surrounding environment. By refining the nexus between the product and these critical facets, user experiences can be enriched. Products should foster user engagement and seamlessly merge with their surroundings. The market's furniture-oriented offerings shed light on this approach. These household devices feature furniture-esque aesthetics and capabilities while preserving their inherent functionalities. Such items adeptly bridge the divide between classic furniture and modern appliances, ensuring aesthetic and functional congruence. In this context, Samsung's "The Frame" TV exemplifies this design paradigm.



*Samsung The Frame is a television product launched by Samsung that combines innovative technology and modern home design to provide users with a dual experience of both a TV and a work of art. Art Mode: When not used as a TV, The Frame can simulate real works of art, displaying paintings or personal photos. Users can also purchase or subscribe to numerous famous works of art from Samsung's Art Store. Custom Frames: Users can choose frames of different colors and materials based on their interior design style to ensure that the TV complements their home decor.*

**From a "light product" viewpoint:**

The primary requirements of young consumers concerning garment care products can be broadly categorized into several areas. Functionally, they prioritize rapid and efficient garment drying and refreshing, daily odor neutralization and disinfection, brilliant mode selection, and compact, lightweight designs suited for confined spaces. Aesthetically, they lean towards unique and expressive designs that seamlessly integrate with interior décor. They prefer intuitive, streamlined interactions that efficiently incorporate intelligent care mode selections for usability. From a sustainability perspective, there is an inclination towards products that minimize resource and energy consumption.

Efficient clothing drying

+

Daily Disinfection

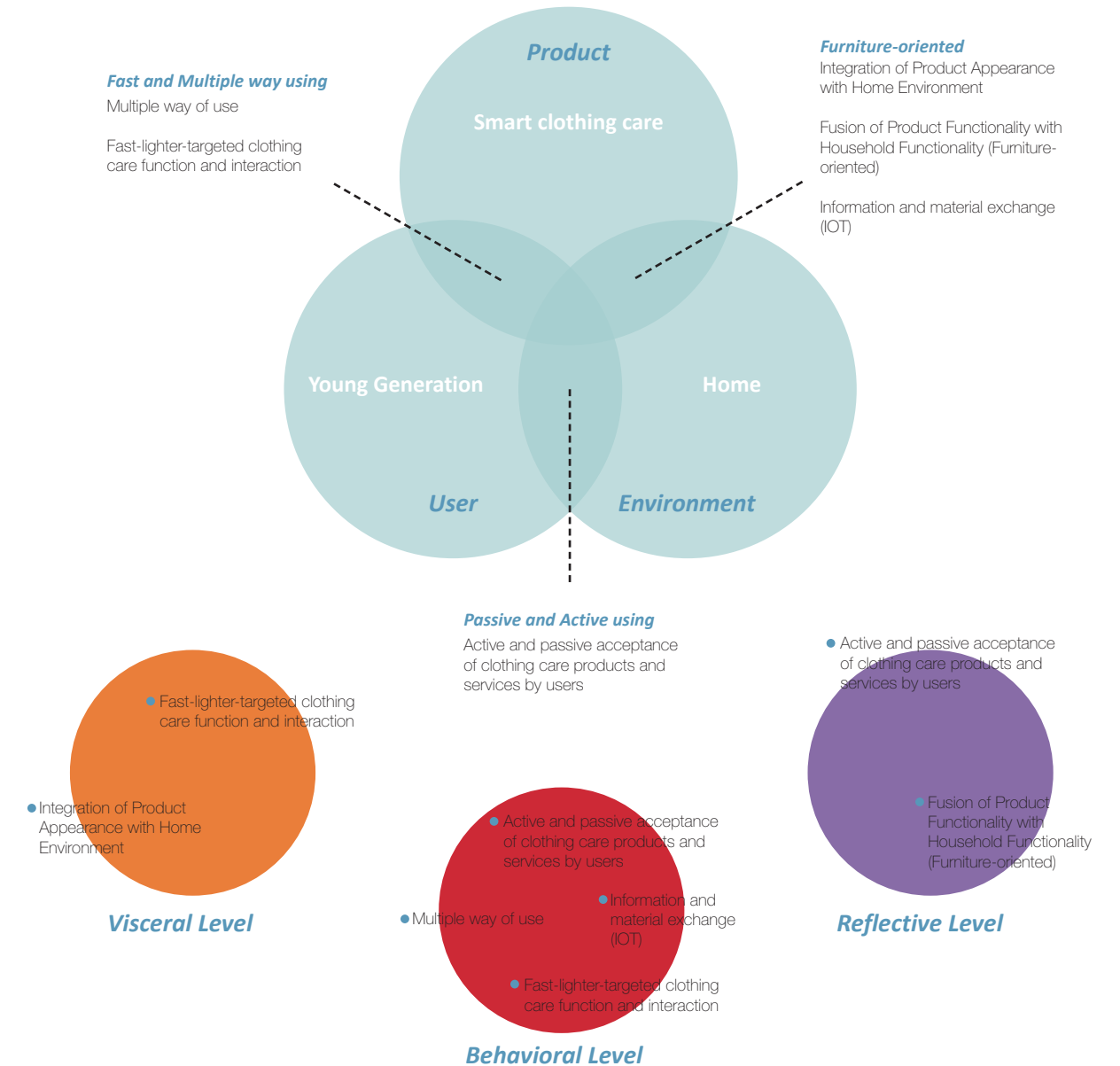
+

Clothing Deodorization

**From a "Furniture-oriented" viewpoint:**

How might garment care products be seamlessly integrated with household furnishings while catering to the preferences of younger consumers for lighter designs? Central to the design is the notion of reconfiguration and connectivity. An understanding can be drawn from the values previously discussed. Conventional indoor furniture serves various roles, including storage (e.g., bookshelves, wardrobes), aesthetics and emotional resonance (e.g., artwork, photo frames), utility (e.g., stools, tables), illumination (e.g., desk and floor lamps), and comfort and entertainment (e.g., sofas, textiles). Merging these roles with garment care functionalities reveals innovative design possibilities. The product's aesthetics can mirror the furniture, enabling household devices to merge with the interior as furnishings when idle and as daily garment care tools when activated. Such dual functionality addresses and enhances user needs and experiences.

## 4.5 Lighter & Furniture-oriented Scenario Summary



# 05

## **IDEATION & CONCEPT**

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During this stage, our goal is to discover fresh design ideas and solutions that are informed by our previous research and analysis

## 5.1 User Need and Design Challenge

This section aims to extract new design inspirations and proposals based on existing user research, user targeting, project overviews, requirements, and design challenges. This section's structure and thought process adhere to the guidelines of IDEO's Double Diamond model (Wang, 2023), encompassing persona development, case studies, the "how might we" strategy for problem articulation, ideation sessions, and conceptual sketching.

In order to better guide the development of subsequent concepts and plans, it is necessary to clarify the user requirements, user positioning, and possible design challenges again. The previous user research and literature review have been quite comprehensive, so here is a reorganization of the user requirements:

### *User Needs:*

1. The primary user group for the product is the younger generation in the modern era.
2. This new generation needs a convenient, efficient clothing-care product that mainly features drying, daily disinfection, and odor removal capabilities.
3. The product's functionality and aesthetics should harmonize with indoor environments.
4. The product should encourage users to develop good clothing-care habits (intelligent care label recognition and clothing organization and management)
5. Emotional design in household appliances: The product should offer functional and emotional value even when not used.

## Design Briefing

*"A flexible and fast clothing refresh product that meets the needs of users' clothing care and fits the lifestyle of young generation  
It should provide users with positive emotional value in appearance and user experience. It is both a home appliance and a piece of furniture"*

## Briefing

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In order to transition seamlessly from the research phase to the concept phase, formulating a design summary becomes an imperative step. This summary synthesizes information gathered during the analysis phase, translating it into concrete requirements for the project. These requirements are predicated on design opportunities identified in the user research, namely, Lighter & Furniture-Oriented and Scenario Summary.

Accordingly, a new design direction for a smart clothing-care product aimed at the new generation of young users has been established. *The product is intended to be lighter, efficient, and convenient, catering to users' emotional needs through furniture-oriented Design while addressing their daily requirements for drying, disinfecting, and odor removal in clothing care.*

### Lighter Product (Flexible and Fast)

Young users prioritize rapid, efficient clothing care, focusing on odor, comfort, and hygiene, as these factors directly influence their social and outdoor activities.

### Furniture-Oriented Design

This user group also places a high value on emotional well-being and psychological health, leaning towards individual expression. They anticipate that household items will provide positive emotional experiences. Living conditions and spatial limitations further influence their appliance size and flexibility requirements.

### Type of Furniture

**Storage & organization** (wardrobes, laundry baskets)  
**Decorative & emotional** (sculptures, lamps)  
**Placement & support** (tables, coffee tables, chairs)  
**Lighting & illumination** (desk lamps, floor lamps)  
**Comfort & entertainment** (sofas, carpets, etc.)  
**Others furniture** (drying racks, brooms)

## Design Challenge

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### 01 *Emotional Value and Furniture-Oriented Design of the Product:*

One of the key challenges lies in imparting emotional value to the product through both form and function, particularly for a younger user demographic with fundamental clothing-care needs. Within the framework of furniture-oriented design, it is critical to select product forms and functions that harmonize with the home environment. This congruence necessitates in-depth deliberation and balancing during the design phase to ensure compatibility with indoor settings while avoiding incongruence or awkwardness.

### 02 *Lighter Product and User Experience:*

Addressing users' requirements for swift clothing care in terms of functionality and user experience while simultaneously alleviating their operational burden constitutes a direction worth exploring. This step requires meticulous attention to user behavior patterns and optimization of the human-machine interface.

### 03 *Internal Structure of the Product:*

The design phase faces the core challenge of integrating various technologies and components to fulfill three essential functions—drying, disinfecting, and odor removal—in a confined space.

# Personas



**Marco/25 Male**  
Programmer

I live in an apartment and enjoy socializing and outdoor activities. I don't have much free time on weekdays, but I often hang out with friends or participate in outdoor activities on weekends.

I'm also a loyal follower of internet and pop culture. I like wearing streetwear brands and do laundry about twice a week. I prefer using automatic washing machines and dryers.

**Ability level of clothing care**



**Frequency of Laundry**

2/3 times per week

**Clothing Taste**

Mainly streetwear and sportswear (many of T-shirts), Daily clothes.

A small amount of formal wear.

**Need & Goal**

Enjoy outdoor activities, I often need to clean my sports equipment and clothes.

Need a quick way to dry his clothes so that he can be ready for outdoor or social activities.

Want to reduce the sweat smell from his sports clothes, and disinfect them to reduce germs.

Looking for a simple and fast clothes care solution.

**Problems & Frustration**

Long working hours and high pressure leave little time for careful clothing care, with only basic knowledge of clothing maintenance.

Due to wearing trendy brands, a certain method is needed to better protect the color and pattern of clothing.

It has been discovered that many outdoor sports equipment and high-tech fabrics are not suitable for traditional washing methods.

# Personas



**Li Xue/22 Female**  
College student majoring in design

I currently live in a studio apartment and live alone. I enjoy good food and try out new restaurants or cafes in the city every week.

I like fast fashion brands like Zara and H&M, but also purchase some luxury or streetwear items. I usually do laundry once a week, but due to a busy schedule with my studies, I prefer using simple and quick clothing care products.

**Ability level of clothing care**



**Frequency of Laundry**

1/2 times per week

**Clothing Taste**

Most of them are Fast-fashion brands/some luxury or streetwear items

Daily clothes like (T-shirt, pants)

**Need & Goal**

Clothes that are worn often are more likely to get damaged due to frequent washing and wearing.

Enjoy going out to try new foods and socializing, and I like to wear different outfits for these occasions.

Need a quick and efficient way to take care of my clothes, especially for fast fashion and streetwear clothing.

**Problems & Frustration**

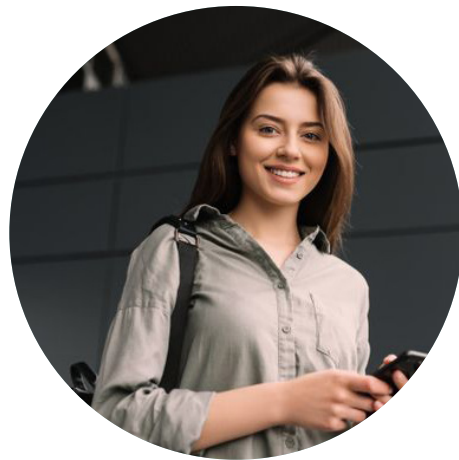
Clothes often get smelly and damp from daily activities.

Have a lot of clothes in different styles, which makes organizing them difficult.

Don't know much about taking care of clothes. Plus,

Due to laziness, forget to organize her clothes and let them pile up.

# Personas



**Carla/28 Female**  
Teacher

I enjoy running and doing yoga. I have a pet dog and live with my husband in an apartment. I am very passionate about my job and pay great attention to details.

I am a bit of a neat freak and, being a teacher, I need to keep my clothes clean and appropriate. I usually do a thorough cleaning of the clothes I wore during the week every weekend.

**Ability level of clothing care**



**Frequency of Laundry**

1 times per week

**Clothing Taste**

Most of them are Fast-fashion brands/some luxury items

**Need & Goal**

Need a clothing care plan that can accommodate both formal and casual wear.

Would like a convenient and quick way to take care of her jewelry and accessories.

Need to eliminate odors and bacteria/viruses from her clothes caused by pets.

Want to get rid of the cooking odors from her clothes.

**Problems & Frustration**

Have pets, and her clothes often get covered in hair and odors. Need to eliminate bacteria and viruses.

Too busy with work to take care of her clothes, and the process takes a long time.

Have high standards for cleanliness, but her don't have the time.

# From User to Concept

During the research on clothing care, the user needs definition and concept development; it was found that existing products often need to improve in volume and user experience. Specifically, these products are often oversized and have complex operations. At the same time, young users are mainly concerned with clothing drying, disinfection, and odor removal, and they require fast clothing care solutions in emergencies. Therefore, these issues must be particularly focused on during the design concept phase.

Regarding the starting point of the design concept, this research is based on the "User-Product-Environment" and "user-emotional experience" models previously organized to find design inspiration. Donald Norman pointed out in his book "Emotional Design" that products with emotional elements are likelier to be liked by users than products that are only functionally complete(Norman, 2004). This view particularly applies to home product design and provides helpful guidance for household appliance design.

Base on the Furniture-oriented design concept, which integrates furniture and household appliances. As the goal is to reduce product volume, bulky types should be avoided in furniture design. At the same time, it should be related to clothing in terms of functionality. The following is a classification of indoor furniture.

**Type of Furniture**

- Storage & organization (wardrobes, laundry baskets)
- Decorative & emotional (sculptures, lamps)
- Placement & support (tables, coffee tables, chairs)
- Lighting & illumination (desk lamps, floor lamps)
- Comfort & entertainment (sofas, carpets, etc.)
- Others furniture (drying racks, brooms)

## Concept Introduce:

# LAMP × LIGHTER Clothes Refresher



### Fast Clothes Refresh

**IN USE**

Fast clothes refresh (wrinkle removal, drying, sterilization, and deodorization) for 1-3 pieces of clothing

### Clothes Storage

**NOT IN USE**

Can be used as a hanger for daily clothing storage and placement.

### Lamp & Disinfection

**IN USE**

Serves as a UV light source for garment care, sterilization, and deodorization

**NOT IN USE**

Serves as a lamp to provide lighting.

### Why connect with lamp

Lamps provide a suitable source of inspiration for clothing care design. Firstly, in terms of functionality, clothing care requires a closed-space environment. Similarly, lighting fixtures are usually composed of lampshades to better display light characteristics.

