CHALMERS
UNIVERSITY OF TECHNOLOGY

UNIVERSITY OF GOTHENBURG

WASH-E

Designing personality for futuristic washing machine

Master's thesis in Interaction Design & Technologies

KITTIPON CHAIKITTIWANICH
WASAMAS LEAKPECH

Interaction Design & Technologies
CHALMERS UNIVERSITY OF TECHNOLOGY
UNIVERSITY OF GOTHENBURG
Gothenburg, Sweden 2019

Master's thesis 2019

Master Thesis Report

WASH-E: Designing personality for futuristic washing machine

KITTIPON CHAIKITTIWANICH
WASAMAS LEAKPECH

UNIVERSITY OF
GOTHENBURG

CHALMERS
UNIVERSITY OF TECHNOLOGY

Interaction Design & Technologies
Chalmers University of Technology
University of Gothenburg
Gothenburg, Sweden 2019

Master Thesis Report
WASH-E: Designing personality for futuristic washing machine
KITTIPON CHAIKITTIWANICH
WASAMAS LEAKPECH

Supervisor: Marco Fratarcangeli, Chalmers University of Technology
Examiner: Staffan Björk, Chalmers University of Technology

Master's Thesis 2019
Interaction Design & Technologies
Chalmers University of Technology and University of Gothenburg
SE-412 96 Gothenburg
Telephone +46 31 772 1000

Master Thesis Report
WASH-E: Designing personality for futuristic washing machine
K. CHAIKITTIWANICH & W. LEAKPECH
Interaction Design & Technologies
Chalmers University of Technology and University of Gothenburg

Abstract

Doing laundry is highly considered as one among many important household activities as it is a common hygienic process, however, it seems to be a quite repetitive and boring task based on the authors' own experiences. With traditional box-shaped machine and limited interface that have not been changed over decades, we could assume that laundry business tends to direct research and development more towards improving its functionality and efficiency rather than user experience. Therefore, it is interesting to explore, design, and evaluate social interaction aspect of a common washing machine and identify the key factors that have a potential to affect future laundry experience and users behaviors in order to encourage sustainable use of the machine and influence better user decision for each laundry session.

Wash-E is a design prototype that integrates various emotions and personalities into the washing machine using a digital connection between a professional washing machine and an android device. It aims to raise laundry users' conscious regarding sustainable use of the machine and to explore a new area in the design space of social household appliance.

The concept of Wash-E is to create a character that represents a living soul inside each washing machine. Wash-E's dynamic personalities and emotions will give social feedback to the users based on their selected washing programs or laundry parameters in relation to sustainable energy usage and water consumption. It will also educate users by giving laundry facts and tips. Moreover, there is a virtual environment for each machine to be shared among other users with the purpose of simulating the consequence of action and emphasizing the mood of Wash-E. The whole user interface is newly designed to support both the emotional elements of Wash-E and washing machine functionality. A couple of design iterations are done and many design methods are applied and discussed how it work or not work with this design project.

After the discussion of the final design, it can be concluded that the concept of emotions and personalities in washing machine can affect the laundry experience in both positive and negative ways. For positive aspect, the washing machine becomes highly interactive and users can engage with the character. Users are likely to try their best to keep it happy. This positive reaction can definitely to more sustainable laundry behavior. However, there is a big trade-off between unnecessary interaction and rich interaction which involves emotional engagement. It is quite a challenge to include the emotional aspects into the users flow together with mandatory laundry information, while balancing the importance and presentation of both aspects.

Adding extra interactions can definitely interrupt or slow down the flow of users whose main goal is to quickly clean dirty clothes. It may cause frustration or hatred towards the character.

Nevertheless, new insights might pop up if a long-term design evaluation is done in an actual context as it takes time to see the changes in settled behavior of an individual and the acceptance of the new design in the laundry activity.

This master's thesis report consists of 10 chapters: *Introduction, Background, Theory, Method, Ethics, Schedule, Final Design, Design Alternatives, Discussion and Conclusion.*

Keywords: interaction design, washing machine, emotion, personality.

Acknowledgements

We would first like to thank our thesis supervisor Marco Fratarcangeli of the Computer Science and Engineering Department at Chalmers University of Technology. He consistently provided valuable advice and support whenever we came across either technical or non-technical issues or had a question about our research or writing. We are also thankful for every helpful advices from Interaction Design and Technologies examiners, professors, and lecturers.

We would also like to thank Marius Stücheli from Electrolux Professional Laundry who played an important role in making this master thesis happen. We are grateful for your involvement in every steps from the very beginning to the very end of this master thesis. In addition, we would like to thank all related employees of Electrolux Professional Laundry for their kind support and cooperation. Our master thesis would not be accomplished Without their passionate assistant and input.

We would also like to acknowledge our beloved SQUAD friends and classmates from Interaction Design and Technologies master program as the important source of inspirations, motivations, supports, and joyousness.

Finally, we must express our profound gratitude to our family members and to our close friends for providing us with unconditional support and continuous encouragement throughout our years of study and through the process of researching, designing, and writing this thesis. This accomplishment would not have been possible without them. Thank you. Kob-Khun-Krub/Kah!

K. Chaikittiwanich & W. Leakpech, Gothenburg, 2019

Contents

1

Introduction

There are many household chores necessary to be done in order to maintain cleanliness and tidiness condition of the living space along with people using it. Within the long list of various household chores ranging from dusting to cooking, doing laundry can definitely be considered among the most boring ones. Possible explanation could be that each laundry session is a loop of repetitive processes and quite time consuming. It requires multiple waiting time in between, which often interrupts other activities when a session is done and needs user attention once more. Motivation and enjoyment of doing laundry decrease through time due to this particular reason. Less motivation in doing laundry potentially leads to less education and research in laundry area. It seems that laundry business tends to direct research and development more towards improving the machine's functionality and efficiency rather than user experience due to the obvious fact that doing laundry is considered an essential household chore. Also, there are very few academic researches in user experience with the focus of a washing machine.

Therefore, it is interesting to study the problems and user's motivation in doing laundry and seek innovative solutions that could transform their experience. In the future, the advancement of artificial intelligence and robotics will become part of human world. Hence, it is useful to study how users react with the social interaction aspect of a static machine and how it would affect the user's behaviors in laundry. In addition, the educational aspect can also be considered as potential result from persuasive affect of the social interactions, which may lead to creating sustainable user behaviors.

Accordingly, an idea of transforming an ordinary washing machine into a laundry assistant with personality as social interaction was explored during 24-hour Designathon 2017 event arranged by Electrolux in Gothenburg, Sweden. Wash-E, in Figure 1, is a concept prototype of futuristic washing machine with an ability to express various emotions based on its current functionality and circumstance. The team received the second prize from this event and were offered a master thesis to further look into the potential implementation of this design concept afterward. Since the team initially consists of five people, the project is divided into two master thesis topics for three people organized as two teams: Theoretical Conceptual Design and Design Implementation. The authors will be focusing on the latter topic, while Alejandra Torres will work on the former one.

Figure 1: Wash-E Prototype from Electrolux Designathon'17

1.1 Stakeholder

There are three major stakeholders involved in this master thesis: Electrolux company, laundry users, and thesis authors. Each party has its own interests and risks which will be described in detail below.

1.1.1 Electrolux and its affiliates

Electrolux Group is a global appliance company established in 1919 with a mission of making a life of every customers easier and profitable through the use of right tools and instruments [13]. This project is supported by Electrolux Laundry Systems Sweden AB, a part of the Electrolux Group developing and producing equipment for professional laundry. Accordingly Electrolux is obviously a stakeholder.

products improved regarding efficiency; for further reduction of environmental impact of laundry it's important to include user behaviour

Although Electrolux Professional Laundry leads global professional laundry mar-

ket through energy and water-efficient machines, there is always a room for further reduction of environmental impact of laundry by including user behavior. The improvement can be done in term of human-machine interaction by adding a persuasive goal of encouraging users to "Feel Better and Do Better" through making more responsible choices and using the machine more effectively. With these potential improvements, the company and its affiliates will not only be able to achieve better customer satisfaction, but also strengthen an opportunity to compete in future laundry market. Hence, this thesis may not only provide a visualization of the concept idea, but also help evaluating potential risks, which may include feasibility of technologies, cost of production, confidentiality of the product development, and emerging competitors.

1.1.2 Washing Machine Users

Users of the washing machine can be categorized into 3 main groups based on usage and ownership: those who own and use a private machine, those who privately use a professional machine owned by a company, and those who pay to use a professional machine. Since laundry is considered an essential activity for both household and organization, individual washing machine users in general tend to seek for the product that satisfy them in term of both productivity and robustness. Nevertheless, while appearance and design can be considered important quality of private washing machine in attracting buyers, design along with interactive feedback may even have a potential to bring out positive impact in term of sustainable and economical user behavior on those who use professional machine.

In all cases, current user interactions are often quite limited when it comes to laundry process. User deposits a load of clothes into the machine, adds some necessary detergents, then selects and executes appropriate washing modes. It seems interesting to explore other potential interactions that may enhance laundry experience in general. Hence, the final product may not only help user save cost, time, and energy, but also let the user enjoy doing laundry as well.

1.1.3 Master Thesis Team

Master thesis team includes not only authors, but also other master thesis students, thesis supervisor, program director, and the university. Besides continuing to develop an original idea from Designathon event, the authors of this thesis also aim to successfully put practical and theoretical knowledge gained from various interaction design courses to use in real-world working environment. In this case, the team will involve related design methods, tools, and practices in every phases of the thesis: planning, prototype development, and prototype testing. The team also needs support from both thesis supervisor and related persons in term of both technical knowledge and official procedures. Additionally, the team will collaborate and share

research results with another thesis team who works in another area within same context (Theoretical Concept Design - Alejandra T.). Hence, this master thesis will be a good chance for the authors to interact and create a network with various people within both academic institute and Electrolux company. There are also several concerns regarding the feasibility of modifying existing product, ownership of the final prototype, and publication confidentiality.

1.2 Research Problem

"How can a professional washing machine with personalities and emotions affect future laundry experience?"

This thesis will focus mainly on professional washing machine in which multiple laundry users within the same area share one or more machines owned by a company/organization, instead of private machine for single household. Possible examples include a laundry room in an apartment building, coin-operated washing machine, and hotel laundry service. It will be interesting to explore the design possibilities of how artificial intelligence and interaction design work together to add personalities and emotions to existing traditional washing machine. According to current market, such washing machine has not been made available, making this aspect quite fascinating and fresh for laundry industry. How this new feature affects user's behavior in doing laundry is yet to be studied. Hence, the insights from this thesis will be valuable for the design of any smart appliances in the future.

1.3 Expected Result

The expected result is the high-fidelity workable prototype that will be installed on the Electrolux washing machine W575H at HSB Living Lab. The team strongly believe that the final outcome of this master thesis will play an important role not only on the future enhancement of Electrolux washing machine, but also on potential development of a better overall laundry experience.

2

Background

Thesis domain and scope will be described in this section along with several related work on machine with personalities and emotions.