During the disinfection stage of clothing care, a light source is needed. There are mainly two methods of disinfection: one is to use gaseous media such as high temperature or ozone for sterilization, and the other is to use a light source, such as ultraviolet light for sterilization.

On an emotional level, lighting fixtures can resonate with people's psychology and emotions. The color temperature and brightness of lighting fixtures have been proven to enhance user experience and regulate emotions in interior architecture and product design. Similarly, household appliances used in indoor environments should also consider adding emotional elements to improve user experience.

### Fast & Multiple Using

Multiple way of use:  
1. Clothes refresh  
2. Lamp (Lighting and UV light)  
3. Clothes hanger storage

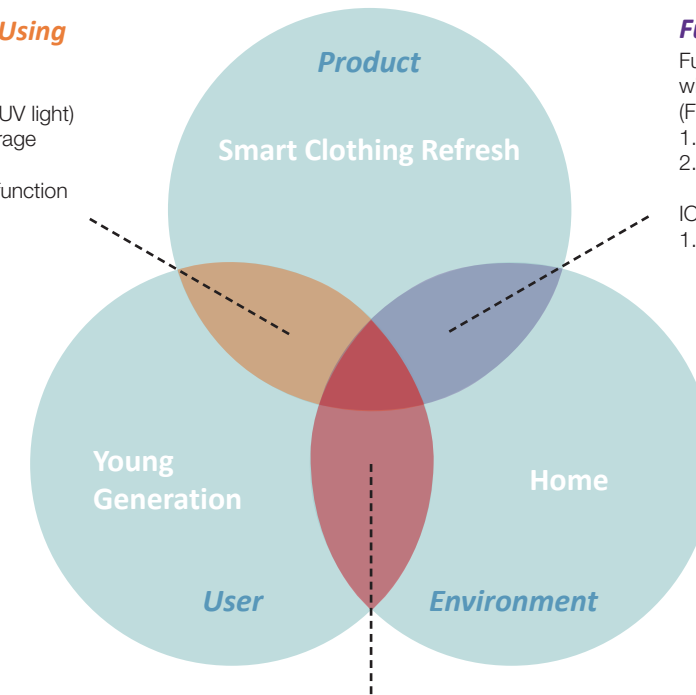
Fast clothing refresh function  
1. Wrinkle removal  
2. Drying  
3. Sterilization  
4. Deodorization

### Furniture-oriented

Fusion of Product Functionality with Household Functionality (Furniture-oriented)

1. Lamp  
2. Clothes Hanger

IOT (Internet of Things)  
1. Identification of Clothing Care



### In Use & Not In Use

Active and passive acceptance of clothing care products and services by users



### Fast Clothes Refresh

**Fast & Multiple Using**  
**In Use**



### Clothes Storage

**Furniture-oriented**  
**Multiple Using**  
**Not In Use**



### Lamp & Disinfection

**Furniture-oriented**  
**Multiple Using**  
**In Use & Not In Use**

Combine products with common needs at home. Lamp, clothes hanger, and storage are functions that people use frequently on a daily life, while clothes care and lights are also linked in form and function, for example, the lamp shade is similar to the closed cover of clothes care. The final design direction is a clothes refresher, also is hidden lamp



# 06

## **TECHNOLOGY AND PROJECT DEVELOPMENT**

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Based on the design opportunities and values discovered through previous user research, further develop the design project.

## 6.1 Design Requirements

Before entering the formal product design phase, it is imperative to clarify various elements and outstanding issues based on user needs and preliminary concepts. A well-structured design project should effectively guide the design process, establishing a more definitive and planned design trajectory. These requirements are aligned with previous research and assumptions, ensuring seamless integration between design and research. Specifically, these project requirements can be broadly categorized into the following: association with the DeLonghi brand, Lighter product(flexibility and fast), furniture-oriented focus, and product design dimensions.

### *1.Relate to the DeLonghi brand*

Based on prior analysis of the DeLonghi brand, the smart clothes care product under study introduces a new category within the home comfort and care domain, aiming to innovate beyond existing product frameworks. Following user research and survey work, the design objectives and concepts align with DeLonghi's core values and vision: A DeLonghi product always turns everyday activities and moments into something special. Special attention is given to a young user demographic, delivering a user experience that is lightweight, flexible, fast, and enriched with emotionally resonant design elements.

From the perspectives of design, aesthetics, and CMF (Color, Material, Finish), the overall design must be consistent with DeLonghi's established style and categories. Predominantly employing low-saturation hues of white and gray, the design is complemented by a classic high-saturation color, achieving a simple yet dignified appearance that highly resonates with residential interiors.

In terms of materials, extensive use of frosted or mirrored plastics is recommended, with metal or metal-like materials accentuating details to emphasize product finesse, intricacy, and a sense of technology. The exterior design adheres to DeLonghi coffee machines' typical form and function-oriented semantics, avoiding unnecessary complexity and aligning with contemporary minimalist home aesthetics.

### *2.Lighter product(flexibility and fast)*

Focusing on young people's lifestyle and daily clothing care needs, this product is designed for quick clothing care (completed within 10-20 minutes), including essential functions such as wrinkle removal, drying, disinfection, sterilization, and odor removal. In addition, the product's multifunctional design allows quick clothing care and includes additional functions such as clothing storage, household lighting, and daily necessities disinfection.

The product is easy to operate regarding user interaction and avoids complex interaction experiences.

This product adopts a furniture-oriented design concept, and its appearance should be highly compatible with the indoor environment. From a functional perspective, in addition to clothing and jewelry storage, it also has an indoor lighting function to meet users' emotional needs.

### *3.The product dimension*

Needs to meet the following standards:

1.Suitable for small indoor spaces.

2.The capacity design should accommodate the size and dimensions of young people's daily clothing. Specifically, it should be able to handle 1 to 3 pieces of clothing simultaneously.

## 6.2 Technology Research

This study investigates the essential mechanisms required for rapid garment care at a technical level. It encompasses the categorization of relevant technologies, the examination of internal functional components, and the analysis of the dimensions and spatial arrangement of electronic components. The primary objective is to assess both size and functional specifications, focusing on identifying components capable of fulfilling rapid garment care needs within compact dimensions. This assessment aims to inform and optimize subsequent designs of the product's internal structure and layout.

### 6.3.1 Aroma

#### Principles

Aromatherapy predominantly utilizes atomization technology to create an atomized state by facilitating the interaction between water and essential oils through diffusers and atomizers. Aroma molecules disperse in the air in this atomized form, contributing to effective diffusion throughout the environment and into fabrics.

#### Functional

**Odor Masking:** Strong fragrances can effectively mask foul odors, although this is only a temporary solution and cannot eliminate them.

**Antimicrobial Properties:** Certain essential oils exhibit antibacterial and antiviral characteristics, aiding in the mitigation of odors originating from bacterial or fungal sources.

**Neutralizing odors:**

Specific components within certain essential oils can chemically interact with airborne odor molecules, thereby neutralizing or eliminating them.

**Psychological Impact:**

Aromas can modulate an individual's psychological perception of unpleasant odors, rendering them more tolerable.

### Household Appliance Aromatherapy Diffusion Technologies

#### ULTRASONIC DIFFUSION

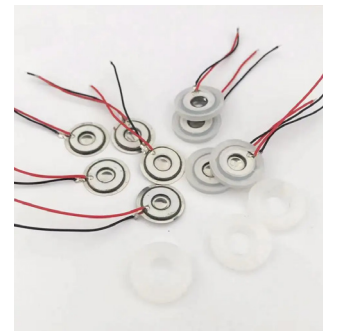
Ultrasonic diffusion technology employs ultrasonic vibrations to atomize a blend of water and essential oils before dispersing it into the ambient atmosphere.

#### Advantages:

Operational simplicity, elimination of heating process, high essential oil utilization efficiency, and minimal operational noise.

#### Disadvantages:

This technique is primarily suitable for water-soluble essential oils and requires a water-based environment for effective diffusion.



Ultrasonic diffusion (Flat)

#### HEAT STEAM DIFFUSION

Heat steam diffusion utilizes a high-temperature heating element to generate steam, which then serves as a medium for essential oil dispersion. This approach commonly employs aromatherapy boxes or tablets, installed on the high-temperature steam conduit.

#### Advantages:

Comprehensive volatilization, uniform distribution, and low operational noise.

#### Disadvantages:

The efficiency of essential oil utilization is typically moderate, and the generation of heating steam is necessary as an auxiliary component.

#### FAN DIFFUSION

Fan diffusion disseminates essential oil into the air and ultimately onto fabrics by passing air over a pad or filter saturated with the oil.

#### Advantages:

Operational simplicity.

#### Disadvantages:

Essential oils are prone to rapid evaporation and are challenging to preserve for extended periods.

### Diffusion Technology Selection: Heat Steam Aroma Diffusion

Heat steam diffusion emerges as the most advantageous method in developing the garment care products under consideration. This preference arises primarily from the garment care products' reliance on high-temperature steam for wrinkle elimination. Integration of the essential oil carrier with the high-temperature steam conduit offers a cost-effective solution. Additionally, this approach exhibits low operational noise and ensures uniform fragrance distribution, thereby effectively realizing the desired aromatherapy effect.

## 6.2.2 Air dryer & Steamer

### Air Dryer Principles

The essential mechanism for drying garments involves facilitating the evaporation and expulsion of internal moisture. Predominantly, current garment dryers and care systems employ convection drying technology, which utilizes heated air circulated through the fabric to achieve drying.

### Air Dryer Selection

Traditional condensation-based and heat pump drying methods prove to be infeasible due to constraints on device size and energy utilization. In contrast, PTC (Positive Temperature Coefficient) thermistor heating technology emerges as the most efficient and appropriate solution for compact systems.

The pivotal component in this technology is the PTC thermistor, customizable in various shapes and dimensions. The technology's advantages encompass stable temperature heating, high thermal conversion rates, extended service life, energy efficiency, elevated reliability, and flexibility in size specifications. A primary drawback, however, is its relatively high power consumption.



PTC thermistor

### Steam Principles

When high-temperature steam interacts with fabric surfaces, it induces thermal effects on the fabric fibers, thereby altering the thermodynamic state of the material and causing fiber deformation, ultimately resulting in an ironing effect. Upon analyzing the components responsible for high-temperature steam generation in household appliances like garment steamers and fabric care machines, the heating element for high-temperature steam was identified as the primary component for steam generation.

### Types of Steam Generators

#### OPEN STEAM GENERATOR:

Characterized by its simplistic design, this system heats water in an open container, generating steam at a relatively slow rate. It is suitable for applications that do not require the continuous generation of large volumes of steam.

#### CLOSED STEAM GENERATOR:

In this design, water is stored in a sealed container and heated via resistive elements, facilitating the quick and continuous generation of steam.

#### INDUCTION HEATING:

This system employs an electromagnetic field to heat water. While efficient, it is also notably more expensive.

### Comparative Analysis

**Efficiency:** Closed systems typically exhibit greater efficiency and offer rapid, continuous steam generation.

**Cost:** Closed and induction heating systems generally incur higher costs compared to open systems.

**Maintenance:** Open systems offer ease of cleaning and maintenance. Conversely, closed systems are often preferred for commercial or professional use, owing to their high efficiency and continuous output capabilities.

**Temperature Control:** Closed and induction heating systems often provide more precise temperature control features, while open systems lag in this aspect.

### Steam Selection

Given the project requirements, a closed steam generator was chosen for its high efficiency, precise temperature control, and its capability to provide a stable output of high-temperature steam over durations of 10 to 20 minutes, making it well-suited for fabric care applications.



Closed Steam Generator(Flat)



Closed Steam Generator(Vertical)



Open Steam Generator

### 6.2.3 Lamp & Disinfectant

#### Light and Emotion Principles

Lighting can have a myriad of effects on human behavior, psychological state, and physiological responses(Chen, 2022). Optimal lighting configurations can enhance user experience significantly, whereas suboptimal lighting conditions can impede daily activities(Gharib, & Shohdy, 2023). Accordingly, selecting appropriate lighting solutions for specific applications and products remains a pivotal concern. This study examines two distinct lighting requirements: general lighting and ultraviolet (UV) disinfection.

#### Light Type

Key variables in basic lighting include brightness, color temperature, light scattering, and indirect lighting. A variety of light sources are currently available in the market, such as light-emitting diodes (LEDs), incandescent lamps, halogen lamps, and fluorescent lamps, each presenting their own set of advantages and drawbacks.

	LED	Halogen Lamps	Incandescent Bulb	Fluorescent Lamps
Advantage	Small size, low power, long life, high brightness and low heat	low cost, brightness easy control, good color rendering, high color temperature	Uniform light, good color rendering, small size, low cost	High luminous efficiency, high lumen maintenance rate, and low luminous decay, long life
Disadvantage	Toxic element content, narrow luminous surface, harmful to the eyes	Low luminous efficiency, light source is not concentrated	High power consumption, low optical performance, short life	Size large, bad color rendering, stroboscopic, electromagnetic interference

Figure 30 Type of Light(Chen, 2022).

#### Light Selection

After an exhaustive analysis, LED light sources emerge as the most favorable option for this project. LEDs offer a range of benefits including energy efficiency, environmental sustainability, compact size, customizability, high efficiency, and extended lifespan, along with the ability to adjust brightness and color temperature flexibly.

In indoor settings, research indicates appropriate ranges for both brightness and color temperature. For instance, a brightness level ranging between 50-100 LX is generally considered comfortable, while the color temperature should ideally lie between 2500K and 4500K, particularly in residential environments(Chen, 2022).



LED light

#### UV Light for disinfectant

The study also considers UV light sources, specifically UV-C light within the 100-280 nanometer wavelength range. This spectrum is primarily used for disinfecting purposes as it is capable of disrupting the DNA structure of microorganisms(Hsu, 2021). Typical UV-C light sources are either mercury lamps or LED lamps, with power consumption ranging from 10 to 100 watts.

Considering variables such as disinfection efficiency, lighting specifications, and user experience, the study recommends the use of LEDs for UV-C lighting and advises a thorough evaluation of factors like light intensity, distance, and exposure time in the design layout.

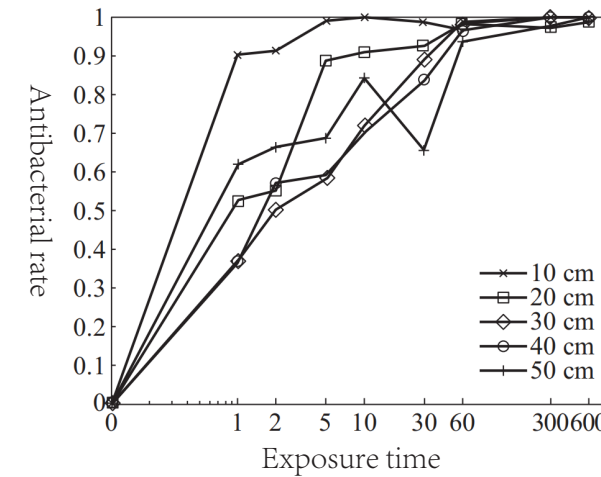
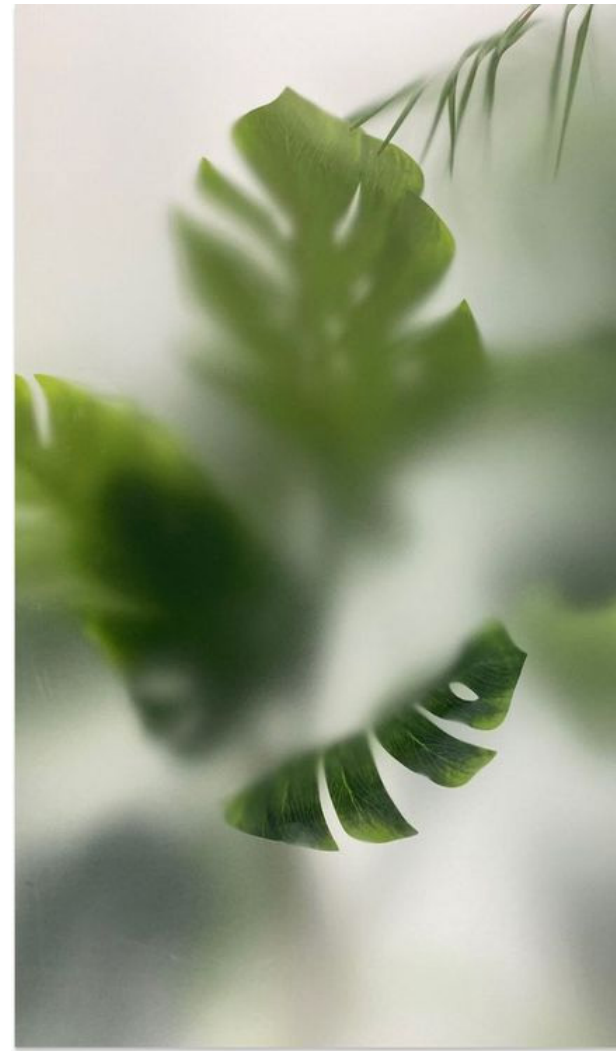
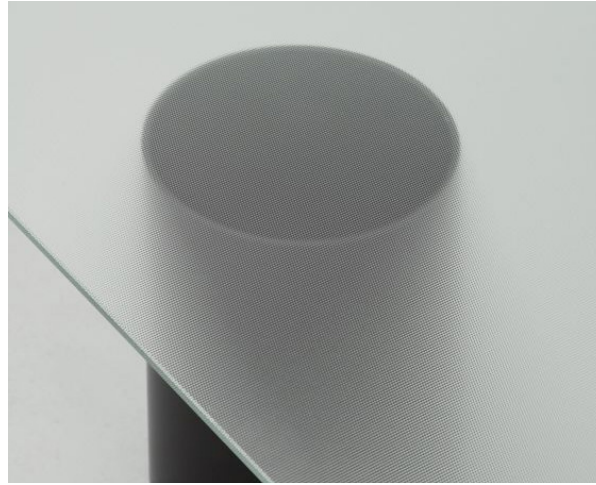
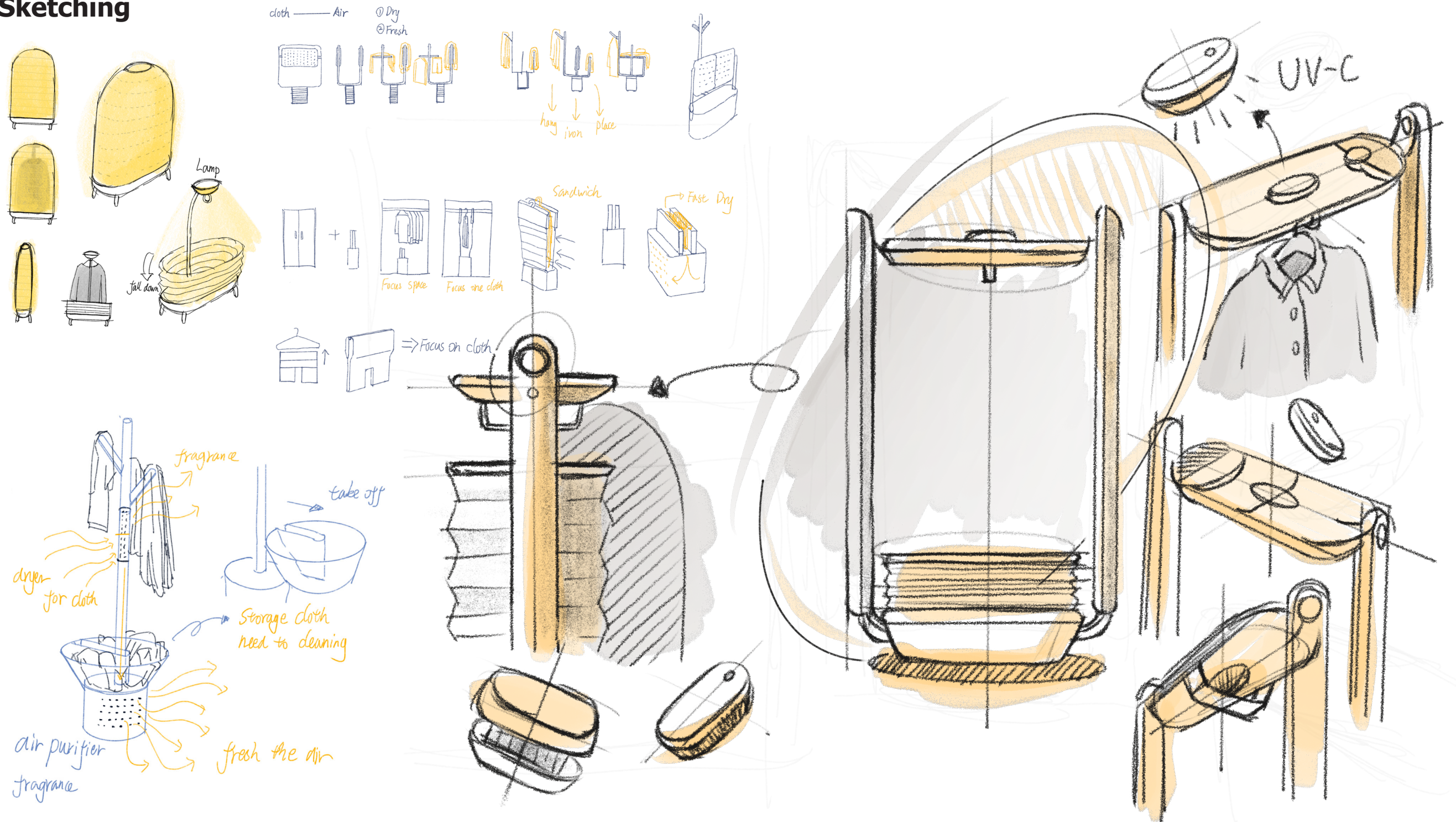


Figure 31 Sterilization rate of UV sterilization effect experiment (Weihong, 2019).

### 6.3 Mood Board



## 6.4 Sketching



07

## **Final Project-THE FLOW**

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Fast Clothing Care and Furniture-oriented  
Product Project Results Presentation



# THE FLOW

*A new fast clothing care product,  
more than a clothing care product*

FLOW is a multi-functional clothing care device designed for young people, providing fast and convenient solutions to meet daily clothing care needs such as refreshing, drying, disinfecting, and deodorizing. This device removes odors from clothes quickly, giving them a new lease of life. Its simple operation and interactive design make it easy for users needing more clothing care knowledge.

Unlike traditional household appliances, FLOW also functions as furniture, blending seamlessly with a home's indoor environment. Its versatility includes but is not limited to being a storage space for small items, temporary clothing storage, and indoor lighting. These diverse functions make FLOW not only limited to clothing care but also a furniture-oriented solution. Combining these features, the fast and convenient clothing care, and furniture-oriented functions bring users a pleasant user experience and a lighter lifestyle.

## Fast & Smart Clothes Care

In fast and intelligent clothing care, FLOW provides innovative experiences and services for young consumers. Compared to traditional clothing care devices, its small size and minimalist design make it particularly suitable for indoor environments with limited space.

The device provides a fast and efficient clothing care solution, especially for young users with limited time and energy. Its functions include clothing refreshing, odor removal, and clothing disinfection, which is highly compatible with the daily habits of young users and solves the problem of daily clothing accumulation.

Using FLOW, users can renew worn clothing from a damp, wrinkled, and odorous state, making them suitable for wearing again. This reduces the frequency of washing and energy consumption.

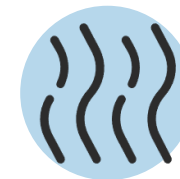


### Fast Care

10 to 20 mins

For time dimension, each mode requires a different amount of time. The standard care mode usually takes 30 minutes, while the quick care mode only takes 20 minutes, which is suitable for emergencies. For specific functions, such as UV-C sterilization, it only takes 5 minutes; clothes drying can be completed within 10 to 20 minutes (depending on the type and number of clothes).

### Multifunction



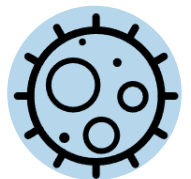
Refresh

High Temperature Steam



Drying

Gentle Drying

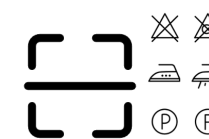


Sterilization

UV Light & Steam

Flow is designed specifically to meet the specific needs of young consumers for common types and materials of clothing. Young people's clothing is mainly made of cotton, linen, and synthetic fibers, prone to dampness and odor. The brand mainly focuses on fast fashion and sportswear, so there is no need for particularly complex or time-consuming, meticulous care, reducing time consumption. The device provides quick clothing care through three main functions: high-temperature steam for refreshing, eliminating odor, reducing wrinkles, and disinfecting; clothing drying for dehumidification and drying; and UV-C lamp for sterilization and odor elimination.

### Eazy care



NFC Scanning

NFC Clothes Care Label



Hanging

UP To 3 Clothes



Closing

Automatic Close

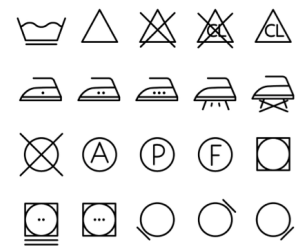
## Fast & Smart Clothes Care

- Mask Auto Lift



The furniture-Oriented design of Flow is one of its most notable features. This design not only breaks through the traditional functions and appearance of home appliances for clothing care but also achieves a higher degree of integration with the indoor environment and daily life, achieving a "hidden" product in the environment.

- NFC Scanning for Clothes Care Label

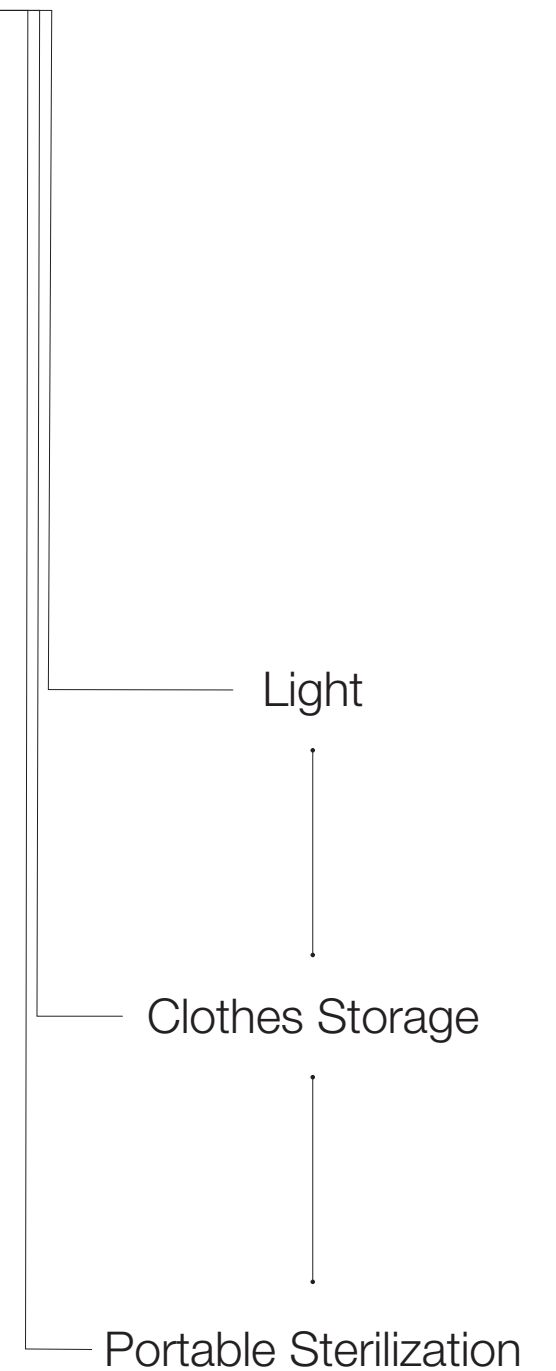


## Furniture-Oriented

The furniture-Oriented design of Flow is one of its most notable features. This design not only breaks through the traditional functions and appearance of home appliances for clothing care but also achieves a higher degree of integration with the indoor environment and daily life, achieving a "hidden" product in the environment.

The product integrates various functions commonly found in modern homes (such as lighting, storage and placement, and portable sterilization) and closely combines them with the clothing care process. While meeting the core needs of users for clothing care, its furniture-Oriented function can also meet other implicit needs in the clothing use process.

The appearance design of Flow products uses symbolic expression to enable users to intuitively identify each function, ensuring a high degree of consistency between appearance design and function, further realizing the furniture-like design of Flow.



Problem  
NFC Scanning

## Furniture-Oriented

### Light

Lighting has unique symbolism and functional significance in indoor environments and multiple functions in clothing care applications, such as UV-C lamps for disinfection and sterilization.

Flow are designed with furniture as the direction, and their primary feature is the close combination of lighting fixtures and clothing care. In daily use scenarios, Flow can not only serve as a lighting device, but also provide emotional value for users. In the process of clothing care, lighting has dual functions: 1) as an operation indicator, notifying users that the product is in operation; 2) during the disinfection and sterilization stage, the light switches to UV-C ultraviolet light to achieve sterilization and deodorization. In terms of design, the product cleverly integrates the key components of lighting and clothing care equipment - lampshade and protective cover.



### Clothes Storage

Storage and placement are important functions in indoor household settings, divided into long-term storage and temporary storage (for example, long-term storage usually uses wardrobes and bookcases, while temporary placement usually uses tables and coffee tables). Flow successfully integrates these two needs by carefully designing its appearance and function, providing a versatile storage and placement solution. The product is equipped with a cover on top, which serves as an interactive area for clothing care and temporarily stores daily necessities. In addition, when the clothing care function is not in use, the drying rack can be used as a storage area for daily clothes, with the flexibility to store 2 to 8 pieces of clothing depend on their thickness.