2.1 Domain

Laundry is an activity that every household needs to do with washing machine as a facilitator of this activity. Majority of people think that it is a repetitive and boring task and there is a possibility of making various avoidable mistakes when using a washing machine, for example, incorrect clothes categorization or too much detergent [32]. With the advancement in technology such as Internet of Things, AI, and Machine Learning, there are many new opportunities to explore how the current washing machine can be designed and improved for the near future. These breakthrough technologies will create new ways of interaction and between users and the washing machine, leading to easier, enjoyable and sustainable the user's laundry experience. In long term, this can create a transformative experience of the behavior and encourage more sustainable society. The project aims to design a washing machine that has its own personalities and emotions as a being with abilities to have a conversation and interaction with users, within the design space of tangible aspects of current washing machines and digital aspects of technologies.

2.1.1 Electrolux W575H Washing Machine

A washing machine model that will be the main focus for this thesis is W575H in Figure 2, It is a professional front-load washing machine designed to be used in different context including self-service laundry, multi-housing laundry, and facility laundry management. This washing machine provides basic laundry functions along with ergonomic and resource-consumption efficiency. In term of user interfaces, the machine offers a limited display screen with a control knob for program selection. Selectable options include language setting, frequented wash program packages, and wash options. Additionally, the user has an option to customize wash programs

of this washing machine model through Electrolux Laundry Program Manager, a pc-based software allowing users to create and customize wash programs.

Figure 2: W575H: Electrolux Professional Washing Machine

2.2 Thesis Scope

The scope of thesis is mainly to explore how to incorporate personalities and emotions into existing Electrolux washing machine through available information and technologies. The main context of use will be focused on professional washing machine described above. The thesis scope is divided into several sections as follow:

2.2.1 Research on related topics

The thesis will include results from several researches and workshops related to both general washing machines available in the market and the specific ones from Electrolux. In order to construct a final prototype, the team needs to learn how user interface of current washing machine works and what kind of information the team

can get from it. Additionally, it is also crucial for the team to apply design knowledge and practices to appropriately plan the whole thesis. Proper methods and tools will be mapped with different aspects of the washing machine - for instance, user interface display, programming language, brand identity, and machine's functionalities.

2.2.2 Concept and prototype development

From the research knowledge on related topics, the design concept and the prototype are needed to design and develop in order to evaluate the concept and improve the design iteratively. Various types of prototypes will be developed and improved iteratively in order to evaluate different aspects of the design such as user experience, interaction and aesthetic. The final prototype will be a workable prototype that can be connected and ready to test with the existing machine.

2.2.3 Prototype testing and evaluation

Several testing sessions will be conducted in order to evaluate the prototype and its user interactions. A main user test session with the installation of final prototype and user feedback collection is planned to be held at the HSB Living Lab during the last phase of the thesis. The goal of user test is to evaluate the influence of new washing machine prototype in comparison with user's usage and interaction frequency. Test session will involve all stakeholders including Electrolux employees, laundry users in general, and thesis authors.

2.3 Related Work

Researches and publications related to this thesis topic will be mentioned in this section. The study of futuristic washing machine will be described along with examples of household appliances with emotions and personalities.

2.3.1 The Impatient Toaster

The field of incorporating personality of a living creature into household artifacts has been around for many years already. In 2009, an Impatient Toaster was introduced by Burneleit et al [7] as a prototype to explore an influence of a kitchen appliance with life-like behaviors -a toaster in this case- on user habit and motivation. This Impatient Toaster aimed to regulate user eating routine through its waggle movement simulating a demand for user attention via sensors and haptic feedback. For instance, the toaster would shake nervously when inactive for a certain period of

Figure 3: The Impatient Toaster, waggling excitedly to alert its user

time and would calm down after user feed it with bread or pat it for a while. The feedback from user test session was quite positive in term of both user perception and reaction towards this life-like toaster. Although a couple of users were initially frighten from the toaster's sudden movement, they overcame their fear from its adorable and unique characteristics afterwards. This project has proven that it is not only possible to make everyday object come alive with life-like movement and characteristic, but user behavior has a potential to be affected through developed emotional engagement and sympathy towards the object.

2.3.2 iRobot's Roomba: A Vacuuming Robot with Personalization Toolkit

Besides a toaster, a vacuum machine with personalization toolkit was also introduced in the same year by Sung et al [36]. Domestic vacuuming robots, iRobot's Roomba, were equipped with appearance customization tools and were distributed to 15 different households with a purpose of observing their interactions with these personalizable robots. Based on the study result, it was proven that user gained positive experiences from using such appliance. Emotional attachment developed between user and the robot was one of the key factors in creating better user experience. By putting different stickers and decorations on Roomba, not only an ordinary vacuuming robot was given its identity, but its user also obtained a sense of ownership towards the machine as well. A main takeaway from this research is that, as a designer, providing personalized option for a technology could be beneficial in term of increasing technological acceptance, user commitment, and user experience.

Figure 4: Personalized iRobot Roombas

2.3.3 A Concept of Anthropomorphic Lamp

A concept of Anthropomorphic Lamp was recently presented in 2015 by Angelini et al [1] with an idea of integrating human form and behavior to a sphere-shaped lamp in order to explore possibilities of enhancing natural and spontaneous user interaction with life-like artifact. Main functionalities of the lamp was to collect various user emotion states along with expressing different emotions through facial expressions and colors. To illustrate user interaction, two potential application scenarios were described as a companionship lamp and a computer-mediated communication lamp. As a companion, the lamp attracted, recognized, and communicated with user using color and facial expression. Unpredictable behaviors was also included as an element of surprise with an intention of prolonged user engagement. Another scenario was related to providing emotional expression channel for long-distance relationships. The lamp served as bi-directional emotional telepresence interface where emotional state of one lamp would be reflected by gestural input from a distant person on the other one. By implementing an anthropomorphic aspect into an ordinary lamp, the affordance of natural gesture became much obvious to the user, thus, intensifying both user attention and reaction.

Figure 5: Various emotional states of Anthropomorphic Lamp

2.3.4 DooBoo: Pet-Like Interactive Electric Vehicle Dashboard

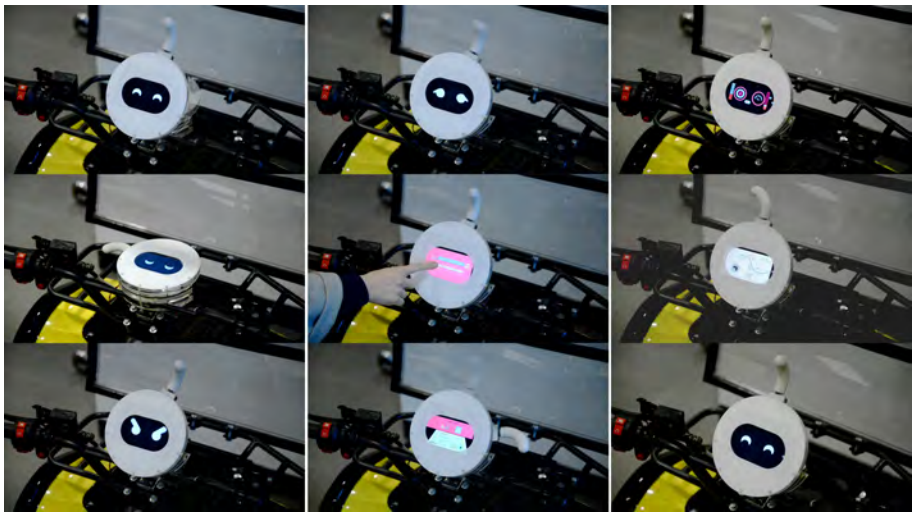

Figure 6: The face and tentacle express various emotions and information

Lastly, an emotional electric vehicle with pet-like interactive dashboard, DooBoo, was introduced by Row et al [34] in 2016. Instead of designing an electric vehicle that focuses on technological improvements and addresses common issues like engine, energy consumption, or pollution emission, the team looked into emotional experience in the vehicle. The prototype was constructed based on 4 aspects of pet dog behaviors that human sees valuable: emotional comfort, ownership attach-

ment, delightful active behaviors, and serving utilitarian purposes. As a result, this pet-like vehicle dashboard had a potential to provide enjoyable user experience in various aspects. Driver entertainment was the most obvious key finding. Furthermore, DooBoo encouraged cherishing and sustainable usage among the users through emotional attachment and sense of personal ownership. Lastly, it had a strong contribution as a gentle medium of communication among users due to its pleasant appearance. Although this project provided valuable insights on vehicle with personality, safety of the driver from distraction still remained an important issue to be further investigated.

3

Theory

Result from pre-study research on related topics will be summarized in this section. The first part of Theory Section will include various literature under the topic of design frameworks and tools. The latter part will be focusing on design and scientific methodology to be considered in this thesis.

3.1 Framework/Tool

This section describes design frameworks and tools that are related to area of this thesis. According to the scope, theories and relevant concepts are researched and discussed in the first part of this section. In addition, the design tools used for prototyping will be summarized in the second part.

3.1.1 Conceptual Aspect

In order to design the emotions and personalities into the machine or make a machine a being that has social interaction with human, the design processes and methods related to Human-Robot Interaction (HRI) is one important aspect to be studied.

Luria, et al suggested three interrelated aspects of HRI: Morphology, Nonverbal behavior and Interaction Schema - that were emphasized in the design process of the social robot design of Vyo, a Robotic Smart Home Assistance [22]. They also identified design goals for the social robot which are Engaging, Unobtrusive, Device-like, Respectful and Reassuring. These aspects of HRI together with the design goals were taken into account throughout the design process. In the process of sketching and low-fidelity prototypes, they divided the design into two paths which are the physical design and the expressive design. The former one is about the components itself like shapes and graphical information, while the latter focuses on robot's morphology and nonverbal behavior like gestures. Thus, the puppet-like prototypes was created to explore possible movements, gestures and expressions of the design idea when responds and interacts with the human. In addition, other interesting aspects in their idea to mention about is to consider a robot between

inspection device that enables users to 'look through' its head or social agent that express the movement to users and to consider the combination of human-robot interaction with tangible interface objects.

It is interesting to consider how a robot expresses and communicates its emotional states; by facial expressions in humanoid robot or using body languages in non-humanoid robot. As mentioned above in the related work section, Roomba, the vacuum cleaner robot, it is designed to match its purpose which is home-working task. Thus, Novikova and Watts argued that it is not that useful for that kind of robot to have human-like faces. However, in order to create a social signal, it is still somehow needed to show expressive cues [28]. It is useful to explore the design space to see the possibilities to design how robot expresses the emotions by body languages instead of facial expressions which the thesis's scope of washing machine can be fit in. They also argued that facial expression could give more information on an internal state of a person while bodily expressions direct attention to a person's actions [28].

Novikova and Watts proposed the design framework for modelling emotionally expressive non-humanoid robotic movements in five basic emotions: Fear, Anger, Happiness, Surprise and Sadness. Their modelling framework is in the context of approach and avoidance behaviors and the dimensions of valence, arousal and dominance. They map and classify the model into two categories: Shape and Effort, where Shape is a feature that concerns overall posture and movement as shown in Figure 7, while Effort is defined as quality of the movement as shown in Figure 8 [28]. For example, the results show that it is easier to decrease a perceived valence of an expression by making it of a short duration or high speed, by increasing the frequency of limb movements to a high level, or by expressing avoidance. They concluded that fear, anger, happiness and surprise are recognized easier as a dynamic bodily emotional expressions while sadness is recognized easier with static facial expression due to slow, long movements of a low frequency of the body movement.