Scenario and Atmosphere



Lighting function



Running Instructions

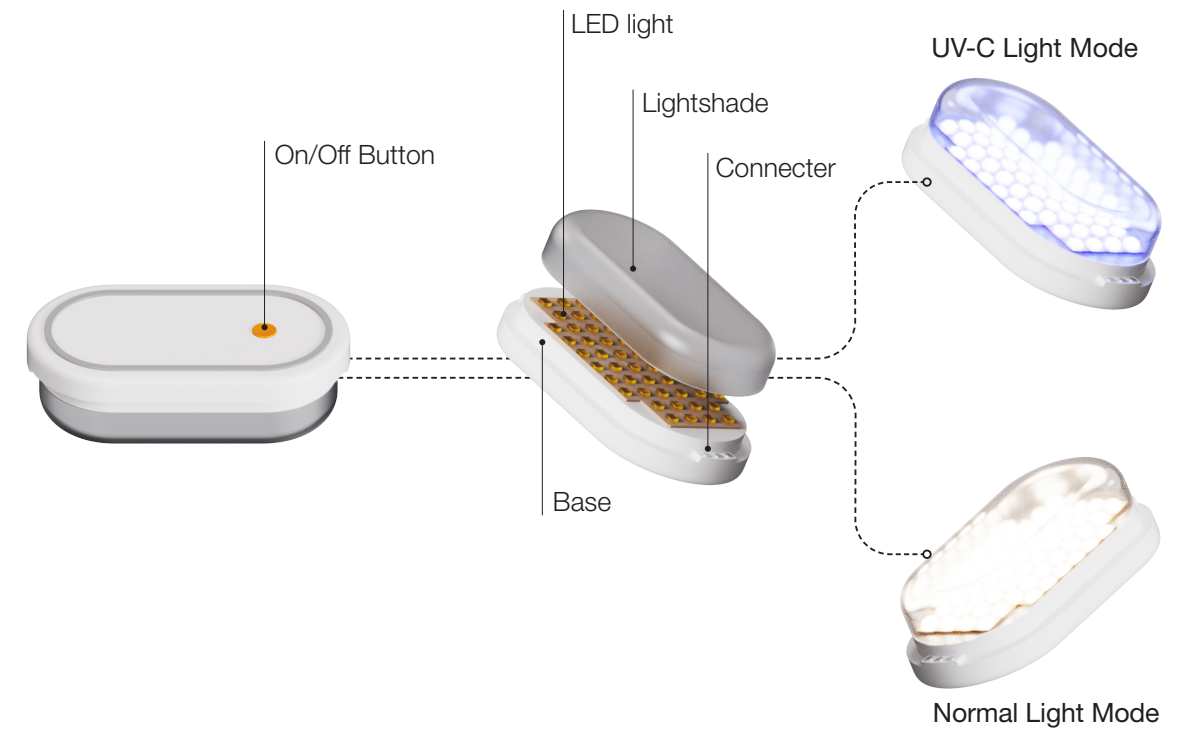


## Portable Sterilization

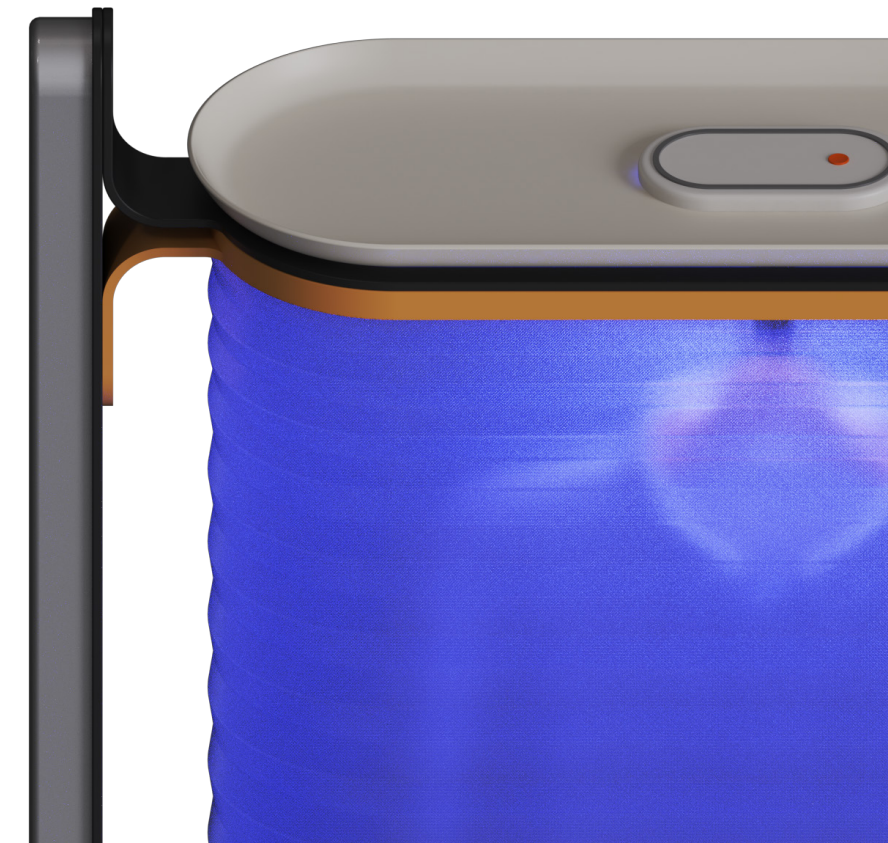
One notable feature of the Flow device is its multifunctional top light. During the clothing care process, this light can act as a ultraviolet (UV-C) lamp to sterilize and deodorize clothes. In addition, the light can be taken off from the top cover of the device and used as a portable lamp.

Due to its small size and built-in battery design, this portable lamp is suitable for outdoor or travel occasions, and can be used to sterilize daily necessities and clothes with ultraviolet light.

The portable lamp is connected to the Flow body through the connect point, port responsible for data transmission and charging, thus providing a more convenient and efficient user experience.



In the Flow clothing care application, the portable lamp connected to the Flow serves two roles: a regular lighting lamp and a UV-C ultraviolet sterilization lamp. When using the UV-C function for sterilization, it only takes 1.5 to 2 minutes to achieve sterilization and deodorization effects on clothes. After connecting to the Flow, users can directly control the various functions of the lamp through the interactive panel on the top of the device.



# IN USE

# NOT

## Clothes Care

Refresh  
+  
Drying  
+  
Sterilization

To optimize user experience, it is imperative to consider the non-primary operational states when researching and designing household appliances. Employing the "Flow" design concept, which integrates furniture-oriented aesthetics and functionality, allows these appliances to generate added value in both operational and non-operational states.



Refresh

Drying

Sterilization

The term "in use" refers to periods when the product is being utilized for its primary functional purposes and objectives



## Home Furniture

Light  
+  
Clothes storage  
+  
Daily Sterilization

During its "IN USE" phase, Flow is primarily oriented around garment care processes, offering users the capability for rapid garment maintenance, fabric refreshing, drying, and odor elimination. In contrast, during the "NOT IN USE" phase, Flow retains auxiliary functions related to garments and furniture, serving as a lighting fixture, clothing rack, and everyday item storage.

Conversely, "not in use" denotes intervals during which the product's main functions and purposes are not being engaged.



The product is suitable for indoor environments in terms of appearance and usage scenarios. It can meet the needs of daily clothing care and storage, while the lighting function can also provide functional and emotional value for users' daily lives, such as lighting, reading, or relaxation.



Fast

Lighter

Portable Sterilization

## User Experience

A good user experience can meet users' potential needs. Flow products consider both clothing care and furniture integration, meeting users' needs for use experience. In terms of clothing care, the product adapts to the clothing lifestyle of young users. Clothes can be stored in advance on Flow products, reducing clutter. Users can easily set the care mode, and the system will automatically select the appropriate care mode by scanning the care label on the clothes. Regarding furniture integration, Flow products can serve as daily lighting sources, providing emotional value to users and coordinating with the indoor environment.



Hang clothes on the shelf



The curtain rises automatically until it is closed



User operates on the interface to select the mode and start



Users can view information at any time during the clothing care process



The UV light start to sterilise, when clothes care finished

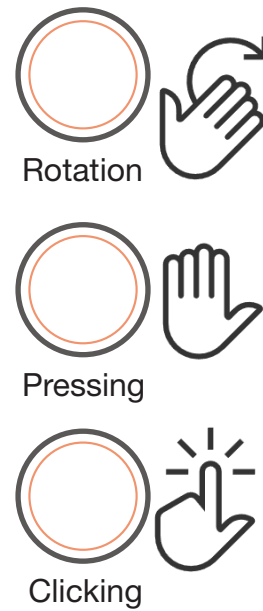


When there is no light, it means the clothing care process is finished and the curtain will open

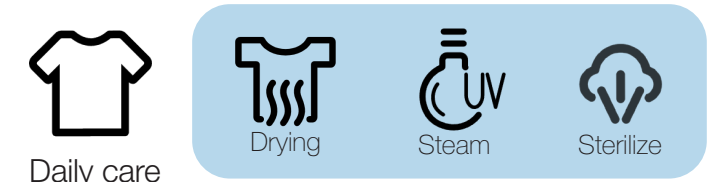


## The Interface

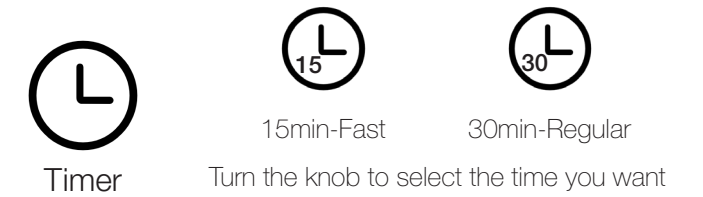
Unlike other clothing care products on the market, Flow's interactive interface is located at the top of the device. It consists of an operating knob and an LCD screen to achieve lightweight and efficient user interaction. The interface interaction only includes two levels: mode selection and specific function selection, thus avoiding the typical complexity of household appliances. Flow offers three main modes: light control, clothing care, and care mask lifting, to optimize the clothing care process. As the only input method, the operating knob reduces operation complexity. The interface also displays the device's run-time and the selected specific function, allowing users to understand the device status in real time. Overall, Flow's interactive interface can effectively promote human-machine information transmission.



### Clothes Care Mod



Click on the icon to select the function

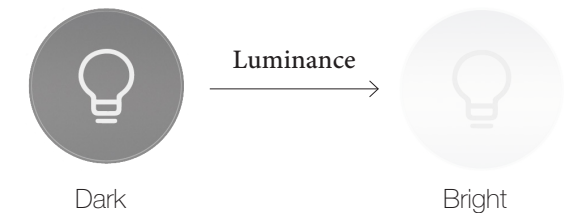


Turn the knob to select the time you want

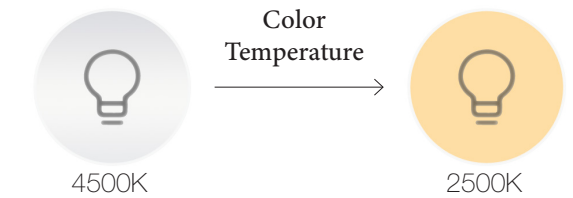
### Round Controller

The circular control knob can be interacted with in three ways: rotating (to select function, time, or brightness), pressing (to confirm an operation), and clicking the center of the knob (to go back or cancel).

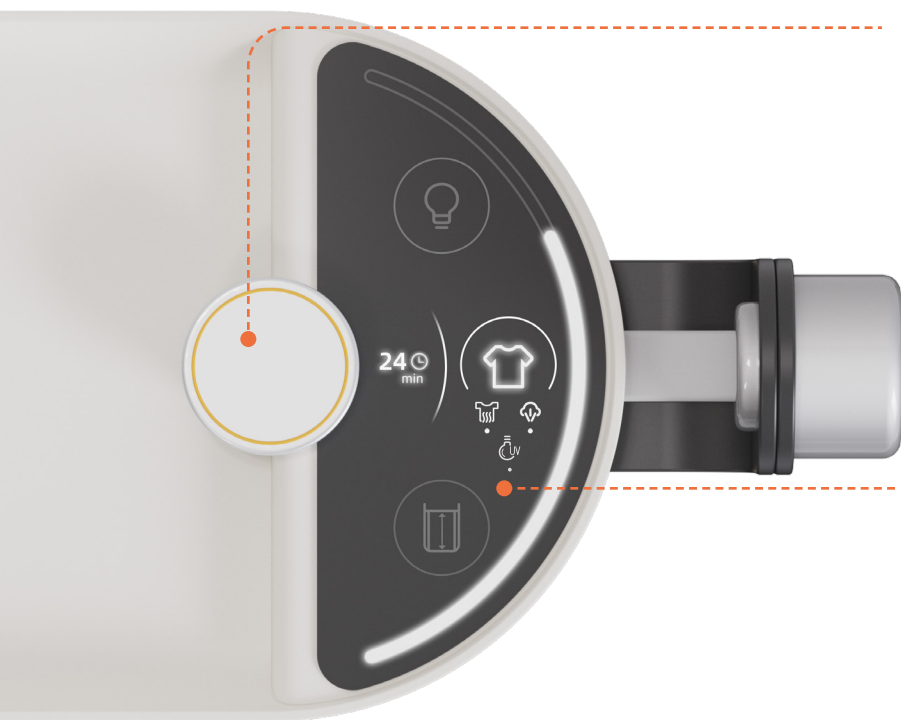
### Lamplight



Turn the knob to change the brightness of the light

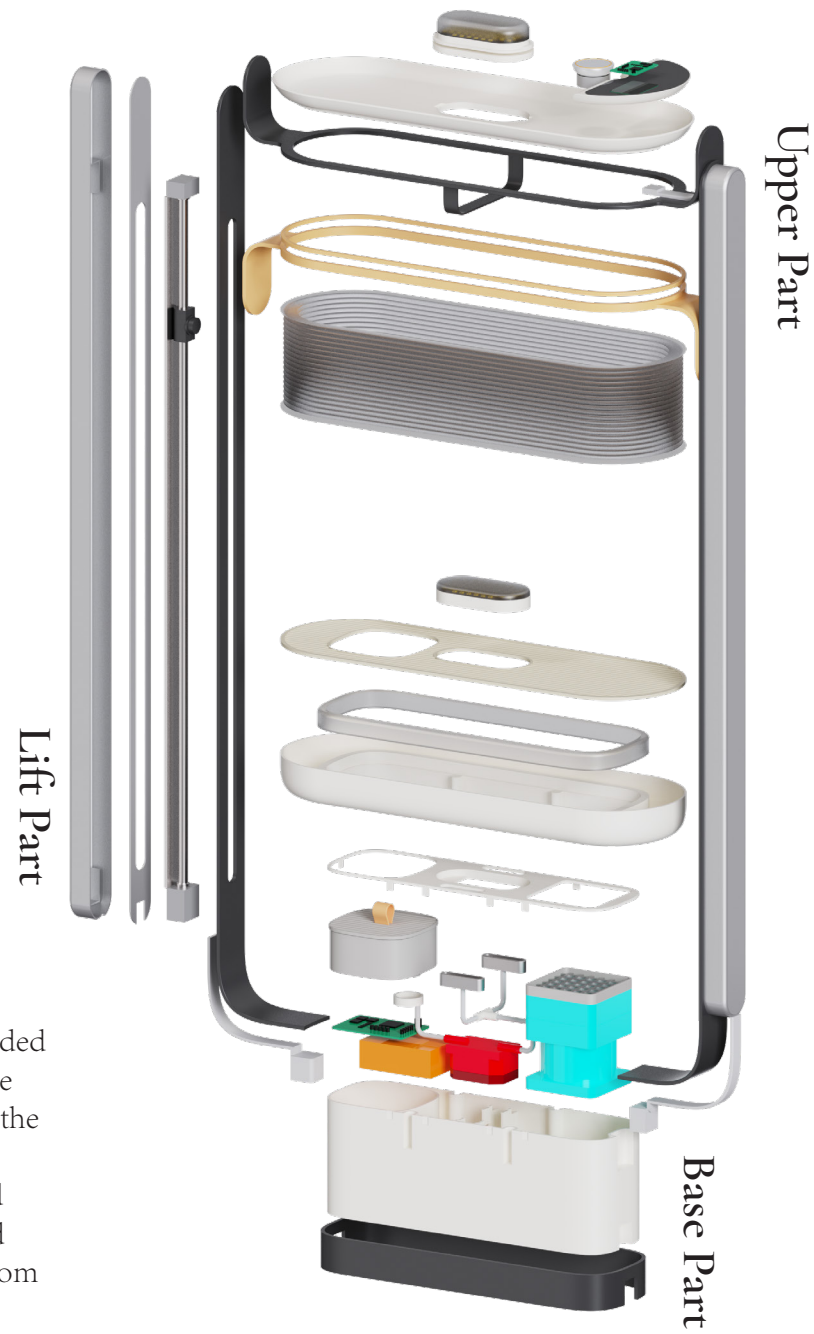


Press and turn the knob to change the color temperature of the light, it will show on the icon



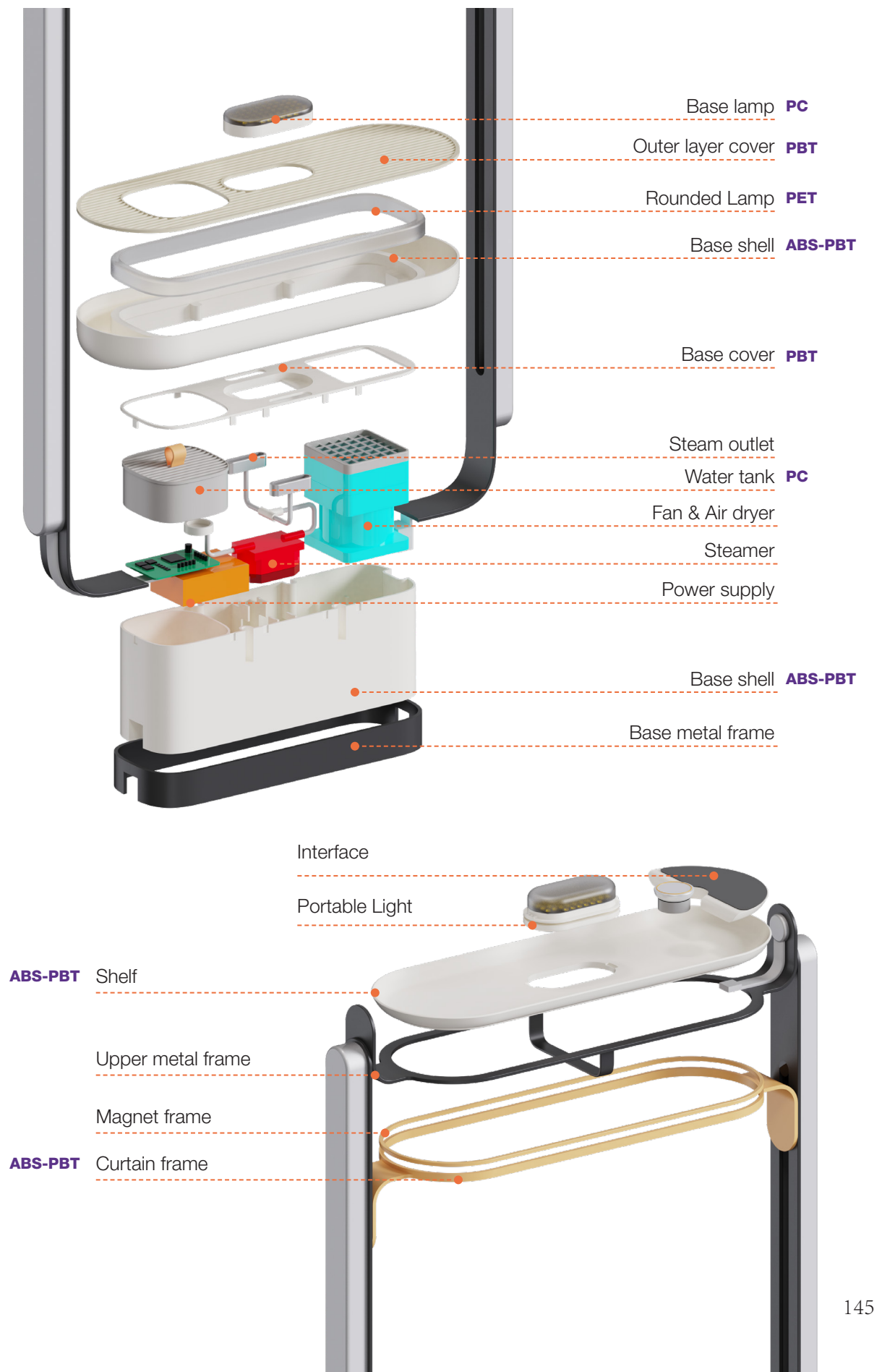
### LCD Screen

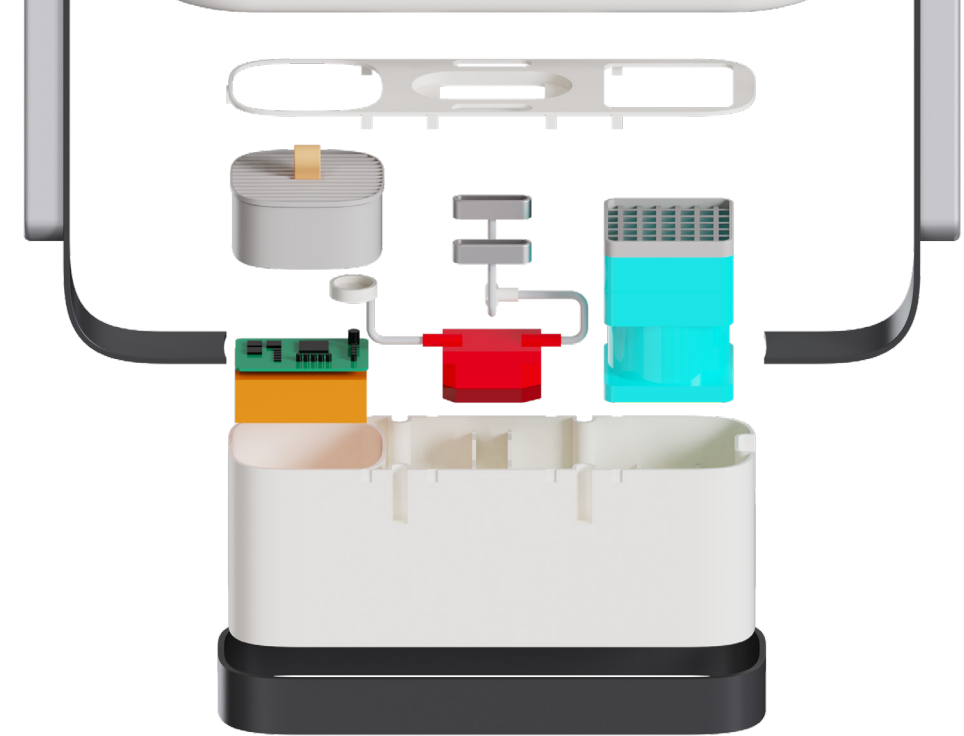
The display panel uses an LCD screen with a large display area, making it easy for users to identify information. It displays a single color (white) for user convenience.



Product structure is divided into three main parts: the base part at the bottom, the frame and auto-lift structure at the side, and the interactive panel and shelf at the top. The bottom part integrates the main functions of the product, clothes care (steam, drying), water tank, light, power, electronics, etc.

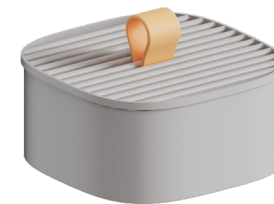
## Product Architecture





## Clothes Care Function

Water Tank



The water tank is located on the left side and provides a source of high-temperature steam for clothing care. It can hold up to 900ml of water and provide 10 complete clothing care.

Steamer  
Aroma



The high-temperature steam is generated by a small steam heating element, which is small in size and high in efficiency. There are two steam outlets on the middle sides, which can evenly distribute the steam. At the same time, there are aroma essential oil tablets at the steam outlets to deodorize the clothes.

Dryer

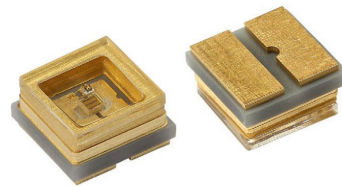


The drying system is located on the right side. The air enters from the bottom air inlet and passes through the fan and air duct to enter the PTE heating element, producing a hot airflow for drying the clothes.

## Lighting Function

### • UV light-Sterilization

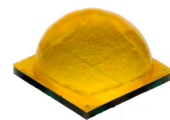
UVC light is used as a disinfection function in the process of clothing care, and operating for 1.5 to 2 minutes can achieve the bactericidal effect. The layout of the lamp is arranged up and down side of Flow, so that the UVC light source can cover all clothing, improving the disinfection effect.



UV-C light Unit

### • LED light-Daily using

In order to meet the needs of product use, satisfying the requirement for small-sized products based on users' daily lighting needs and emotional demands. The lighting uses LED light-emitting components, which can intelligently adjust the brightness and color temperature of the light, with low energy consumption, high luminous efficiency, long service life, compact size.



LED light Unit

### Color temperature change

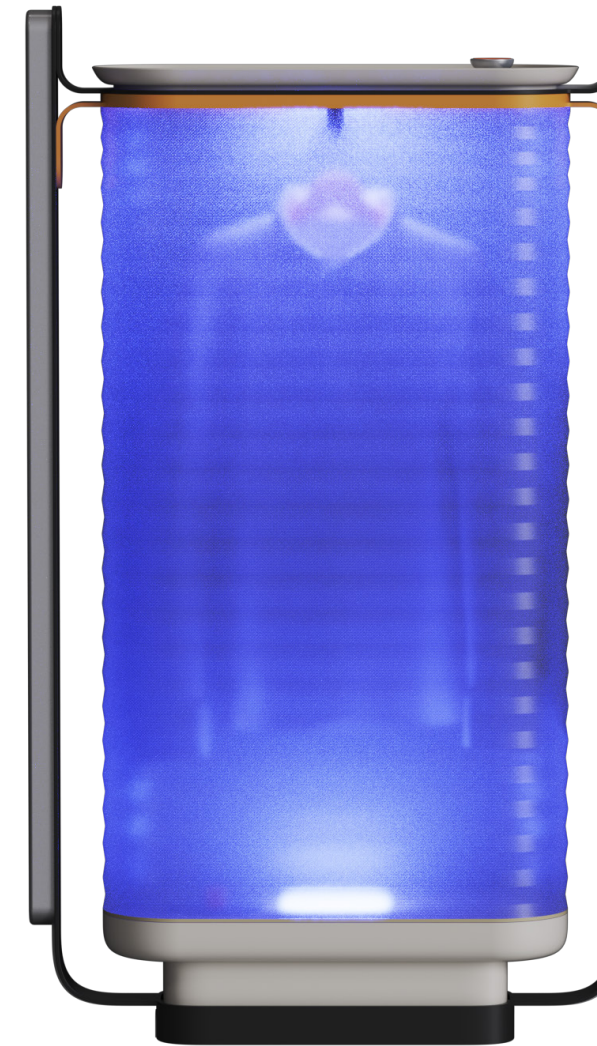


2500K

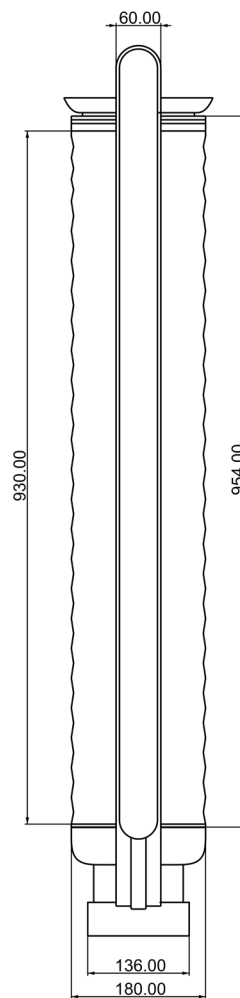
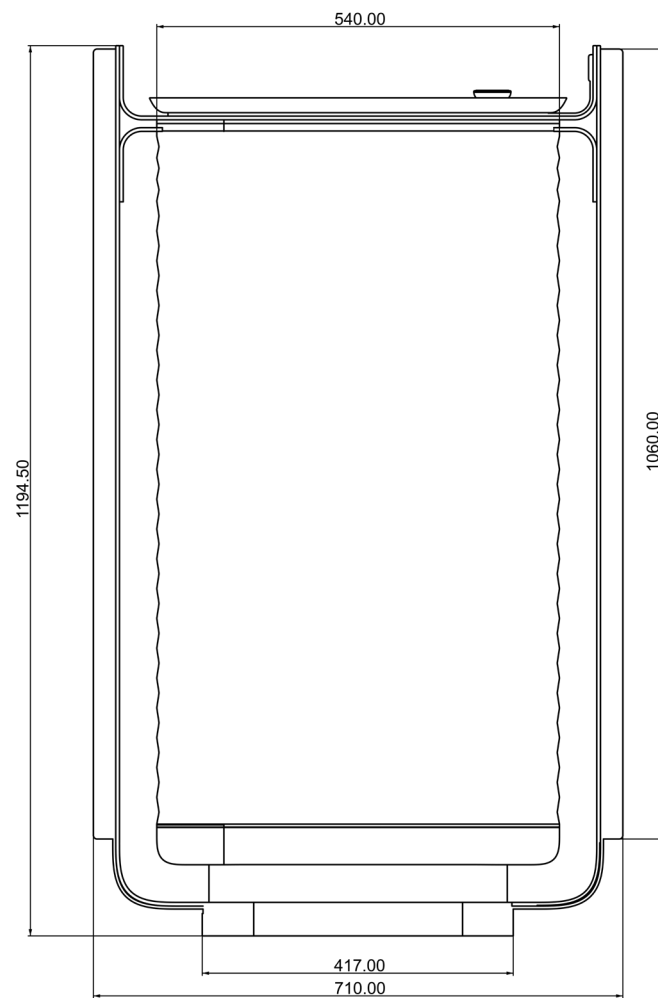
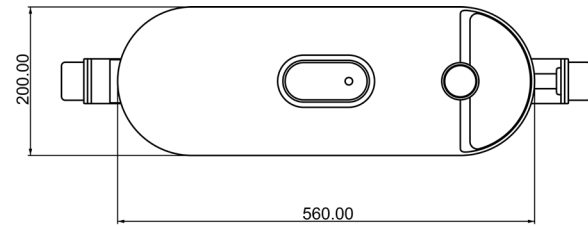


4500K

### UV light-Sterilization



## Dimension



# Material

Material selection and application must be considered to meet the design goals of product appearance and component functionality. The properties of the materials must meet the requirements of daily use and clothing care functions. In this design, two components need to be analyzed and considered:

- the material selection for the clothing care cover
- the material selection for the product shells