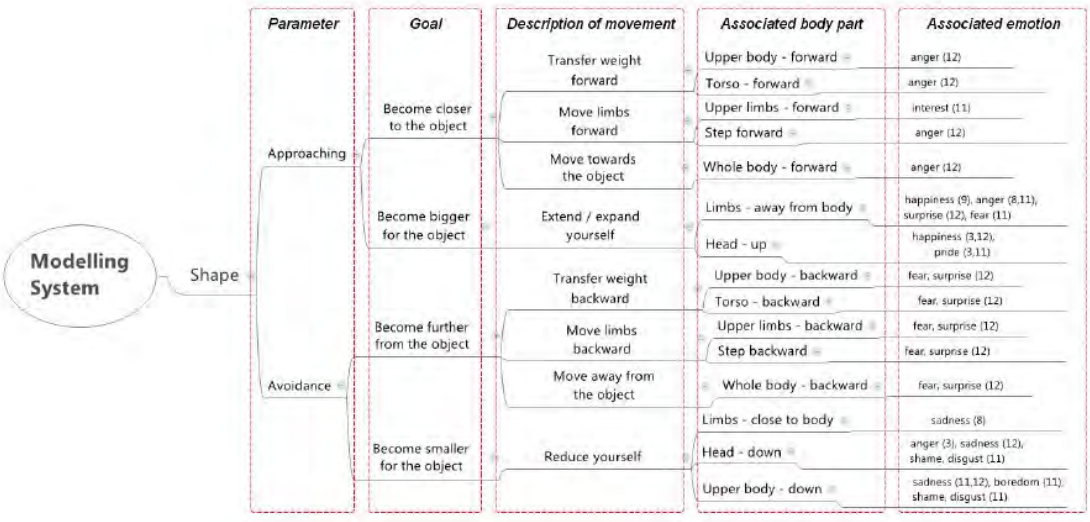

Figure 7: Novikova's emotional modelling system of Shape (See Appendix 52)

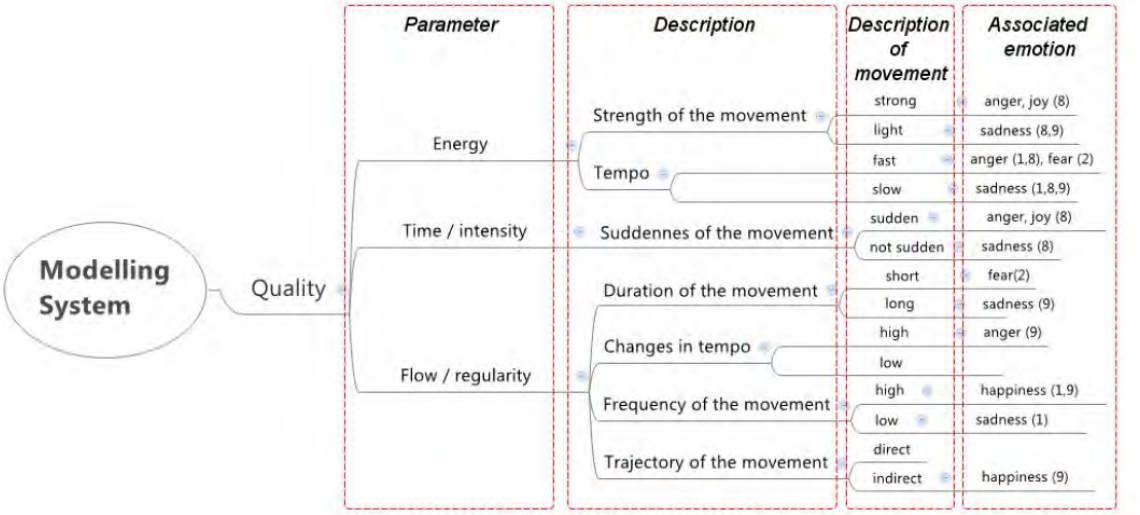

Figure 8: Novikova's emotional modelling system of Effort (See Appendix 53)

To design and add emotional states to the products, Koepfinger and Turkmen proposed the rules for designing the automated future home products [20], which can be useful to take into account when designing emotional states to washing machine. They suggested to look to the affordances and original functionalities of everyday home objects as the basis of the design. The products should borrow from nature and innate human behavior to create intuitive and natural interaction, however, not to fully replicate or replace humans. They also suggested to avoid using of any physical human attribute in the design to avoid the phenomenon of the Uncanny Valley The products should react to human presence in some way and have emotional connection as part of the their functionalities. One example of their product was a lamp that become drooping if it is left on while becoming excited by users' presence.

Another design aspect to be considered since it seems likely to have a strong impact on user perception is color. A concept of Anthropomorphic Lamp, a lamp with ability to recognize and express human emotions, mentioned Plutchik's Wheel of Emotions [30] as a design guideline for emotion-to-color matching. Plutchik studied evolution of human emotions and proposed a visual representation of emotion-color relationship as a color wheel. This color wheel, in Figure 9, consists of 3 main dimensions in which different attributes of emotion are analogous to those of color.

In the first dimension of color wheel, primary emotion is mapped to primary color in a manner that similar ones are placed side by side, while opposite ones are placed 180 degrees apart. The total number of primary emotions are supported by the psychoevolutionary theory with 8 basics ones coupled together into 4 pairs: joy-sadness, trust-disgust, fear-anger, and surprise-anticipation. Respectively, the second dimension shows a mixture of primary emotions as a combination of primary colors. For instance, joy and trust produces love, whereas disgust and anger produces contempt. The last dimension, intensity, is presented as cone-formation extended from

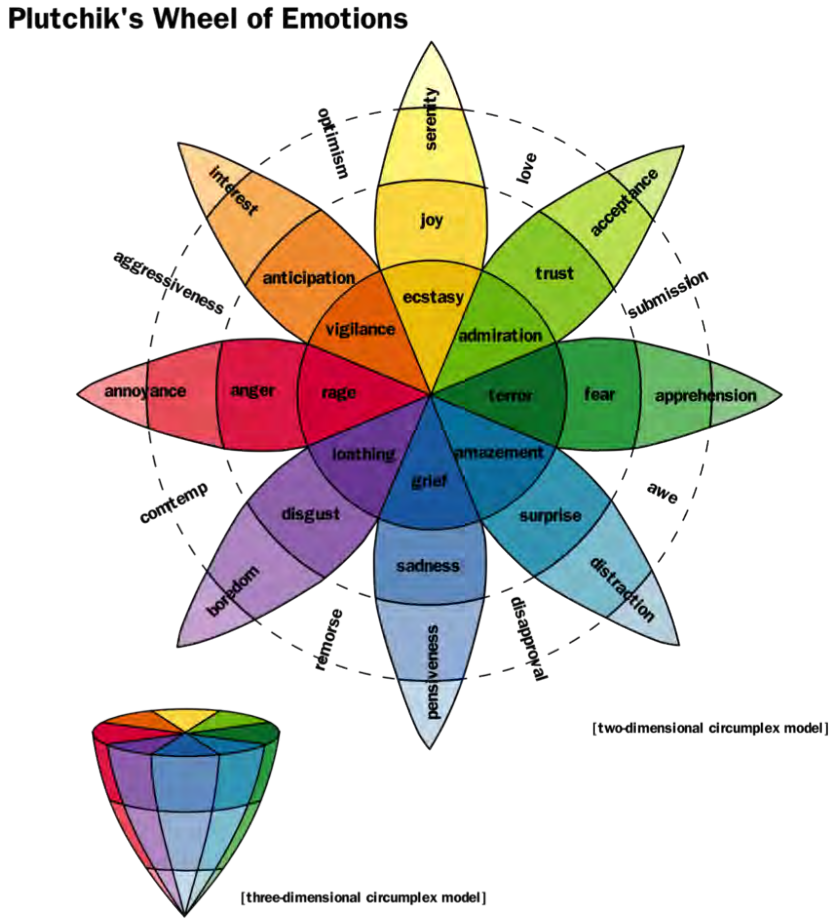

Figure 9: Plutchik's Wheel of Emotions

2-dimensional color wheel by matching intensity of color to those of each emotion. Joy, for example, can be used to illustrate this dimension with serenity as low-intensity emotion and ecstasy as high-intensity one.

Additional interesting aspect of this concept is related to personality traits of human. Personality traits and emotional states are sometimes blurred together as both can be used to describe an individual. A example given by Plutchik was the use of the word 'depress'; a person can feel depress (emotional state) or be a depressed person (personality trait). Thus, plutchik's wheel of emotions has a strong potential to serve as a useful design guideline when working with not only emotions, but also personality attributes, which both are essential elements in design a professional washing machine for this master thesis.

In order to develop a robot for use in everyday social contexts such as in private homes, it is important to understand both social and technical constraints in its intended context of use. Sabanovic el al, presented a case study of iterative pro-

totyping and evaluation of a break management robot, called Dewey, to get the insights of how particular design characteristics affect people's responses in robotic application for everyday use that take into account both social and technical aspects of robotics [35]. The insights from the case study can be applied in the thesis scope as the context of use of the professional washing machine is also considered similar to everyday social context.

There is challenge in how to develop prototypes in HRI due to complexity. They researched several prototyping techniques that can be used in HRI - Wizard of Oz, 3D animations with a puppet, rapid prototyping with Lego Mindstorms, and prototyping using Arduino, mbed platform and the Raspberry Pi computer, without expressive fully functional prototypes [35].

There are three design iterations in the design process of Dewey. The first iteration is to learn from context of use by exploring how people take a break in an office environment and initial design of a physical break reminder technology. The design methods included observation, interview, diary study and survey. The insights from the initial exploration allowed them to develop an idea use scenario and the first prototype. They found that although it was not fully functional, but it was useful when using it to discuss with focus group in terms of physical form and possible behaviors. The findings also included preferable minimalist design and concern about amount of effort for using technology.

In the second and third iteration, they use a comparative approach of evaluating multiple version of functioning prototypes at the same time to promote exploration of ideas without investing in one idea too early. In the second iteration, they compared between physically embodied prototype and virtual prototype to find the effects and preferences on the break-taking behaviors. Users preferred embodied prototype and requested more interactivity and personalization.

In the last iteration, they aimed to explore how the robot's social interactivity affects effectiveness of the break-taking behaviors and user perceptions. They compared two different design ideas: one functioned as a simple alarm and the other with social behaviors and gave participants different prototypes to use for two weeks. The prototypes were added social behaviors by adding some interactive movement such as move its head up when turned on, combination with LED, dancing to indicate the break time. They also applied idea of nurturing as the user feeding the robot to initiate the interaction which in this case using the RFID cards. Their findings from participants in the effect of the robot's social interactivity on behavioral change and perception of users are interesting. For example, ones gave social robot a name, personalized their robots by putting sunglasses and scarf, compared them to pets, suggested adding a face would make a robot more cute and mentioned that the robot increased their social interactions with colleagues.

3.1.2 Technical Aspect

Technically, to add an intelligence to the machine, it is interesting to study how the current technological devices and methods such as sensor data, BLE beacon, and computer vision methods, are used which can be useful to apply and transform within the thesis's design space of emotional states to explore new idea and see the feasibility of technology. Civitarese and Bettini proposed how the objects recognize the activities of daily living (ADLs) in smart home [8] using the technological devices. They proposed the usage of sensor subsystems such as sensors revealing presence, pressure, temperature, power consumption, apart from RFID-based subsystem to perform an unobtrusive object manipulation monitoring. They argued that the solution with wearable devices is critical as there is no guarantee that they are constantly worn, however, it depends on how the data will be used. In the thesis scope, the recognized data can be analyzed and applied with the appropriated emotional states in the washing machine to reflect the user's activities. It is also useful when implementing the workable prototype to see the variety of devices that can be used.

Recently, conversational interfaces like chat-bot have been emerging in the instant messaging applications. As it has the artificial intelligence aspect and interactive communication between human and computer, it is useful to study to explore new ideas which can be applied with the emotions and personalities in the conversational context via messaging platform. Klopfenstein, et al defined the term Botplications as a conversational agent accessible through a messaging platform, which provides access to data, services or enables the user to perform a specific task. They characterized Botplications as Thread as app where services and information are provided as steams of messages and notifications, History awareness which is to keep the history and collected preferences of user for providing context to future interaction, Enhanced UI which the interfaces are not limited to plain text messages, Limited use of Natural Language Processing (NLP) because of unexpected turns of phrase in human languages which breaks down the complex dialogues in many scenarios, Message self-consistency in which each single message contains the full context of the conversation without the need for user to figure out from the conversation history, and Guided conversation like proactive suggested actions and welcome message for on-boarding experience [19].

3.1.3 Social Aspect

There is a research studying on persuasive effects of social feedback provided by embodied agent, on changes in behavior. Also, both positive and negative social feedback on persuasive effects were studied. Midden and Ham conducted experiments which participants carried out laundry tasks with a simulated washing machine to see how the feedback affect how they conserve energy. They did experiments on three aspects: the effects of social feedback compared to factual feedback, the effect

of positive and negative feedback and the effect of low versus high perceived agency as a characteristic of the feedback source [25].

In the experiment, they used energy meter to give participants factual feedback while used a robot called iCat which is stylized head of a cat that is able to display social expressions by moving lips, eyes, eyebrows and eyelashes and by playing verbal speech files. The difference in low and high perceived agency is that the latter one describes participants a characteristic of the robot such as telling the name of iCat as "Victor", the story of Victor as a very advanced robot that had a little mind of its own who will inform them about the energy consumption. Also, as iCat will utter a word for feedback, in high-agency social feedback, it will use various synonyms of uttered word while the low one used only one specific brief speech utterance repeatedly.

Their findings showed that people are sensitive to social feedback as provided by embodied agent and the effect is greater compared to factual-evaluative feedback. They also suggested that providing single negative feedback is more effective than providing single positive feedback, however, the negative feedback might lose its persuasive ability when it is not situation and behavior specific. Lastly, They did not find the strong difference between low and high perceived agency because the verbal manipulation was overruled by participant's direct experiences with the robot. The insights from this study can guide the thesis in finding out how the washing machine can express the social interactivity in the way that change the user's behavior in both use experience and sustainability.

4

Methodology

This section describes various design methodologies that will be used in this thesis. These methodologies not only serve as a guideline for thesis planning, but also define structure and procedure of this thesis as well.

4.1 Research through design

From the nature of design research, the scientific methods from normal science might not be exactly applied to. The main difference between scientific and design theory is its falsifiability, an aspect of theory in which can be disproved. Most scientific theories are based on inductive reasoning with multiple supported evidences. However, a single incompatible outcome that contradicts with existing evidence may lead to the falsification of that particular theory. Design theories, in contrast, are rather vague with no single correct solutions when dealing with wicked problems. Design theories are mainly supported by practices, driven from particular set of theories rather than contradicting them.

Based on Gaver [38], exploring different designs through various prototyping methods is important not only for achieving a good final result, but also discovering a new solution from its synthetic nature. Gaver also introduced design convergence approach in which a particular design, concept, method, tool, or even artifact can be combined, elaborated, altered, or transformed to produce a better result that may lead to future innovative breakthrough.

Specifically, in order to conduct the research through design, one method that will be used for conducting the thesis will be to borrow conceptual perspectives from other disciplines and discuss their applicability for design as suggested by Gaver. Within the domain and the focus of the thesis, the discussion, analysis and translation on borrowed concepts or theories will be related to, for example, the concept of emotional design and artificial intelligence, in order to give rise to and inspire new concepts and to articulate the existing ones. In addition, the method of learning from design examples or artifacts can be used. In the research through design perspective suggested by Gaver, theory underspecified design, however, design examples are definite and capture the owner's perspective of how they address the issues within

the design as the implicit theories ranging from philosophical, functional, social and aesthetic aspects. The design artifacts can also be seen as occupying a point in design space which can be moved around to explore the design space resulting in the new design possibilities. In the thesis's domain and scope, learning from existing washing machines and from examples of smart home appliances and related technologies will become a valuable set of theories that drive the thesis toward answering the proposed research problem.

With the wicked problems addressed by design, they are complex enough that no correct solutions exist a priori. The design activity is then needed to conduct in an iterative way to formulate the problems while addressing them and it can build upon one another in a cumulative fashion. The reflections and discussions on important issues from each design activity are then needed as input theories for the next design activity. Thus, it is important to go into the detail of the design methodologies and tools on how to conduct the design activity in the ways that lead to the better solution toward the wicked nature of the design problems.

4.2 Jones Model of the Design Process

The planning of this thesis will follow Jones Model of the Design Process [16] consisting of divergence, transformation, and convergence phase as in Figure 10.

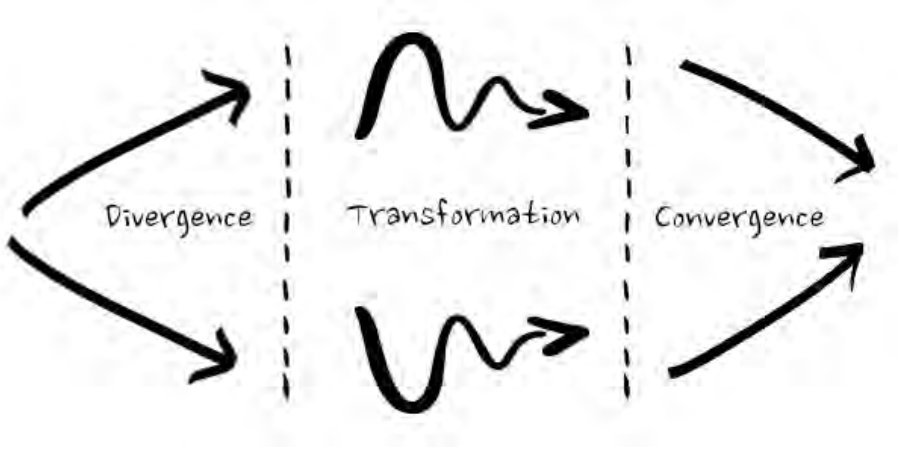

Figure 10: Jones Model of the Design Process

4.2.1 Divergence

Divergence phase focuses mainly on exploring alternative solutions related to the topic. The goal of divergence phase is to collect as many ideas and alternatives as possible, hence, evaluation of each entry is not necessary at this point. Before ideation session, the team plans to use ethnography approach [6] as a method to

conduct user research in order to get a better understanding of various user activities in their own context. Besides observation, mixed-method approach will be used for collecting user responses by combining short semi-structured interview with field-work questionnaire together. Apart from user research, methods for ideation [10] such as brainstorming, persona, and literature study will be used within this and the next phase. Result from divergence phase will be a pool of numerous ideas in which some will be feasible, while others will not. Due to this particular reason, these ideas must be analyzed, combined, and refined in the following transformation phase.

The following sub-section describes various methods applicable for the divergence phase.

4.2.1.1 Brainstorming

Brainstorming is a classic and the most common method for creative idea generation. The goal of brainstorming session is to harvest as many ideas as possible, hence, there are several rules for the participants to follow. According to CreatingMinds.org [10], most common rules include no criticism, quantity over quality, idea stimulation, as well as mutate and combine ideas. During the session, each participant may express the idea in various ways such as a short textual description, a rough sketch, a combination of both, or by other simple means of visualizing ideas. A brainstorming session has limited duration which may take up to a hour. Although there is a possibility of participants running out of ideas, brainstorming allows participants to make use of each other's ideas as an inspiration.

4.2.1.2 Design Workshop

The main goal of design workshop is to explore the design space in wider perspective from people with different background than designer as the designers. The design workshop not only help the designers with ideation, but also allow both designers and participants to discuss the ideas and especially to have fun in the workshop.

The method to be used in design workshop is called 'Draw it'. Draw It method, based on a definition from by IDEO [14], is a method for ideation and inspiration phase of design process in which the design team and a group of participants visualize ideas and concepts through various drawings and sketches. This method is quite simple, requiring basic setup and equipment. A session usually starts with a design team explaining the drawing goal to the participants, then let them draw their ideas using pens and papers. Normally, the session lasts from 30 minutes to an hour. Every participants in the workshop should actively contribute, so it is best to keep numbers relatively low. Therefore, a group of 9-10 people is planned as participants so that the two designers can handle the question equally.

The design workshop usually starts by explaining the goals and objectives followed by instruction to the participants. Then, they have 30-60 minutes to complete their design idea and write the description. The results from each participants are collected after the session for design evaluation afterwards.

4.2.1.3 Field Study

Field study is a general method for collecting data from users or stakeholders that involves observation and interview. In order to understand the requirements from stakeholders, especially with Electrolux Professional, there is a plan for conducting a field study at the company at the early stage of ideation, which will help gathering important data that is beneficial to the development of the ideas. Visiting the company will enable the author to meet not only with the supervisor and main collaborator of the thesis, but also with other related people such as product managers, product designers or engineers and learn about their visions and requirements in different perspectives. In addition, the visit also enable the author to see the various types and designs of existing washing machines.

4.2.1.4 Sketching

Sketching is a distinctive form of drawing that help the designers explore, refine and communicate the ideas. It allows the designers to explore more fully and quickly while preventing the designers to focus on sub-optimal design choices such as the aesthetic of the design [33]. This method will be used by everyone in the group to continue developing ideas after applying the brainstorming session and affinity diagram. The main purpose is to illustrate, share and discuss the ideas between designers. This will make the ideas more concrete as well as enable the group to see the possibilities of connection and combination between platforms, machines and devices.

4.2.1.5 Persona & Extreme Character

Personas and Extreme Characters are design techniques in which fictional characters are described in term of characteristics, personalities, and behaviors. According to Nielsen [27], both of these techniques play an important part in design process in term of understanding user requirements as well as identifying potential user interactions toward the design. Moreover, interaction designers use them as tools to explore ethical and sociocultural aspects of the design.

While setting of Personas is usually based on reality and may have some influences from potential or existing users, that of Extreme Characters is based purely on surrealistic and imagination. Another major difference between these techniques is the richness of appearances, actions, and roles. Personas illustrate fictional characters

based on real people with ordinary personality, attitude, and profession. In contrast, Extreme Characters create exaggerated emotional characters with richness in appearance, attitude, and role within the society based on Djajadiningrat et al [17].

Persona is an appropriate approach to be used when target users are identified and there is already a rough scope or a focus of a design. Persona can then be modeled after target users with specific detail in attitude or personality in order to explore further requirements and potential problems. On the contrary, Extreme Character gives designers an insight of a specific aspect of the design with its rich characteristics. It seems to be suitable for designers to use when gathering more ideas for the design or trying to solve specific design problem.