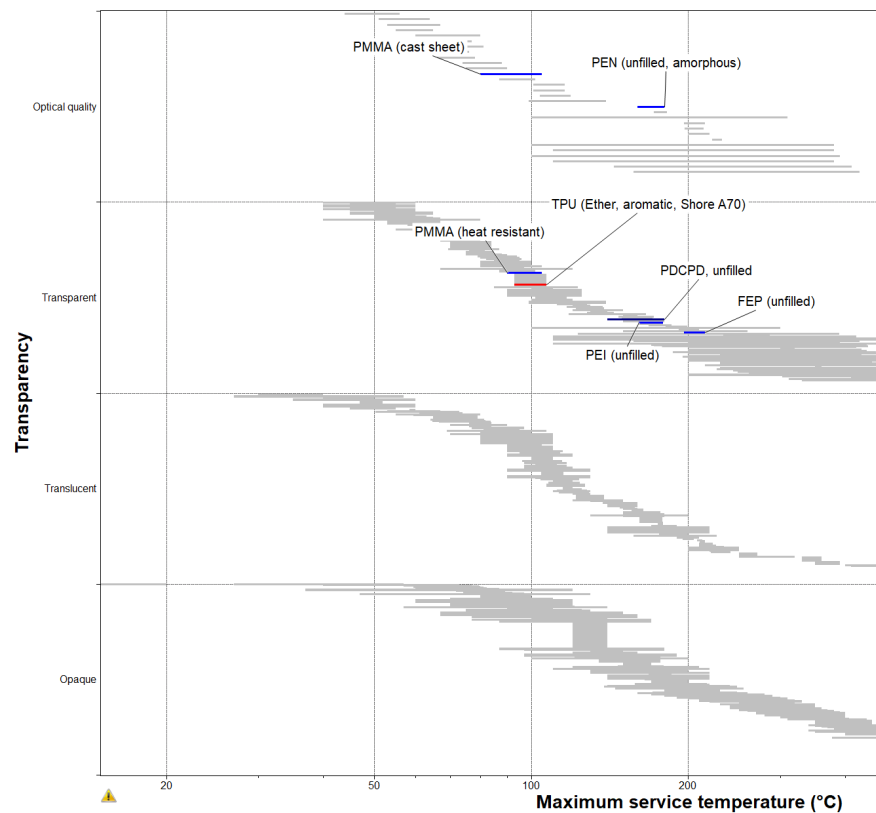


Figure 30 Material analysis and selection from Granta EduPack 2023

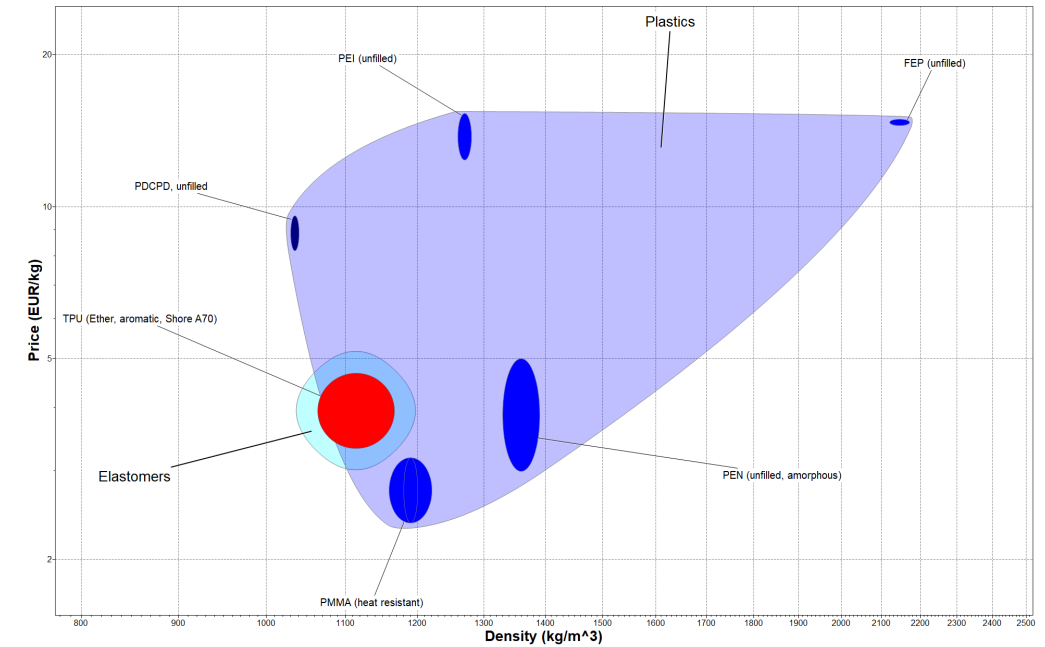


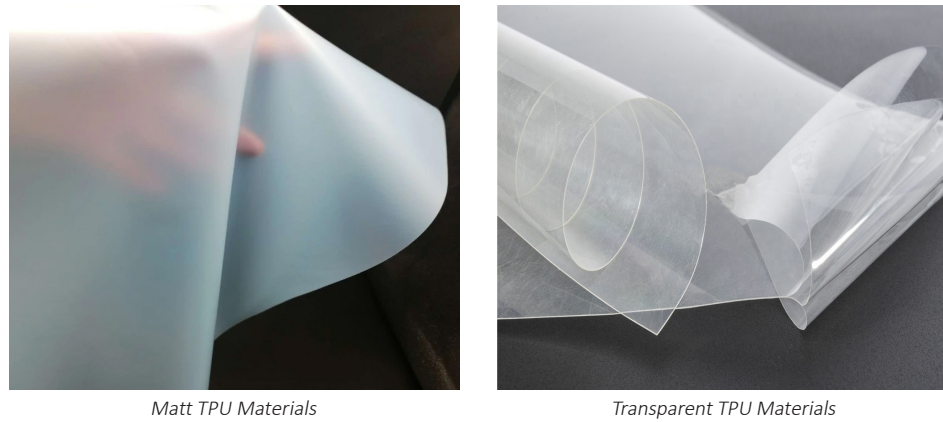
Figure 31 Material analysis and selection from Granta EduPack 2023

## 1. Clothing Care Cover

Clothing care covers need to have a sealing and isolation function during the clothing care process and as lampshades for lighting functions.

Therefore, the selected material must meet the following characteristics: transparency, high-temperature resistance, waterproofness, high durability, low cost, and lightweight.

After material selection analysis, TPU material was determined as the best choice. It has a maximum service working temperature of over 100 degrees Celsius, good UV resistance, high elasticity, wear resistance, durability, transparency, and good resistance to oil and water. In addition, TPU is suitable for common plastic processing technologies such as injection molding, extrusion, and blow molding.



## 2.Product Shells

The material selection for the product shell of Flow has two aspects. Firstly, the material should be suitable for daily use as a household electrical appliance, with high durability, low cost, and lightweight. After analyzing the materials, the following materials meet the requirements: ABS, PVC, PA, PC, PET, PBT, and PLA.

ABS is a suitable shell material: it is a widespread material for household electrical appliances. It combines strength, stiffness, toughness, and gloss.

	FEP (unfilled)	PDCPD, unfilled	PEI (unfilled)	PMMA (heat resistant)	TPU (Ether, aromatic, Shore A70)
<b>General information</b>					
<b>Composition overview</b>					
<b>Composition detail (polymers and natural materials)</b>					
<b>Price</b>					
Price (EUR/kg)	14.5 - 14.9	8.2 - 9.6	12.4 - 15.3	2.37 - 3.18	3.33 - 4.68
Price per unit volume (EUR/m <sup>3</sup> )	30700 - 32300	8450 - 9980	15600 - 19600	2750 - 3880	3540 - 5460
<b>Physical properties</b>					
Density (kg/m <sup>3</sup> )	2120 - 2170	1030 - 1040	1260 - 1280	1160 - 1220	1060 - 1170
<b>Mechanical properties</b>					
<b>Impact &amp; fracture properties</b>					
Fracture toughness (MPa.m <sup>0.5</sup> )	1.49 - 4.18	2.25 - 3.24	1.99 - 4.03	0.7 - 1.6	0.384 - 0.478
Toughness (G) (kJ/m <sup>2</sup> )	7.66 - 42.4	2.93 - 5.77	1.46 - 5	0.18 - 0.761	13.4 - 21
Impact strength, notched 23 °C (kJ/m <sup>2</sup> )	590 - 600	17 - 31	3.81 - 4.2	1.9 - 2.1	590 - 600
Impact strength, notched -30 °C (kJ/m <sup>2</sup> )		9.28 - 16.9	3.81 - 4.2	1.9 - 2.1	
Impact strength, unnotched 23 °C (kJ/m <sup>2</sup> )	590 - 600			19 - 21	590 - 600
Impact strength, unnotched -30 °C (kJ/m <sup>2</sup> )				16.4 - 19.8	
<b>Thermal properties</b>					
Melting point (°C)	264 - 286				139 - 181
Glass temperature (°C)	81 - 96	139 - 155	215 - 217	105 - 120	-58.2 - -22.8
Heat deflection temperature 0.45MPa (°C)	119 - 161	180 - 197	207 - 210	97 - 112	
Heat deflection temperature 1.8MPa (°C)	49 - 82	120 - 137	197 - 200	92 - 107	
Vicat softening point (°C)			205 - 225	101 - 116	148 - 162
Maximum service temperature (°C)	196 - 215	140 - 180	161 - 179	90 - 105	93 - 107
Minimum service temperature (°C)	-205 - -195	-273 - -196	-49 - -29	-75 - -65	
Thermal conductivity (W/m°C)	0.242 - 0.261	0.17	0.123 - 0.13	0.19 - 0.21	
Thermal conductivity with temperature (W/m°C) #			0.191		
Specific heat capacity (J/kg°C)	1010 - 1050	1700	1470 - 1530	1400 - 1480	1720 - 1880
Thermal expansion coefficient (µstrain/°C)	83 - 105	85 - 90	84.6 - 101	72 - 128	
Thermal shock resistance (°C)	433 - 569	244 - 329	255 - 313	167 - 338	
Thermal distortion resistance (MW/m)	0.00238 - 0.00304	0.00189 - 0.002	0.00125 - 0.0015	0.00156 - 0.00278	
<b>Electrical properties</b>					
<b>Magnetic properties</b>					
<b>Optical, aesthetic and acoustic properties</b>					
Refractive index	1.34 - 1.35		1.65 - 1.67	1.49 - 1.5	
Transparency	Transparent	Transparent	Transparent	Transparent	Transparent
Acoustic velocity (m/s)	395 - 406	1270 - 1340	1510 - 1550	1410 - 1800	942 - 104
Mechanical loss coefficient (tan delta)	0.113 - 0.119	0.0952 - 0.105	0.0132 - 0.0138	0.0105 - 0.0166	0.242 - 0.265
<b>Restricted substances risk indicators</b>					
<b>Critical materials risk</b>					
<b>Absorption &amp; permeability</b>					
<b>Processing properties</b>					
Polymer injection molding	Limited use	Excellent	Acceptable	Acceptable	Acceptable
Polymer extrusion	Limited use	Unsuitable	Acceptable	Excellent	Excellent
Polymer thermofoming	Unsuitable	Unsuitable	Acceptable	Acceptable	Limited use
Linear mold shrinkage (%)	3 - 6		0.5 - 0.7	0.2 - 0.8	0.8 - 1.2

Figure 32 Material analysis and selection from Granta EduPack 2023

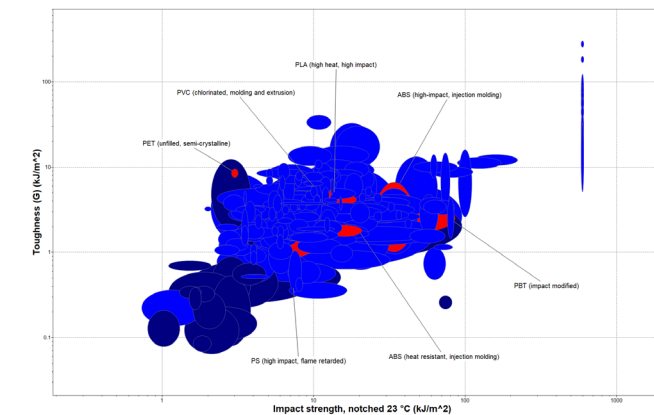
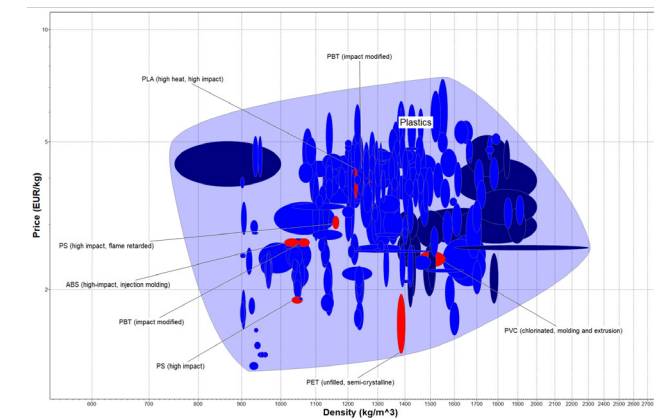


Figure 33 Material analysis and selection from Granta EduPack 2023

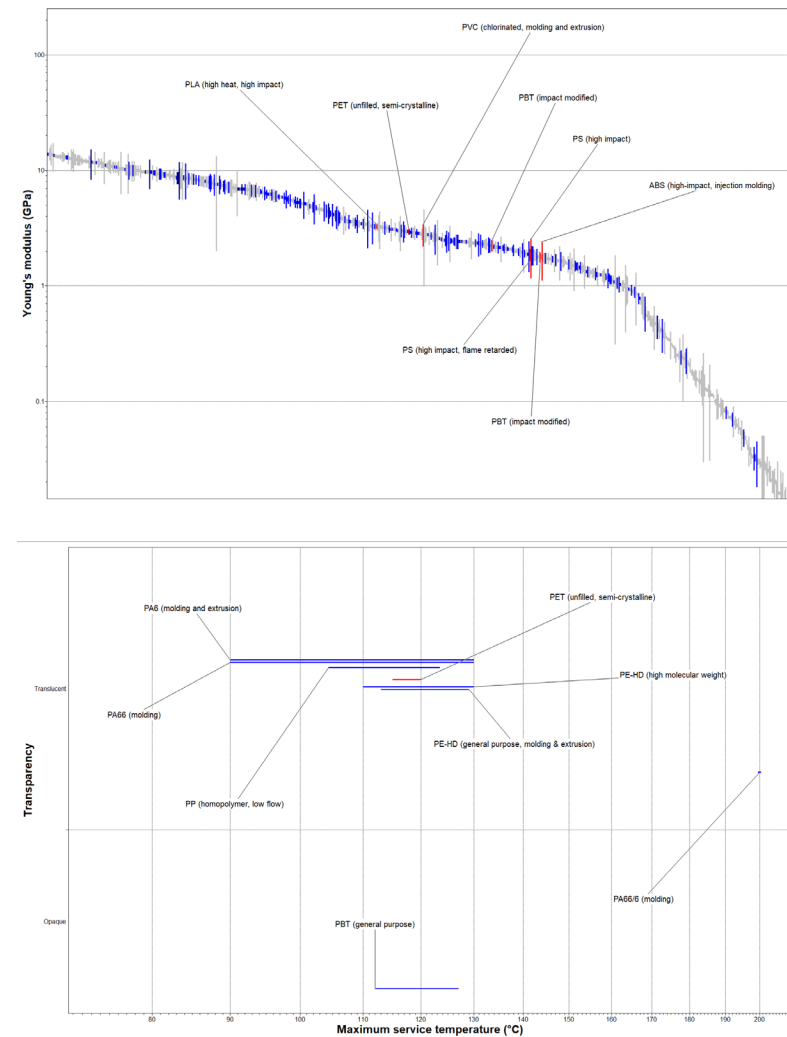


Figure 34 Material analysis and selection from Granta EduPack 2023

Another aspect is the selection of internal materials, which must have high-temperature resistance while meeting the above conditions. After comparing and researching materials, it was found that the following materials are suitable: PA, PBT, PET, PP, and PE.

Eventually, PBT was chosen as the internal structural material due to its excellent mechanical properties, high durability, heat resistance up to 150°C, good chemical stability, and good appearance and gloss.

## Outer shell

ABS (Acrylonitrile Butadiene Styrene):

Advantages: Good mechanical properties, rigidity, and impact resistance, easy to process and paint, with excellent appearance and gloss.

Disadvantages: Relatively low heat resistance, usually between 70°C to 100°C.

PVC (Polyvinyl Chloride):

Advantages: Good chemical resistance, low cost, easy to process.

Disadvantages: Poor heat resistance, may release toxic chlorine gas at high temperatures, harmful to the environment and health.

PA (Polyamide, Nylon):

Advantages: High strength and rigidity, wear-resistant, can be used at higher temperatures.

Disadvantages: Sensitive to humidity, may not be as aesthetically pleasing as other plastics.

PC (Polycarbonate):

Advantages: High transparency, high strength, excellent impact resistance, good heat resistance (up to 125°C).

Disadvantages: Relatively high price, prolonged exposure to UV may cause degradation.

PET (Polyethylene Terephthalate):

Advantages: High rigidity, good heat resistance, can provide excellent gloss and transparency.

Disadvantages: Processing needs to be controlled, as it may hydrolyze.

PBT (Polybutylene Terephthalate):

Advantages: Good mechanical properties, good chemical stability, and excellent gloss.

Disadvantages: Slightly lower continuous use temperature than PET.

PLA (Polylactic Acid):

Advantages: Biodegradable, derived from renewable resources, good transparency.