4.2.1.6 Design Concept Portrait

Concept portrait method was introduced to the authors in one of an exercise in Design for User Experience course. The goal of this method is to help designers get a deeper understanding of chosen emotion. Concept portrait is done by asking questions that related emotions to certain object, place, or location. Examples of questions include "if your emotion was a hobby, what would it be?", "If your emotion was a weather phenomenon, what would it be?", or "If your emotion was a public building, which one would it be?". Each designer answers each question individually. These answers and motivations are discussed in group afterwards with the purpose of finding common theme.

This thesis aims to use this method for designing the appearance of each emotion on the washing machine. Concept portrait will be helpful not only for the team to understand each chosen emotion, but also to design the interfaces and select related materials to be used in the prototype implementation.

4.2.1.7 Questionnaire

Questionnaire is one among the methods to get the rough insights or information from a large group of people, characteristics or attitudes which are typically in written form [2]. These information is useful in the ideation phase as an user research to gather and explore the current problems, the needs or what are people's opinions in the same context of the design ideas. The way question is asked will affect the type of response and analysis, for example, open-ended questions for qualitative response where as closed-ended ones are aim for quantitative [2]. The question should be designed and matched with the particular goal of what insights designers need from the questionnaire. Pilot-testing of the questionnaire is then required before handing out it to the target people. In the scope of the thesis, This method is adapted to use as an online form via Google Form instead of written form in order to easily reach the people and gather information. The questionnaire is include both quantitative and qualitative questions aiming to do number analysis like ranking and scoring of

the features needed together with to see the opinions and explore ideas which will be useful to the ideation phase.

4.2.1.8 Interview

The other method of survey research apart from questionnaire, is Interview. It is fundamental method to gather experience, attitudes, perceptions and opinions from participants. The main difference between questionnaire is that the personal conversation in an interview can recognize personal expression and body language [2]. It is also easier to have following up questions to clarify the inputs from participants. In the scope of the thesis, the interview with stakeholders in this ideation phase is to gather, for example, the visions and requirements from the perspectives from Electrolux, the inputs from owner of shared laundry room and also from the typical users. These will be help inspire the ideas and set the constraints in design space.

4.2.1.9 Observation

To understand how the users interact with a product, Observation provides a great way to understand the usability of a product and overall user experience [15]. There are two types of observation which are Controlled observation that takes place in laboratory environment focused on quantitative data with the participants know they are being observed, and Naturalistic observation that studies users in the wild by observing their behaviors with a product in day-to-day life focused on qualitative data [15]. In the divergence phase, the naturalistic observation is selected to use because it is more reliable to see users use product in real life and qualitative data opens up more possibilities of ideas for product improvement. The observation will be conducted in the shared laundry room in an apartment to observe how typical users including the authors interact with a washing machine.

In addition to gain more insight information on how typical users including the author use the washing machine, the observation method is used to explore the problems and ideas to suit the existing use cases. The shared washing machine rooms in the author's apartments were selected to be observed. The focus of the observation is to observe the flow and procedure of the particular users when they are doing laundry and to see what problems do they face started from when they enter the laundry room and the final step of using washing machine. Naturalistic observation is used as the observer taking notes trying not to interfere with the people being observed.

4.2.2 Transformation

In transformation phase, these scattered ideas will be grouped together according to their similarities and patterns. Affinity diagram along with rank-and-vote approach will be used to organize and group similar ideas together. Therefore, the result from this phase will be several string of potential conceptual design for professional washing machine with personalities and emotions. Each set of concept ideas will be evaluated and compared in the later phase of the design process called convergence phase.

The following sub-section describes various methods applicable for the transformation phase.

4.2.2.1 Affinity Diagram

Affinity diagram is a design method mainly for categorizing and grouping ideas in a meaningful ways. Based on the Universal Methods of Design book [2], there are 2 variations of affinity diagram: one for contextual inquiries and another for usability tests. The major difference between 2 variations is the source of data. Data from the former variation mainly comes from interview and observation results in different context, while one from the latter comes from usability test feedback. In both cases, common features of each piece of data are clustered together first in bottom-up manner. Then, these clusters are formed into a larger and more meaningful theme at the end.

4.2.2.2 Storyboard

Storyboard is considered another fast and simple method for visualizing design concept according to CreatingMinds.org [10]. This methods can be used for several purposes including problem definition, solution exploration, idea communication, and implementation planning. In order to create a good storyboard, designer team needs to have a basic understanding of the dynamic of the situation, then use simple drawings, cliparts, texts, diagrams, or magazine cut-and-paste photos to illustrate the situation in sequential order. Since storytelling is commonly considered a key medium of communication, storyboard provides a visual representation of the story. Hence, combining these 2 mediums of communication together will benefit design team in term of visualizing and conveying idea concepts.

4.2.3 Convergence

In order to convert these diverse ideas into usable and meaningful user design, they has to be carefully analyzed and evaluated by taking into account strength and

weakness of each idea string. Internal evaluation of these alternatives using proper technique ranging from weighed matrix to semantic differential will be done in order to select the most valuable or suitable design to proceed to the next design phase. Multiple criteria including functionality, ease of use, performance, appearance, and safety perspective will all be considered during the evaluation. Besides internal evaluation, a workshop or testing session with involved stakeholders such as Electrolux employees and a group of end users will also be arranged to gather some feedbacks using the same mixed-method approach when conducting user research in divergence phase. The team strongly believes that these valuable comments and feedbacks will be extremely helpful for rationalizing ideas and modifying the prototype to avoid design malfunction. Thus, it can be concluded that this last phase is a perfect time to perform concept design evaluation before making any conclusion on final design. At the end of these 3 phases, there will be one set of alternative solutions that has the strongest potential to be turn into a prototype for testing and evaluating in the later prototyping process.

The following sub-section describes various methods applicable for the convergence phase.

4.2.3.1 Prototyping

In order to evaluate the choices of the design, prototyping is one of inevitable methods in the design process. Lim and Stolterman suggested the role of prototyping as learning vehicles: "Prototypes are the means by which designers organically and evolutionarily learn, discover, generate, and refine designs." [3]

Prototyping provides several benefits to the design process, for example, prototyping leads the designers to be able to identify the problems when it is still possible to fix them. Prototyping also provides reflective practice which are the repeated framing and evaluation of a design problem by producing a concrete manifestation of the ideas rather than only thinking it through [3].

This type of problem with ambiguous definition and incorporate solution mentioned above, according to Coyne [9], is known as wicked problem. This type of problem is extremely dynamic depending on viewpoint of each person and subjected to change over time. To emphasize, every interaction designers need to aware that there is only “good enough” design, not flawless one. What makes wicked problem distressing according to Design Paradigms and Wicked Problems lecture is that there is neither definite solution nor known stopping rule. Moreover, one wicked problem might even lead to unforeseen consequences or another wicked problem. Therefore, in order to find the best solution to cope with wicked problem, the designer uses various prototyping methods to visualize and foresee the design and usability problem.

In order to maximize the benefit of prototypes in particular stage in the design process, the fidelity of prototype is needed to consider to match the level of detail of the questions that the designers need to ask from the prototypes. Low-fidelity

prototypes will be developed after formation of ideas and sketches to evaluate the interaction and interface arrangement in two or three selected design choices while high-fidelity prototypes will be developed iteratively toward the final prototype focused on the improvement of one design idea.

Benyon [5] gave several examples of prototype trade-offs in his work; a good graphical prototype that would definitely wow users may be mistaken as possible commitment or a realistic prototype that would produce a qualitative test result may take longer time to make.

4.2.3.2 Paper Prototype

In order to develop prototypes from ideas quick, paper prototype is one type of prototype that will be used. Paper prototype lets designers create the representation of your ideas and throw their multiple versions away without wasting time compared to digital prototype. Therefore, it can be created and compared among multiple design choices. It is useful for exploring questions of interface layout, content and structure without worrying about the aesthetic of the design. However, at later stages in the design process, paper prototype will become less useful as it provides inaccurate feedback from its nature that the human is the one who rearranges UI elements by individual imagination which dynamically changes the experience of an interface. Thus, it is less useful for exploring interactive behaviors in user interfaces [3].

4.2.3.3 Digital Prototype

Digital prototype also plays an important role in interaction design process. The blurry boundary of digital services, digital systems, and the product itself makes it easier for designers and developers to use them as a prototyping form and carry out user testing sessions afterward. The major advantage of digital prototype is that they are extremely simulative, adaptable, and dynamic with realistic look-and-feel which considered as hi-fidelity prototype according to Benyon [5]. Digital prototype could replicate rough visualization of each interface screen as well as mimic interactions between those screens and user actions. With the help of Wizard of Oz method, the interactions with buttons and touch areas will be correctly simulated and the design will be immediately adjusted according to user feedbacks.

4.2.3.4 Wizard of Oz

Wizard of Oz in interaction design context is mentioned by Bernsen et al [26] as an interaction simulation technique in which designers perform the interactions for users to make users think that they are working with the real interactive system.

The technique is often used by interaction designers to present their interactive aspects of the design to users for feedback evaluation purpose.

4.2.3.5 Emotion evaluation/interpretation

Emotional response from users is substantial aspect that need to evaluate in order to figure out how expressive of the design can reach the users leading to the empathy to and awareness of the machine as a being.

One method to evaluate emotional response is by visual measures whereby participants report their emotional state by picking the cards with emotional phrases or words that best match with the emotions that the product has aroused on them at particular time [18].

Another method to evaluate emotional attachment is called Tech Break Up method introduced by Gerber [12]. This method is similar to love-break up letter where users of the product express their emotion and experience through a letter addressing to an actual technological entity. Tech Break Up method takes it further by having users perform a conversational break up with a video camera in combination with the break up letter. The camera, in this scenario, is regarded as a technology that the user is breaking up with. This method gives the designer insights on how user becomes detached from certain technology by allowing a user to express strong emotions through words and gestures.

4.3 Spatio-Temporal Designs

Spatio-temporal design corporate dynamic time and space into a design. It means that changes in time and space will affect the design either as an input, an output, or both. Benford introduced the concept of interactional trajectories as an idea in which an interface or a user creates a trajectory through itself or towards other users [4]. Interactive user experience develops from these interactional trajectories relies heavily on 4 factors; space, time, roles, and interfaces.

Space is the spatial location where the interaction and experience take place. It could be either physical, virtual, or combination of both. In reality, user experience often occurs in a complex hybrid space with a combination of multiple physical and virtual ones. These spaces can be adjacent where user can move from one to another in sequence, connected with users through communication, or overlaid to provide simultaneous user experience. In this case, space is the laundry area which covers from each washing machine space to a whole laundry room.

Time is the temporal structure which involves a time when the interaction occurs and the length of user experience. This temporal structure can also be hybrid

through combination of different time frame. Referring to Benford, there are 5 layers of hybrid temporal structure; story time, plot time, schedule time, interaction time, and perceived time. An author creates a fictional universe which defines story time. Plot time focuses on the order and timing of a particular narration of the event. Actual available time for users is considered a schedule time. Interaction time mainly relates to a time in which user interactions happen. Lastly, perceived time is described as an overall sense of story timing that user perceives from the interaction. A laundry experience is considered a combination of different time frame ranging from interaction time in which laundry users interact with the washing machine to perceived time in which they describe their perceptions of the whole experience.

Roles defines type of intended user engagement regarding the experience. User can be a participant who is the main target of the experience. A spectator, public member who witnesses participant's actions, is another important key role that consists of audiences, those who intentionally observe the action, and bystanders, those who unintentionally witness the action. The experience may also include professional roles such as actors, technical operators, and orchestrators. Laundry users who directly interact with the washing machine is a user, while the others in the laundry area are either spectators or bystanders depending on whether they observe the user or not.

The last factor is the interfaces, which act as a connector between 3 other factors. The experience usually involves diverse combination of interfaces, but the most common one is a computer and its various interfaces. Interfaces usually serves 3 main functions; an interface used by participants to create the experience, an interface for spectators to view actions of participants, and a plethora of interface to provide technological support for operators and orchestrators. For this thesis, the interface refers to a tablet screen that receives input from the laundry users and provide output accordingly. Additionally, a washing machine itself also provides various tangible interface that the users can interact with such as machine door, detergent slots, and physical knob and buttons.

4.4 Critical Design

The final prototype of this thesis aims toward persuasive design that will encourage laundry users to make sustainable laundry choice and become aware of consequences of their actions. Hence, the designers also considered incorporating critical design concept into the prototype as well.

Malpass [23] briefly defined critical design as a design practice that addresses and criticizes current social, cultural, and ethical aspect through the involvement of either tangible, intangible, or combination of both design products. Critical design makes use of Juvenalian satire approach by attacking user's perception, logic, and thought. In addition, polemic narratives that involves obscenity and violence is

incorporated in the critical design product in order to bring forth dark humor and challenging status quo.

The result from critical design should lead the user to question their interactions and interpretations of the design product. By involving user's fantasy and reality together, the user of the product is expected to experience dilemma which guides them towards the feeling of concerns and uncertainty. Hence, the strong impact from critical design makes it possible for designers to persuade users into making desirable decision in long term.

5

Ethics

The aim of this section is to describe potential ethical concerns regarding the design of a life-like professional washing machine. Ethical practices related to design process will be discussed in the first part, while ethical concerns related to the final prototype will be mentioned in the second part.

Ethical behavior is defined by Markopoulos et al. [24] as a right behavior within that current context. Due to the fact that it is context dependent, meaning that different culture has its own definition of ethical codes and legal regulations, making this aspect quite complex and ambiguous to deal with. While planning the research, the team plans to carefully take proper measures to ensure that these codes and laws are not violated. In general, design practices and the prototype must minimize harm and maximize benefit for individual. The team must treat involved stakeholders and individuals related to the project with respect, while evenly distribute benefits an unavoidable harm.

5.1 Design Process

This master thesis requires frequent interactions with many stakeholders with different purposes ranging from user research, design ideation, prototype testing, to final product demonstration. It is necessary to take ethical aspects of these kinds of interaction into account before designing each session. Since most of design approach mentioned earlier will include user data collection of various forms such as written response, photography, audio and video record, it is necessary for the team to ask for permission from participants in the form of either verbal consent or signed consent form or even both before collecting such data. The information to be explained to participant includes purpose of the project, planned workshops, use of information, data privacy, voluntary participation, and contact person. Each participant will be informed of voluntary participation, thus, automatically given a right to withdraw from participating at anytime without any consequences. Photographs, audios, and videos recorded for data analysis and documentation will be collect in the way that identity of each participant is anonymous as to protect individual privacy. Identifiable faces will be blurred in all publications, including but not limited to the

presentation and written report.

5.2 Prototype

Since the main focus of this thesis is to turn an existing machine into somewhat a being with personality and emotions, there is a concern about whether how and what role will the machine fit into the society in the future. Although results from related work such as Impatient Toaster or iRobot Roomba received much positive feedback from users, there were also some negative ones as well. For instance, several users of Impatient Toaster were initially frighten when it started shaking. These negative reactions were mostly overpowered by endearing appearance of the appliance that has a potential to be developed into adoration and trust. Accordingly, it seems possible that user may develop affection towards the machine, which leads to personal and emotional attachment. Another possible consequence is whether this new feature will disturb traditional simple laundry routine. A washing machine with personality may be too overwhelming or demanding for some users since it has a potential to unintentionally pressure the user to constantly monitoring and try to always make it happy. In addition, the team will also considered ethical concerns regarding design processes and methods such as how user test is conducted, privacy and usage of collected user data during user test, storage of confidential information and so on.

6

Schedule

This section consists of time plan and detail description of master thesis schedule. This includes the thesis duration, summarized design phases, and weekly schedule.

6.1 Time Plan

The duration of this master thesis is approximately 5 months starting from February - June 2018. Table below shows the overall schedule of the project.

Content/ Week	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Writing proposal and planning report	■	■																	
Research on existing machines and user research			■																
Ideation			■	■															
Prototyping Iteration 1					■	■													
Prototyping Iteration 2							■	■	■										
Prototyping Iteration 3									■	■	■								
Installation and demo												■	■	■					
Writing final report														■	■	■	■		
Preparing presentation																	■	■	■

More detail description of weekly schedule is described below.

Week	Date (2018)	Plan	Description/Note
5	29/01 - 02/02	Writing thesis proposal and planning report	
6	05/02 - 09/02	Writing Planning report	
7	12/02 - 16/02	Research on existing machines and user research	Learn about related tools: What the information we can get/related protocol
8	19/02 - 23/02	Ideation	1st Visit Electrolux at Ljungby (2 Days)
9	26/02 - 02/03	Low-fidelity prototype and evaluation	Sketches of UI
10	05/03 - 09/03	Improve the prototype and evaluation	
11	12/03 - 16/03	High-fidelity prototype implementation	Interactive digital prototype
12	19/03 - 23/03	High-fidelity prototype implementation	Interactive digital prototype
13	26/03 - 30/03	Evaluation	Pilot test within the team and those involved in the the project **2nd Visit Electrolux at Ljungby?*
14	02/04 - 06/04	High-fidelity prototype implementation	Actual machine implementation
15	09/04 - 13/04	High-fidelity prototype implementation	Actual machine implementation **2nd Visit Electrolux at Ljungby? (Marius is on holiday)*
16	16/04 - 20/04	Evaluation	Pilot test within the team and those involved in the the project *(Marius is on holiday)*
17	23/04 - 27/04	Prototype installation and demo	User test in HSB Living Lab
18	30/04 - 04/05	Prototype installation and demo	User test in HSB Living Lab
19	07/05 - 11/05	Writing thesis report	
20	14/05 - 18/05	Writing thesis report	
21	21/05 - 25/05	Writing thesis report	
22	28/05 - 01/06	Writing thesis report and preparing presentation	
23	04/06 - 08/06	Preparing presentation	

*The schedule was delayed due to technical issue and the time plan was adjusted and extended while working on this master thesis.

7

Final Design

This chapter presents the final design process, concept, and prototype. The digital prototype consists of 4 main elements: a character, an environment, icons and menu, and an information bubble.

7.1 Methods and Tools

This thesis follows Jones Model of the Design Process [16] consisting of divergence, transformation, and convergence phase

7.1.1 Divergence

User research was conducted within this phase through 3 different methods: questionnaire, interview, and observation. The main purposes of user research are to get insights on general laundry habit, current washing machine interaction, and envisioning of future washing machine design in order to determine user scenarios, create personas, and collect useful ideas as well as suggestions and potential problems for later ideation phase.

The following sub-section describes how 3 methods were used within divergence design phase.

7.1.1.1 Brainstorming

The main purpose of this session is to collect ideas related to characteristics and functionality of futuristic washing machine within given 30 minutes. As a result, 55 ideas ranging from practical and realistic ones to insane and impossible ones were proposed as in Figure 11.

7.1.1.2 Design Workshop

The designers make use of 'Draw It' method and asked the participants to imagine and draw their innovative or crazy ideas into an existing boring washing machine and write a short description on it. Figure 54 (See Appendix) shows the form that participant will use in the design workshop. The constraints are also defined in order to keep the design space within the context of the project

Figure 11: Ideas from brainstorming session

by defining the expected time in the future and the scope of the question: 'Futuristic Washing Machine in 2020: If a washing machine can be a smart living creature, what will it look like and what can it do? Draw and express your extreme idea!'

There are total of 8 participants and 2 designers, which seemed to be a suitable workshop sized since both designers were able to manage the facility and time along with handle questions from participants equally and promptly. The participants with different background were asked to participate. They are all students with background of designer, programmer, electrical engineer, biology, chemical engineering and project management.

The design workshop started by explaining the goals and objectives followed by instruction to the participants. They they had 30-60 minutes to complete their design idea and write the description. The result are diverse yet useful and interesting as an input to the design idea. One participant with design background gave the idea of washing machine with the text-based facial expression embed in the typical screen of the washing machine as if the whole machine can express the emotions. One participant gave an idea of showing the emotions and facial expression on the front door of the front loader washing machine. Their educational background also affects the ideas, for example, student in science and biology thought about artificial intelligent aspect that the washing machine can act as an assistant to suggest and automate tasks for users.

7.1.1.3 Field Study

The authors had a chance to visit one of Electrolux Professional office in Ljungby, Sweden at the end of February 2018 in order to learn more about Electrolux professional laundry product and system. From the visit, the authors were given general information regarding wash process. In general, laundry user wash clothes for these 4 major reasons: cleanliness, comfort, hygeine, and restore functions of the clothes. Moreover, there are 4 crucial ingredients that will affect wash process including chemical components (water, tensides, bleach, and enzimes), time (as a catalyst), temperature (molecular vibration and dissolve fat), and mechanical action (friction between fibers).

Figure 12: Design workshop in action

Another the most helpful piece of information gained from the visit besides technical machine connection was practical user scenarios and different marketing strategy in different part of the world. Users of Electrolux Professional Laundry varies from tenents who use consumer operated machines in multi-housing environment to coin-operated users and business owners. This piece of information becomes an important factor for the authors to develop a conceptual design in the later phase.

7.1.1.4 Sketching

In this thesis, there are various sketches for different purpose. When the team explores multiple dimensions of emotions, characters with different facial expressions and actions (Figure 13) are sketched out and are used to conduct user test in early prototyping phase. User interfaces (Figure 14) are also sketched to visualized the whole concept and evaluate the design.

7.1.1.5 Design Concept Portrait

This thesis aims to use this method for designing the appearance of each emotion on the washing machine. Concept portrait will be helpful not only for the team to understand each chosen emotion, but also to design the interfaces and select related materials to be used in the prototype implementation.