Disadvantages: Poor heat resistance (about 50°C-60°C), prolonged exposure to humidity may

## Inside (part, section)

PA (polyamide, nylon):

Advantages: High strength, high rigidity, wear resistance, can withstand temperatures up to 110°C or higher (depending on the specific type, such as PA66 or PA46), and can provide good chemical and impact resistance.

Disadvantages: Humidity can affect its size and performance; may not be as aesthetically pleasing as other materials.

PBT (polybutylene terephthalate):

Advantages: Good mechanical properties, heat resistance up to 150°C, good chemical stability, stable electrical properties, and good appearance and gloss.

Disadvantages: Continuous use temperature may be lower than 110°C.

PET (polyethylene terephthalate):

Advantages: High rigidity, high strength, good heat resistance, up to about 110°C, good chemical stability, usually used to make transparent bottles, so its appearance is superior.

Disadvantages: Harder than PBT or PA, but may not be as wear-resistant as they are.

PP (polypropylene):

Advantages: Low density, lightweight, good chemical stability, easy to process, relatively low cost.

Disadvantages: Continuous use temperature is lower than 100°C, may not be suitable for needs of 110°C. Not as hard as the aforementioned materials.

PE (polyethylene):

Advantages: Good chemical stability, low density, low cost, easy to process.

Disadvantages: Lower heat resistance (usually below 80°C), not hard enough, may not meet high temperature requirements of 110°C.



# 08

## CONCLUSION

Since the outbreak of the pandemic, people have been living in a complex and uncertain era, with increased pressure, especially among young people. They tend to prefer healthy, comfortable, and sustainable lifestyles. This lifestyle change is particularly evident in home life. Under the influence of "fast fashion" and social media, young people's clothing purchases and types have increased, leading to a greater demand for daily clothing care (such as quick refreshing, wrinkle removal, drying, and disinfection). However, many young people need to learn clothing care habits. After in-depth research, it was found that young people expect household appliances to be more intelligent, efficient, and emotional while also having a clear demand for clothing care.

This project aims to design smart clothing care products that adapt to the lifestyle of young people. After a deep understanding of young people's lifestyle and clothing care behavior, it was identified that they need quick, efficient, and emotional clothing care products. This design emphasizes the relationship between "user-product-environment" and aims to meet users' actual and potential needs. Most existing clothing care products are too large and heavy, unsuitable for small homes of young people, have complex operations, overly emphasize product functions, and need to match the appearance of indoor decoration, resulting in poor user experience.

The design goal of the product is to integrate the characteristics of home appliances and furniture, and achieve quick and flexible clothing care. The product requirements, application scenarios, positioning, and functions were deeply analyzed in the design process, emphasizing user experience and emotional design. The product focuses on the all-round experience of users, combining the rationality of the internal structure and the aesthetics of the appearance, aiming to provide convenience and value to users. Ultimately, a user-friendly, complete solution that meets users' potential needs is provided. Flow products meet the needs of young users for quick refreshing of clothing, improve clothing care and usage experience while considering their emotions and clothing placement habits, and reduce resource waste, extending the life of clothing.

Future designs need further to consider the changes in the lifestyle of young people, meet their actual and potential needs, especially in the field of clothing care, provide users with more environmentally friendly and sustainable products, reduce water resource consumption, and help them develop good clothing care habits.

# Bibliography

## Paper

- An, W., Xin, X., Ding, X., & Liu, Y. (2020). Lifestyle as the Object of Design: Elements Exploration from Experience Perspective. Design, User Experience, and Usability. Interaction Design: 9th International Conference, DUXU 2020, Held as Part of the 22nd HCI International Conference, HCII 2020, Copenhagen, Denmark, July 19-24, 2020, Proceedings, Part I 22, 311-323.
- Ashdown, S. P. (2011). Improving body movement comfort in apparel. In *Improving comfort in clothing* (pp. 278-302). Elsevier.
- Baik, K., Yoon, S. Y., Lee, S., & Park, C. H. (2023). Deformation Recovery and Dimensional Stability Properties of Fabrics in a Clothing Care Machine. *Fibers and Polymers*, 24(4), 1453-1462. <https://doi.org/10.1007/s12221-023-00039-5>
- Bergen, M., & Peteraf, M. A. (2002). Competitor identification and competitor analysis: A broad-based managerial approach. *Managerial and Decision Economics*, 23(4-5), 157-169.
- Beton, A., Dias, D., Farrant, L., Gibon, T., Le Guern, Y., Desaxce, M., Perwuelz, A., Boufateh, I., Wolf, O., & Kougoulis, J. (2014). Environmental improvement potential of textiles (IMPRO-Textiles). European Commission, 20.
- Brasquet, C., & Le Cloirec, P. (1997). Adsorption onto activated carbon fibers: Application to water and air treatments. *Carbon*, 35(9), 1307-1313.
- Brynjolfsson, E., Horton, J. J., Ozimek, A., Rock, D., Sharma, G., & TuYe, H.-Y. (2020). COVID-19 and remote work: An early look at US data. National Bureau of Economic Research.
- Castro, J. B., Ramanathan, A., & Chennubhotla, C. S. (2013). Categorical Dimensions of Human Odor Descriptor Space Revealed by Non-Negative Matrix Factorization. *PLOS ONE*, 8(9), e73289. <https://doi.org/10.1371/journal.pone.0073289>
- Chen, Y., Li, T., Yao, H., & Zhang, C. (2022). Reasonable use of Indoor Lighting in Human Living Environment. *Highlights in Science, Engineering and Technology*, 28, 267-272.
- Chrobot, P., Faist, M., Gustavus, L., Martin, A., Stamm, A., Zollinger, M., & Zah, R. (2018). Measuring fashion: Environmental impact of the global apparel and footwear industries study. Full Report and Methodological Considerations.
- Coman, D., Oancea, S., & Vrinceanu, N. (n.d.). Biofunctionalization of textile materials by antimicrobial treatments: A critical overview. *Romanian Biotechnological Letters*, 15(1).
- Doi, M., Howell, J., & Hirakawa, S. (2012). Personal and home electronics and our changing lifestyles. *Proceedings of the IEEE*, 100(Special Centennial Issue), 1646-1656.
- Dunlap, R. E., & York, R. (2008). The globalization of environmental concern and the limits of the postmaterialist values explanation: Evidence from four multinational surveys. *The Sociological Quarterly*, 49(3), 529-563.
- Featherstone, M. (1987). Lifestyle and consumer culture. *Theory, Culture & Society*, 4(1), 55-70.
- Fletcher, K. (2012). Durability, fashion, sustainability: The processes and practices of use. *Fashion Practice*, 4(2), 221-238.
- Gharib, I., & Shohdy, M. (2023). Lighting and Emotions: A Brief Review. *Journal of Design Sciences and Applied Arts*, 4(2), 84-92.

Guerrero, H. M. D.-A., Costas, E., & García, P. M.-A. (n.d.). Why do we iron clothes? Tracking its origins based on a sanitary hypothesis.

Gwilt, A. (2021). Caring for clothes: How and why people maintain garments in regular use. *Continuum*, 35(6), 870-882.

Harris, F., Roby, H., & Dibb, S. (2016). Sustainable clothing: Challenges, barriers and interventions for encouraging more sustainable consumer behaviour. *International Journal of Consumer Studies*, 40(3), 309-318.

Higgs, N. (2017, January 30). HISTORY OF THE WASHING MACHINE | Speedqueeninvestor. <https://speedqueeninvestor.com/news/history-of-the-washing-machine/>

Hsu, T.-C., Teng, Y.-T., Yeh, Y.-W., Fan, X., Chu, K.-H., Lin, S.-H., Yeh, K.-K., Lee, P.-T., Lin, Y., Chen, Z., Wu, T., & Kuo, H.-C. (2021). Perspectives on UVC LED: Its Progress and Application. *Photonics*, 8(6), Article 6. <https://doi.org/10.3390/photonics8060196>

Hughes-Riley, T., Dias, T., & Cork, C. (2018). A historical review of the development of electronic textiles. *Fibers*, 6(2), 34.

Ivanova, S. S., Aksoy, Y. Ü., Krasnikova, Y. S., Mashkin, N. A., Chizh, N. V., & Kryazeva, S. A. (2022). People's views of hygiene and personal care during COVID-19 outbreak. *Eurasia Journal of Mathematics, Science and Technology Education*, 18(4), em2101.

Jackson, T. (2005). Motivating sustainable consumption: A review of evidence on consumer behaviour and behavioural change. *Sustainable Development Research Network*, 29(1), 30-40.

Joy, A., Sherry Jr, J. F., Venkatesh, A., Wang, J., & Chan, R. (2012). Fast fashion, sustainability, and the ethical appeal of luxury brands. *Fashion Theory*, 16(3), 273-295.

Khamsi, R. (2022). Unpicking the link between smell and memories. *Nature*, 606(7915), S2-S4. <https://doi.org/10.1038/d41586-022-01626-x>

Knez, I. (1995). Effects of indoor lighting on mood and cognition. *Journal of Environmental Psychology*, 15(1), 39-51.

Kontaris, I., East, B. S., & Wilson, D. A. (2020). Behavioral and Neurobiological Convergence of Odor, Mood and Emotion: A Review. *Frontiers in Behavioral Neuroscience*, 14. <https://www.frontiersin.org/articles/10.3389/fnbeh.2020.00035>

Laitala, K., Klepp, I. G., Kettlewell, R., & Wiedemann, S. (2020). Laundry care regimes: Do the practices of keeping clothes clean have different environmental impacts based on the fibre content? *Sustainability*, 12(18), 7537.

Li, W., Calle, L., Hanford, A., Stambaugh, I., & Callahan, M. (2018). Investigation of silver biocide as a disinfection technology for spacecraft—an early literature review.

Liang, S., Ding, X. M., Wu, X. Y., Wu, F., & Asmamaw, T. M. (2016). Design and practicability evaluation: A novel platform for fabric steam ironing. *International Journal of Clothing Science and Technology*, 28(4), 449-462.

Ma, B., Bright, K., Ikner, L., Ley, C., Seyedi, S., Gerba, C. P., Sobsey, M. D., Piper, P., & Linden, K. G. (2023). UV Inactivation of Common Pathogens and Surrogates Under 222 nm Irradiation from KrCl\* Excimer Lamps. *Photochemistry and Photobiology*, 99(3), 975-982. <https://doi.org/10.1111/php.13724>

McLaren, A., Oxborrow, L., Cooper, T., Hill, H., & Goworek, H. (2015). Clothing longevity perspectives: Exploring consumer expectations, consumption and use.

Moazzem, S., Crossin, E., Daver, F., & Wang, L. (2021). Environmental impact of apparel supply chain and textile products. *Environment, Development and Sustainability*, 1-19.

Morgan, P. W. (1981). Brief history of fibers from synthetic polymers. *Journal of Macromolecular Science—Chemistry*, 15(6), 1113-1131.

Nayak, R. K., & Padhye, R. (2015). The care of apparel products. In *Textiles and fashion* (pp. 799-822). Elsevier.

Nayak, R., & Padhye, R. (2015). Care labelling of clothing. In *Garment Manufacturing Technology* (pp. 427–446). Elsevier.

Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., Agha, M., & Agha, R. (2020). The socio-economic implications of the coronavirus pandemic (COVID-19): A review. *International Journal of Surgery, 78*, 185–193.

Nikolina, S. (n.d.). Environmental impact of textile and clothes industry.

Nonthermal plasma. (2023). In Wikipedia. [https://en.wikipedia.org/w/index.php?title=Nonthermal\\_plasma&oldid=1172236130](https://en.wikipedia.org/w/index.php?title=Nonthermal_plasma&oldid=1172236130)

Odabaşoğlu, S., & Olguntürk, N. (2015). Effects of coloured lighting on the perception of interior spaces. *Perceptual and Motor Skills, 120*(1), 183–201.

Park, S., Lee, D., & Kim, Y. (2023). Experimental evaluation of the performance characteristics of a heat pump clothing care system under various operating conditions. *International Journal of Thermal Sciences, 192*, 108433.

Remy, N., Speelman, E., & Swartz, S. (2016). Style that's sustainable: A new fast-fashion formula. McKinsey Global Institute.

Sadikoglu-Asan, H. (2022). 'User-Home relationship' regarding user experience of smart home products. *Intelligent Buildings International, 14*(1), 114–130.

Sanders, D., Grunden, A., & Dunn, R. R. (2021). A review of clothing microbiology: The history of clothing and the role of microbes in textiles. *Biology Letters, 17*(1), 20200700.

Sandin, G., Roos, S., Spak, B., Zamani, B., & Peters, G. (2019). Environmental assessment of Swedish clothing consumption—Six garments, Sustainable Futures. *Mistra Future Fashion, 6*.

Scott, R., Joshi, L. T., & McGinn, C. (2022). Hospital surface disinfection using ultraviolet germicidal irradiation technology: A review. *Healthcare Technology Letters, 9*(3), 25–33. <https://doi.org/10.1049/htl2.12032>

Senthilkumar, P., Arun, N., & Vigneswaran, C. (2015). Plasma sterilization: New epoch in medical textiles. *Journal of The Institution of Engineers (India): Series E, 96*, 75–84.

Sharma, A., Kumar, R., Aier, I., Semwal, R., Tyagi, P., & Varadwaj, P. (2019). Sense of Smell: Structural, Functional, Mechanistic Advancements and Challenges in Human Olfactory Research. *Current Neuropharmacology, 17*(9), 891–911. <https://doi.org/10.2174/1570159X17666181206095626>

Singh, S., Kshtriya, S., & Valk, R. (2023). Health, Hope, and Harmony: A Systematic Review of the Determinants of Happiness across Cultures and Countries. *International Journal of Environmental Research and Public Health, 20*(4), 3306. <https://doi.org/10.3390/ijerph20043306>

Sorrentino, A., Leone, D., & Caporuscio, A. (2022). Changes in the post-covid-19 consumers' behaviors and lifestyle in Italy. A disaster management perspective. *Italian Journal of Marketing, 2022*(1), 87–106.

Strategy, B. O. (2005). *How to Create Uncontested Market Space and Make the Competition Irrelevant*. Boston, MA: Harvard Business School Publishing.

Taylor, S., & Asmundson, G. J. (2020). Life in a post-pandemic world: What to expect of anxiety-related conditions and their treatment. *Journal of Anxiety Disorders, 72*, 102231.

Tomassoni, R., Galetta, G., & Treglia, E. (2015). Psychology of light: How light influences the health and psyche. *Psychology, 6*(10), 1216.

Vezzoli, C. (1998). Clothing care in the sustainable household. 7th GIN Conference, Rome.

Wahba, M. A., & Bridwell, L. G. (1976). Maslow reconsidered: A review of research on the need hierarchy theory. *Organizational Behavior and Human Performance, 15*(2), 212–240.

Wang, J., Tang, B., Bai, W., Lu, X., Liu, Y., & Wang, X. (2020). Deodorizing for fiber and fabric: Adsorption, catalysis, source control and masking. *Advances in Colloid and Interface Science, 283*, 102243. <https://doi.org/10.1016/>

j.cis.2020.102243

Wang, X., Huang, Z., Xu, T., Li, Y., & Qin, X. (2023). Exploring the Future Design Approach to Ageing Based on the Double Diamond Model. *Systems, 11*(8), 404.

Wilson, C., Hargreaves, T., & Hauxwell-Baldwin, R. (2015). Smart homes and their users: A systematic analysis and key challenges. *Personal and Ubiquitous Computing, 19*(2), 463–476. <https://doi.org/10.1007/s00779-014-0813-0>

Wu, F., Liang, S. T., & Ding, X. M. (2016). Study on the mechanism of woven cotton fabric during steam ironing. *Key Engineering Materials, 671*, 179–185.

Zamani, B., Sandin, G., & Peters, G. M. (2017). Life cycle assessment of clothing libraries: Can collaborative consumption reduce the environmental impact of fast fashion? *Journal of Cleaner Production, 162*, 1368–1375.