7.1.1.6 Persona & Extreme Character

Total of 2 personas and 1 extreme character are created with different personalities and limitations. The design of a washing machine character and functionality is closely related to these personas

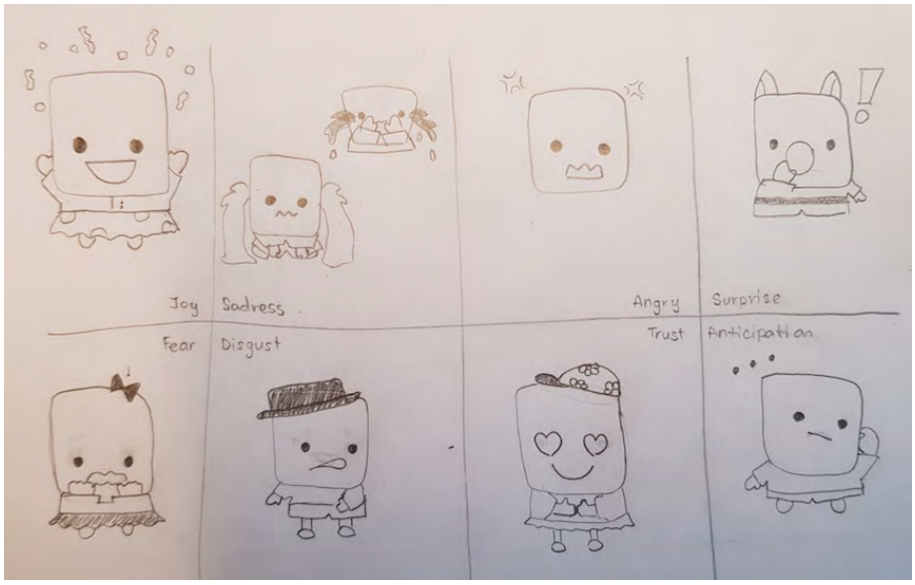

Figure 13: A sketch of character with different actions

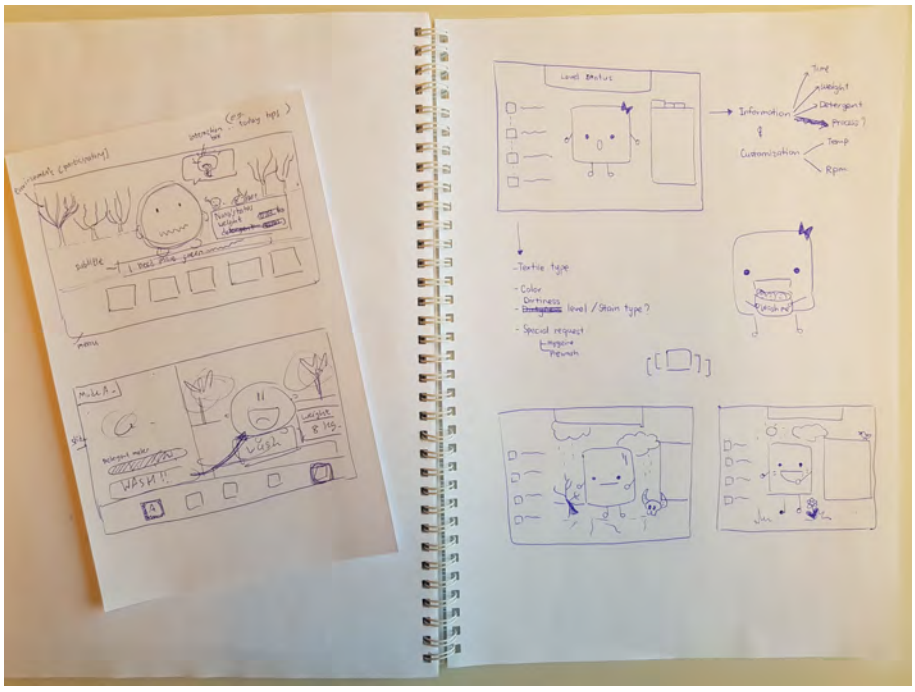

Figure 14: A sketch of different user interfaces

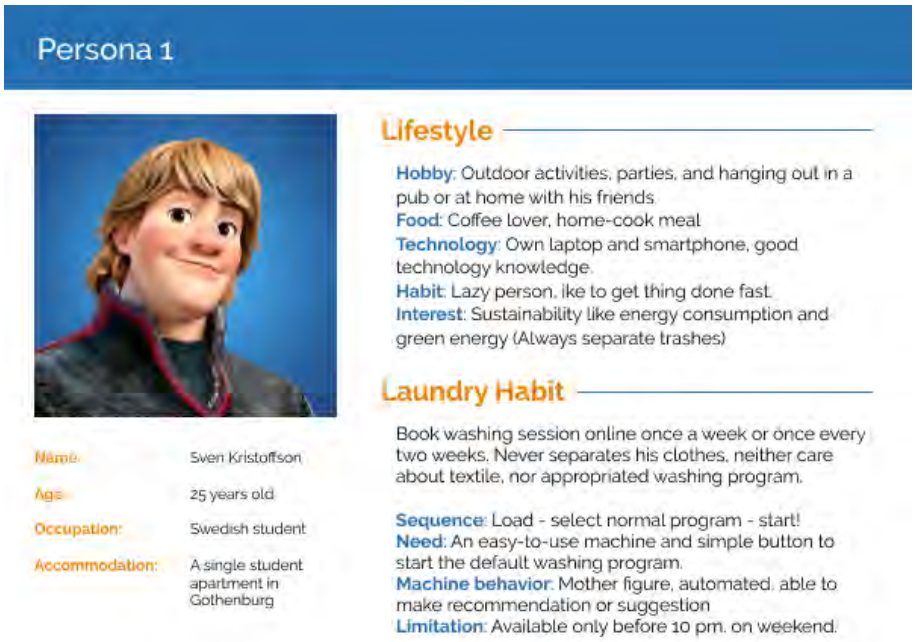

Figure 15: Persona 1: Sven Kristoffson

and extreme character in term of engagement, attachment, feasibility, and usability. Personas and an extreme character used in this thesis are described below.

The first persona in Figure 15 focuses on the normal student who aims to shorten the laundry process as much as possible. Sven Kristoffson is a 25-year-old Swedish student living in a single student apartment in Gothenburg. He enjoys outdoor activities, parties, and hanging out in a pub with his friends. In average day, he drinks many cups of coffee and cooking his own food. He has his own laptop and smartphone and knows technology well. He is a lazy person and would like to get thing done fast. Sometimes, he invites his friends to hangout in his room. He's interested in sustainability like energy consumption and green energy. He always separate trashes.

He book his washing session online once a week, but sometimes once every two weeks. He is quite lazy, hence, he never separates his clothes. He always load everything into the washing machine, select the normal program and press start. Hence, he needs an easy-to-use machine and simple button to start the default washing program. He would prefer the machine to behave like someone who cleans his clothes like his mother did when he was child. The machine should be automated and be able to make recommendation or suggestion so that he does not have to think and know all the programs. Sven's limitation is that he can do laundry only before 10 pm. on weekend. Additionally, he neither care about textile, nor appropriated washing program.

The second persona, Figure 16, is a middle-age lady who uses multiple wash programs and is likely to customized them. Fa Li is a 46-year-old mother of 2 children. She is a Chinese IT consultant living in an apartment in Gothenburg with her Swedish husband, her kids, and a pet cat. Fa Li enjoys cooking and baking for family. She usually hangs out in the park with family during weekends when the weather is nice. She also joins afterwork with colleagues once in a while.

Fa Li does laundry quite frequent since her young children always come back with dirty clothes that needs immediate wash. Plus, she needs to get rid of cat fur from everyone's clothes regularly. Customized washing program for different fabrics and stains is necessary for every clothes load. Moreover, rapid wash and promptly wash program is quite necessary for her to get laundry done fast so that she can better manage her busy schedule. A reminder when laundry is done will be

Figure 16: Persona 2: Fa Li

considered an extremely helpful function for Fa Li. It is also important to take into account her bad eyesight. She will need a clear interface.

The last one, shown in Figure 17, is an extreme character who obsesses with hygienic object and prefers highly anti-bacteria products. Bobb the Minion is Gru Chemical's permanent employee. He has a small build and is currently living in a big house with a big family and a lot of friends. Bobb adores his fluffy unicorn plushies and loves to eat bananas. At work, he likes to experiment with machines and chemicals. His colleagues always find Bobb clicking or tabbing on machine screen, or pushing all the buttons available. Plus, his clothes always has strange stains.

Bobb does laundry everyday since he has many dirty clothes coming from big family and failed experiments. Gru, his employer, pays for laundry detergent and maintenance, so Bobb uses lots of water, chemicals & high temp for every load to make sure everything is clean. He also clean his precious fluffy unicorn once in a while.

7.1.1.7 Questionnaire

The questionnaire used in this thesis consists of 5 sections that covers from general information of laundry user to user's opinion towards futuristic washing machine. The goal of this questionnaire is to get an insight on user perception towards an ordinary washing machine along with collecting ideas for design phase regarding futuristic washing machine. The link to questionnaire was provided at the laundry rooms of 2 student apartments and posted online through social media accounts in order to get responses from different locations.

Out of 80 responses in total, more than 50 percent of them are female (56.3%) with the age between 21-30 years old (87.5%). Responses come from 11 countries including China, Germany, Finland, France, Italy, Japan, Sweden, Thailand, United Kingdom, United States, and Vietnam.

When asking about which aspect laundry users like about washing machine, the top 3 common

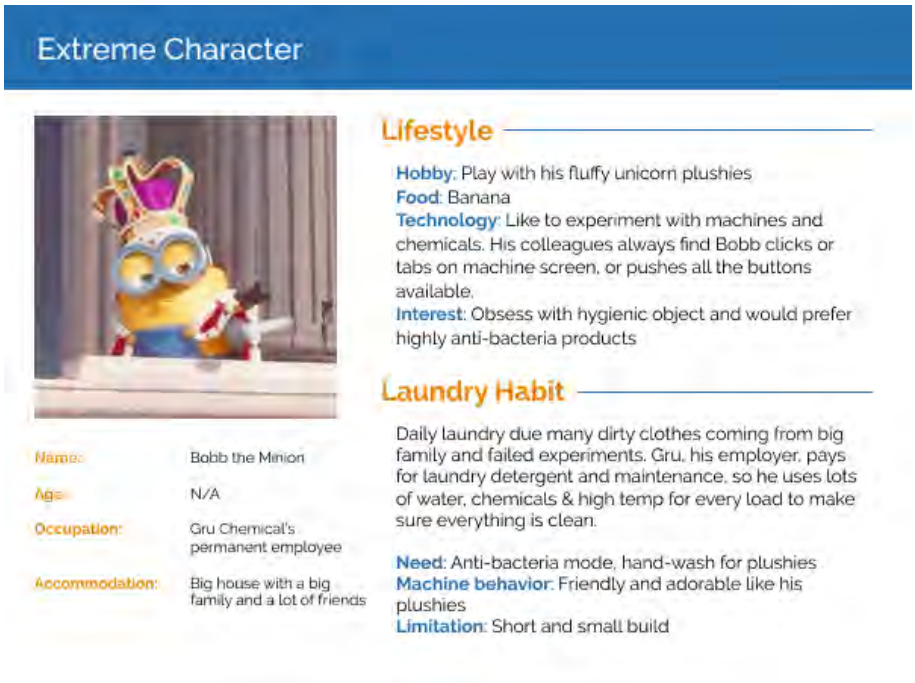

Figure 17: Extreme Character: Bobb the Minion

answers are cleanliness of clothes (22.2%), laundry efficiency (20.5%), and time saving (18.8%) respectively. Other aspects include laundry convenience, easy-to-use design, and textile care feature. In contrast, when asking about what they dislike about a washing machine, majority of the users answer that it is a boring process due to long waiting time (20.7%). Apart from that, other common answers are damaged or tangled clothes as a result from being washed by the machine (19.5%) and high resource consumption including water, chemical components, and energy (13.8%). In addition to these to answers, laundry users also mention the fact that sometimes cleanliness is not guaranteed, the machine produce high noise level, machine design can be improved, as well as procurement and maintenance is expensive.