郭玮宏, 袁士东, 杨锐, & 张涛. (2019). UVC LED 的杀菌特性研究及应用. *北京理工大学学报自然版, 39*(S1), 102–107. <https://doi.org/10.15918/j.tbit1001-0645.2019.s1.019>

张维超, 李轶, 焦晓兰 & 王迪. (2021). 衣物洗护家电健康功能在防护日常微生物污染中的应用. *家电科技 (S1)*, 436–440. doi:10.19784/j.cnki.issn1672-0172.2021.99.103.

崔阅馨, 周李清, 梁帅童 & 丁雪梅. (2020). 蒸汽垂直熨烫下机织物折痕回复效果的评价方法研究. *上海纺织科技 (02)*, 10–13. doi:10.16549/j.cnki.issn.1001-2044.2020.02.003.

## Reports

7 Motivations for Lighter Living Action in BC

Accenture Life Trends 2023

Preferred Fiber & Materials Market Report

Style that's sustainable: A new fast-fashion formula - McKinsey & Company

Sustainability Report - DeLonghi group

Corporate Presentation 2022- DeLonghi group

## Website

Advisory on the Use of UVC Sterilisers in the Home. (n.d.). Retrieved September 6, 2023, from <https://www.nea.gov.sg/our-services/radiation-safety/advisory-on-the-use-of-uvc-sterilisers-in-the-home>

ALC-M2 | AG+ Medical Grade Silver Ion Antiviral Air Purifier. (n.d.). Aurabeat Technology Limited. Retrieved September 6, 2023, from <https://aurabeattech.com/products/alc-m2-ag-pro-silver-ion-antiviral-air-purifier>

Bennett, B. (n.d.). Whirlpool Swash review: Pseudo-dry cleaning at home. CNET. Retrieved September 6, 2023, from <https://www.cnet.com/reviews/whirlpool-swash-review/>

Care For You Yr3040: Soluzione tutto in uno | Rowenta. (n.d.). Retrieved September 6, 2023, from <https://www.rowenta.it/p/care-for-you-yr3040/1830008312>

Fast Fashion Explained and How It Impacts Retail Manufacturing. (n.d.). Retrieved September 6, 2023, from <https://www.investopedia.com/terms/f/fast-fashion.asp>

History | De' Longhi Group—Corporate Website. (n.d.). Retrieved September 6, 2023, from <https://www.delonghigroup.com/en/group/history>

How the LG Styler Works. (2012, July 18). HowStuffWorks. <https://electronics.howstuffworks.com/gadgets/other-gadgets/lg-styler.htm>

Lavatrice TrueSteam™. (n.d.). LG Italia. Retrieved September 6, 2023, from <https://www.lg.com/it/elettrodomestici/true-steam>

LG Styler Steam Clothing Care System® S3WF 3 Hangers—White—S3WF. (n.d.). LG UK. Retrieved September 6, 2023, from <https://www.lg.com/uk/laundry/styler/s3wf/>

Macchine da caffè manuali con caffè in grani | De'Longhi IT. (n.d.). Retrieved September 6, 2023, from <https://www.delonghi.com/it-it/prodotti/caffe/macchine-manuali-per-caffe-in-chicchi>

Nanoe™ X | Air Conditioner | Panasonic. (n.d.). Retrieved September 6, 2023, from <https://www.panasonic.com/global/hvac/nanoe.html>

The journey | De' Longhi Group—Corporate Website. (n.d.). Retrieved September 6, 2023, from <https://www.delonghigroup.com/en/sustainability/journey>

INSIGHTS, B. (n.d.). Gen-Z and Fashion in the Age of Realism. BoF INSIGHTS. Retrieved September 6, 2023, from <https://shop.businessoffashion.com/products/gen-z-and-fashion-in-the-age-of-realism>

等离子体灭菌技术—中国科学院等离子体物理所科普网. (n.d.). Retrieved September 6, 2023, from [http://www.ipp.ac.cn/kxcb/dlz/201210/t20121004\\_99712.html](http://www.ipp.ac.cn/kxcb/dlz/201210/t20121004_99712.html)

## Note

- 1 McLaren, A., Oxborrow, L., Cooper, T., Hill, H., & Goworek, H. (2015). Clothing longevity perspectives: exploring consumer expectations, consumption and use.
- 2 Kerr J. (2017, October 6). 35 Surprising Home Organization Statistics That'll Inspire You to Tidy Up. Organized Interiors Blog. <https://www.organizedinteriors.com/blog/home-organization-statistics/>
- 3 UK Measures of National Well-being Dashboard—Office for National Statistics. (n.d.). Retrieved September 9, 2023, from <https://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/articles/ukmeasuresofnationalwellbeing/dashboard>
- 4 Netherlands, S. (n.d.). Monitor of Well-being and the Sustainable Development Goals 2023 [Webpagina]. Statistics Netherlands. Retrieved September 9, 2023, from <https://www.cbs.nl/en-gb/dossier/dossier-well-being-and-the-sustainable-development-goals/monitor-of-well-being-and-the-sustainable-development-goals-2023>
- 5 Singh, S., Kshtriya, S., & Valk, R. (2023). Health, Hope, and Harmony: A Systematic Review of the Determinants of Happiness across Cultures and Countries. *International Journal of Environmental Research and Public Health*, 20(4), 3306. <https://doi.org/10.3390/ijerph20043306>
- 6 Ivanova, S. S., Aksoy, Y. Ü., Krasinikova, Y. S., Mashkin, N. A., Chizh, N. V., & Knyazeva, S. A. (2022). People's views of hygiene and personal care during COVID-19 outbreak. *Eurasia Journal of Mathematics, Science and Technology Education*, 18(4), em2101.
- 7 Nations, U. (n.d.). United Nations Conference on the Human Environment, Stockholm 1972. United Nations; United Nations. Retrieved September 9, 2023, from <https://www.un.org/en/conferences/environment/stockholm1972>
- 8 Nikolina, S. (n.d.). Environmental impact of textile and clothes industry.
- 9 Laitala, K., Klepp, I. G., Kettlewell, R., & Wiedemann, S. (2020). Laundry care regimes: Do the practices of keeping clothes clean have different environmental impacts based on the fibre content? *Sustainability*, 12(18), 7537.
- 10 Cambridge Dictionary: Find Definitions, Meanings & Translations. (2023, September 6). <https://dictionary.cambridge.org/us/>
- 11 7 Motivations for Lighter Living Action in BC. (2022, February 13). One Planet Network. <https://www.oneplanetnetwork.org/knowledge-centre/resources/7-motivations-lighter-living-action-bc>
- 12 Norman, D. (2013). *The design of everyday things: Revised and expanded edition*. Basic books.
- 13 Worn Wear—Better Than New. (n.d.). Retrieved September 9, 2023, from <https://wornwear.patagonia.com>
- 14 Ergostone—The Multi-Tool For Your Well-Being by Ergostone—Kickstarter. (n.d.). Retrieved September 9, 2023, from <https://www.kickstarter.com/projects/ergostone/ergostone-the-multi-tool-for-your-well-being/description?lang=de>
- 15 McNulty-Kowal, S. (2022, January 25). This multifunctional wall organizer comes with modular planters to add some greenery to your WFH office! - Yanko Design. <https://www.yankodesign.com/2022/01/25/this-multifunctional-wall-organizer-comes-with-modular-planters-to-add-some-greenery-to-your-wfh-office/>
- 16 Behance. (2017, January 15). TAC - air purifier. Behance. <https://www.behance.net/gallery/46650465/TAC-air-purifier>
- 17 Ikea Concept Kitchen 2025: Il tavolo del futuro. (n.d.). Retrieved September 9, 2023, from [https://www.archiproducts.com/it/notizie/ikea-concept-kitchen-2025-il-tavolo-del-futuro\\_58915](https://www.archiproducts.com/it/notizie/ikea-concept-kitchen-2025-il-tavolo-del-futuro_58915)
- 18 Sandin, G., Roos, S., Spak, B., Zamani, B., & Peters, G. (2019). Environmental assessment of Swedish clothing consumption—Six garments, Sustainable Futures. *Mistra Future Fashion*, 6.
- 19 Clothing manufacturers aim to get fashionable with greener practices | Research and Innovation. (n.d.). Retrieved September 9, 2023, from <https://ec.europa.eu/research-and-innovation/en/horizon-magazine/clothing-manufacturers-aim-get-fashionable-greener-practices>
- 20 Black, C. (2022, January 27). How technology is making fashion more sustainable. Heuritech. <https://www.heuritech.com/articles/fashion-retail/technology-fashion-more-sustainable/>
- 21 How Long Before You Wash? (n.d.). Retrieved September 9, 2023, from <https://www.rushorderteens.com/how-long-before-you-wash/>
- 22 Forrester. (n.d.). Weary Consumers Will Seek Immediate Happiness And Comfort In 2022. Forbes. Retrieved September 9, 2023, from <https://www.forbes.com/sites/forrester/2021/11/02/weary-consumers-will-seek-immediate-happiness-and-comfort-in-2022/>
- 23 Household appliance market trends. (2022, May 25). <https://www.slim.it/en/blog/household-appliance-market-trends>
- 24 iF Design—AIR 3. (n.d.). Retrieved September 9, 2023, from <https://ifdesign.com/en/winner-ranking/project/air-3/312449>

- 25 Filtro Microplastiche Samsung Less Microfiber Filter FT-MF FT-MF | Samsung Italia. (n.d.). Samsung it. Retrieved September 9, 2023, from <https://www.samsung.com/it/home-appliance-accessories/less-microfiber-filter-ft-mf/>
- 26 Panasonic Introduces the Shoe Deodorizer: Deodorizes Your Shoes While You Sleep | Appliances | Products & Solutions | Blog Posts. (n.d.). Panasonic Newsroom Global. Retrieved September 9, 2023, from <https://news.panasonic.com/global/topics/5213>
- 27 Higgs, N. (2017, January 30). HISTORY OF THE WASHING MACHINE | Speedqueeninvestor. <https://speedqueeninvestor.com/news/history-of-the-washing-machine/>
- 28 LG Styler Refreshes Your Stinky, Wrinkly Clothes With Steam | TechCrunch. (n.d.). Retrieved September 9, 2023, from [https://techcrunch.com/2012/01/13/lg-styler-refreshes-your-stinky-wrinkly-clothes-with-steam/?guccounter=1&guce\\_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLnNvbS8&guce\\_referrer\\_sig=AQAAAC5WqX6u36aYWtoUVRa5-xfFeiZdNcWoxrBHxHDQmkasSuoJvGGNzItE0dxyfVq0z39g5XDEauMRQ9pvcBdVs1Fit68Y7OV7XmcCkFm\\_drFGBBkQg83tmZDVmCmQID56y9SPfL5CeltMeAuVADmlj2H2NbChpy1\\_\\_9QcsXhR\\_1](https://techcrunch.com/2012/01/13/lg-styler-refreshes-your-stinky-wrinkly-clothes-with-steam/?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLnNvbS8&guce_referrer_sig=AQAAAC5WqX6u36aYWtoUVRa5-xfFeiZdNcWoxrBHxHDQmkasSuoJvGGNzItE0dxyfVq0z39g5XDEauMRQ9pvcBdVs1Fit68Y7OV7XmcCkFm_drFGBBkQg83tmZDVmCmQID56y9SPfL5CeltMeAuVADmlj2H2NbChpy1__9QcsXhR_1)
- 29 Preferred Fiber and Materials Market Report. (n.d.). Textile Exchange. Retrieved September 9, 2023, from <https://textileexchange.org/knowledge-center/reports/preferred-fiber-and-materials/>
- 30 Preferred Fiber and Materials Market Report. (n.d.). Textile Exchange. Retrieved September 9, 2023, from <https://textileexchange.org/knowledge-center/reports/preferred-fiber-and-materials/>
- 31 Preferred Fiber and Materials Market Report. (n.d.). Textile Exchange. Retrieved September 9, 2023, from <https://textileexchange.org/knowledge-center/reports/preferred-fiber-and-materials/>
- 32 Ashdown, S. P. (2011). Improving body movement comfort in apparel. In *Improving comfort in clothing* (pp. 278–302). Elsevier.
- 33 Refresh your wardrobe with your Samsung AirDresser. (n.d.). Samsung Electronics America. Retrieved September 9, 2023, from <https://www.samsung.com/us/support/answer/ANS00085463/>
- 34 Wu, F., Liang, S. T., & Ding, X. M. (2016). Study on the mechanism of woven cotton fabric during steam ironing. *Key Engineering Materials*, 671, 179–185.
- 35 LG Canada Support (Director). (2022, March 5). [Styler] Styler use & operation. <https://www.youtube.com/watch?v=ZU3fFCwCN04>
- 36 LG Canada Support (Director). (2022, March 5). [Styler] Styler Overview. <https://www.youtube.com/watch?v=ZnE1-5XH8VQ>
- 37 LG Nigeria (Director). (2022, September 20). LG Styler with True Steam Technology. <https://www.youtube.com/watch?v=1f13bt2h9OM>
- 38 Commercial Displays Resource Hub | LG US Business. (n.d.). LG USA. Retrieved September 9, 2023, from <https://www.lg.com/us/business/commercial-display/resources-hub>
- 39 Reviewer, H. T. (n.d.). LG Styler Steam Clothing Care System review. Tech Advisor. Retrieved September 9, 2023, from <https://www.techadvisor.com/article/721688/lg-styler-steam-clothing-care-system-review.html>
- 40 Hu, J. (2004). *Structure and mechanics of woven fabrics*. Elsevier.
- 41 Bell, S., & Bell, C.P., «Future Sense: Defining Brands through Scent», *The Journal of Marketing Society* 38, Autumn, 2007
- 42 Nowicki, H. (2016, February 1). The basics of activated carbon adsorption. *Water Technology*. <https://www.waterteconline.com/wastewater/article/15549902/the-basics-of-activated-carbon-adsorption>
- 43 Scott, R., Joshi, L. T., & McGinn, C. (2022). Hospital surface disinfection using ultraviolet germicidal irradiation technology: A review. *Healthcare Technology Letters*, 9(3), 25–33. <https://doi.org/10.1049/htl2.12032>
- 44 Price, S., & Price, L. (2011). *Aromatherapy for health professionals E-book*. Elsevier Health Sciences.
- 45 Sterilizing with Steam Versus Dry Heat. (n.d.). Lab Manager. Retrieved September 9, 2023, from <https://www.labmanager.com/sterilizing-with-steam-versus-dry-heat-1875>
- 46 Gurney, E. (2022, October 6). What every product designer needs to know about brand. Medium. <https://uxdesign.cc/what-every-product-designer-needs-to-know-about-brand-5863f92e97d7>
- 47 De' Longhi | De' Longhi Group—Corporate Website. (n.d.). Retrieved September 9, 2023, from <https://www.delonghigroup.com/en/brand/de-longhi>
- 48 Profile | De' Longhi Group—Corporate Website. (n.d.). Retrieved September 9, 2023, from <https://www.delonghigroup.com/en/group/profile>
- 49 De' Longhi | De' Longhi Group—Corporate Website. (n.d.). Retrieved September 9, 2023, from <https://www.delonghigroup.com/en/brand/de-longhi>
- 50 Air Comfort Appliances for Home: Live Better Everyday | De'Longhi UK. (n.d.). Retrieved September 9, 2023, from <https://www.delonghi.com/en-gb/products/air-comfort>

51 Strategy, B. O. (2005). How to Create Uncontested Market Space and Make the Competition Irrelevant. Boston, MA: Harvard Business School Publishing.

52 Kominos, A. (2020, July 17). Norman's Three Levels of Design. The Interaction Design Foundation. <https://www.interaction-design.org/literature/article/norman-s-three-levels-of-design>