Regarding general laundry habit, majority of people do laundry once a week (46.3%). Others do laundry either a few times a week (21.3%) or once every 2 weeks (21.3%). From 80 people, 50 of them use personal laundry facility, while 25 use professional laundry/shared laundry facility like a laundry room in an accommodation building. The rest uses either coin-operated laundry or paid laundry service. A laundry session usually last about 2-3 hours based on laundry user's response (52.5%). Activities related to entertainment such as watching television, reading, or playing games become the most popular activities (26.5%) that laundry users do to while clothes is being washed. Apart from that, laundry users do either house chores or online activity like surfing internet or browsing social media.

The most common laundry sequence based on questionnaire response is as follow:

1. Load clothes into the washing machine.
2. Fill in chemical components.
3. Select wash program or adjust wash program.
4. Start the machine
5. Unload clothes from the washing machine.

Mostly, clothes are categorized by color (72.5%) before being washed according to the questionnaire response. Other top answers are categorized by textile (45%) and clothing type (42.5%). Two most common answers when asking about factors that affect wash program selection are wash duration (40%) and temperature (33.8%). Although 70 percent of laundry users in this survey said that they measure chemical component, 39.3% of them measure based on suggestion on detergent package without knowing exact weight of the wash load. Additionally, another 35.7% measures chemical based on user's own estimation, hence, guessing the right amount according to their experience.

In term of emotional engagement, there is a question that asked the users to imagine their conversation with a washing machine as if it becomes a living creature. Majority of users make a various request to the washing machine (32.1%) such as "Please take care of my clothes", "Please clean my clothes thoroughly" and "Clean my clothes fast!". On the other hand, another 24.5% tries to create an actual basic conversation with it such as "Hello! We meet again!", "Are you tired?", and "How are you today?".

Lastly, the team also asks a question related to futuristic washing machine including its feature and appearance. For functionality, most users would like to see improvements on automation of washing process (24.8%), laundry capability (23%) like an all-in-one machine that can wash, dry, iron, and fold clothes, and environmental awareness of machine usage (9.7 %). An improvement of washing machine appearance came in forth place with 8.8% of total answers. When looking at appearance perspective, the most important elements a washing machine should have as to represent a living creature are eyes, mouths, and ears, respectively.

7.1.1.8 Interview

An interview was conducted with 2 different user group. The first group consists of Electrolux personnel. The questions mainly related to technical knowledge and Electrolux-specific information such as laundry process, machine specification, marketing strategy, and visualization of futuristic washing machine from business owner/supplier perspective. The second user group consists of various washing machine users such as student, family members, workers, and so on. A set of questions are much different from the one used with the former group. Data obtained from this user group includes general and specific laundry habit, current laundry problem and difficulties, perception towards current washing machine and laundry process, potential improvement of the whole laundry experience, as well as acceptability of a living-creature-like washing machine with emotion and personality.

7.1.1.9 Observation

For the flow and procedure of laundry, the information from the observation show that all observed people start their laundry by firstly putting their clothes into the washing machine. There are both people who separate the clothes and put all clothes in without separating the clothes types (e.g. underwear, heavy dirty clothes) or clothes color (e.g. white and color). After they put the clothes in the machine drum, some of them select the washing program first and then fill in the detergent and softener while the rest fill in the detergent and softener first and then select the washing program. There are also the case that they adjust the washing program again. Finally, they press the start button to start the washing process.

Problems are also observed during their washing process in the laundry room. There are people who put the detergent in the wrong slot where it is for pre-wash state of the washing process. Moreover, many laundry users 'guess' the amount of detergent by fill the detergent slot directly from the detergent box or bottle without properly measuring. The appearance of the machine also

Figure 18: Affinity diagram from 55 brainstorming ideas

plays an important role in the machine selection. When there are 2 models of washing machine, the one with larger digital screen and less physical button are quite popular compare to the other with more physical buttons and knobs.

7.1.2 Transformation

The following sub-section describes how 2 methods were used within transformation design phase.

7.1.2.1 Affinity Diagram

After brainstorming session mentioned in previous section, those 55 ideas are categorized into 6 groups as in Figure 18 using affinity diagram method. The first group mainly relates to an external appearance and design aspect of the washing machine. Ideas includes integration with brand identity, external tangible robot, mother-like personality, mapping washing machine parts with animal anatomy, and design for user with disability.

The second group involves ideas that concerns technologies like artificial intelligence and various smart sensors with respect to laundry process. Ideas such as color detection, textile recognition, RFID clothes tag, warnings and suggestions based on item recognition, and playful user feedback based on item recognition function are mapped into this group. Besides these smart sensors and algorithms, interactions related to technology and user interface are also mentioned and categorized as the third group. This group covers touchscreen-based interaction, icon-based user interface, fingerprint and/or facial recognition function, audio feedback, as well as redesign of laundry process flow and information flow on the digital screen.

Social and environmental aspects of a washing machine are the main focus for the fourth group.

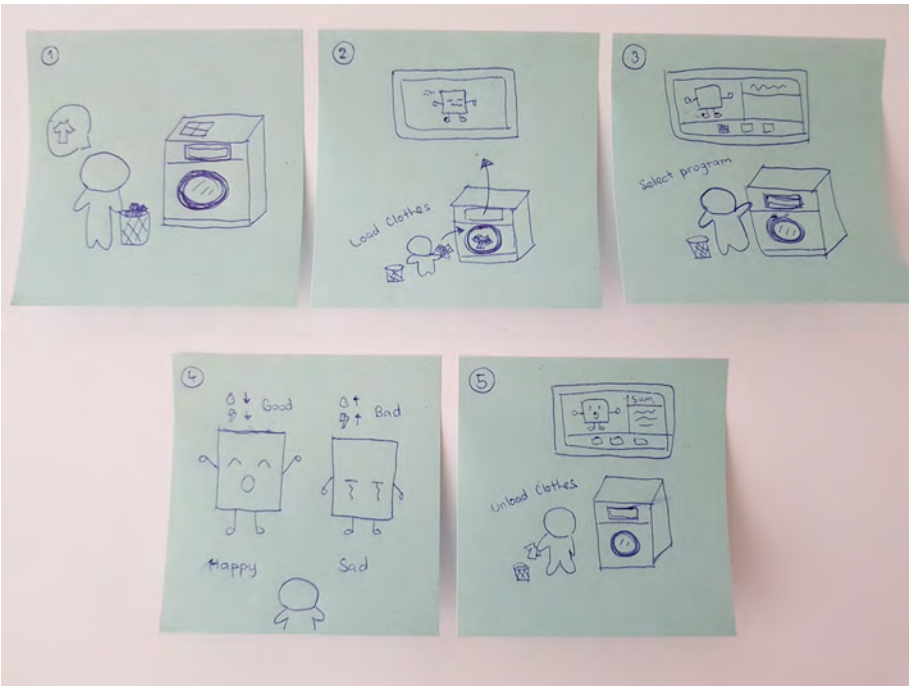

Figure 19: Quantitative result from first evaluation

Ideas include participatory design, customization, personalization, sustainability, along with pursuasive design. There are also ideas related to machine aging with respect to machine maintenance perspective, the display of environmental footprint of each wash, and educational facts regarding laundry tips and tricks.

The next group concerns with related laundry activities such as booking and scheduling system, machine maintenance, machine cleaning, and process notification via voice, motion, or combination of both. Additionally, the last group consists of wild and out-of-the-box ideas that can be useful, but not likely to be essential functions. For instance, a washing machine may implement weather forecast function, a special interaction during fika time, child-safety lock mode, or share wash results or achievements on social media.

7.1.2.2 Storyboard

A storyboard for laundry scenario in Figure 19 is created based on answers from the questionnaire under laundry sequence section. This storyboard consists of 5 scenes. The scenario starts when the laundry user detect an available washing machine. The user then load the clothes, fill in detergent, and select suitable program. The character on the screen changes base on user input and selection. Lastly, the user start wash program and unload clothes when the wash is completed.

7.1.3 Convergence

The following sub-section describes how prototyping were used within convergence design phase.

7.1.3.1 Prototyping

As mentioned in previous chapter, prototyping plays an important role in evaluating the choices of the design. Different forms of the prototype were used at different stage of the design process in order to develop the idea further. At the early phase, low-fidelity prototypes such as paper prototypes were used for communication and exploration of various ideas and for quickly evaluation of problems and possibilities between the design alternatives. High-fidelity prototypes were used in later stage as the main design choice was selected to be further developed. The focus of prototypes were changed to be more specific in particular areas such as aesthetic, user experience, emotional aspect and user interaction. Paper prototypes and Digital prototypes were two main prototyping form which were developed in the design process.

The authors kept in mind the wicked problem aspect of the design process as well. Since there is no such perfect design, time and resource constraints were taken in consideration while making various design choices in each design phase. For instance, several low-fidelity prototype was created and reused for quick evaluation sessions in earlier design phases. High-fidelity prototype was done during the very last phase with small modification and additional detail for the final prototype.

7.1.3.2 Paper Prototype

Paper prototypes were used in an ideation phase of the design process. Because of the characteristic of paper prototypes that are easily and quickly created, they helped represent various ideas that can be evaluated and further developed. They were used for communication of the various ideas from brainstorming sessions. As as result, three paper prototypes were chosen for first design evaluation session. With paper prototypes, they helped the participants and designers in design evaluation to focus more on exploring questions of interface layout, content, flow and representation of the whole design idea, without worrying about the aesthetic of the design which, in this stage, is less important. However, at the later stage, in order to develop and evaluation the main idea further, other types of prototyping are needed because different context of the design such as aesthetic and interactiveness become more important.

[3]

7.1.3.3 Digital Prototype

After one idea was selected to develop further, digital prototype then was used in the design process in order to evaluate more details in various aspects of the design. The prototype became higher-fidelity at this stage. The usefulness of digital prototype iteratively drove the idea to be further developed and evaluated. It was used in the design evaluation to test the user experience, usability, affordances, interaction, as well as aesthetic aspect of the design. Because of its ability to mimic interactions between the screens and user actions, together with Wizard of Oz method, the problems and user flow become more realistic and natural than paper prototype. Animation and visualization can be added to evaluate the look-and-feel of the design and the emotional aspect of the interaction. In addition, because the main interface of the design is already digital with tablet, digital prototype was iteratively developed further to represent the final design.

7.1.3.4 Wizard of Oz

As mentioned in the previous chapter, Wizard of Oz is a technique often used by interaction designers to present their interactive aspects of the design to users for feedback evaluation purpose. The technique was used during prototype evaluation session and prototype presentation of the thesis. Basically, the authors created a simple set of interfaces; with paper for a paper prototype and with simple graphics on a tablet for a digital one. Our test participant was presented with these simple interfaces during the evaluation session. The authors then faked an interaction through paper or digital screen corresponding to participant's action. For instance, a smiley face on the machine was replaced with a sad one by switching a pre-made paper piece.

7.1.3.5 Emotion evaluation/interpretation

As emotional effect and response from users are the main and important aspect in this design project, the design evaluation focused on emotional aspects were used to help deciding the choice of the design and improve the emotional aspect of the design that influences the users to be aware of the machine as a being.

At the early design evaluation, one method was asking participants to select the pre-defined emotions that the machine expresses to test on what attributes (e.g. eyes, arms, eyebrows, mouth) of the machine as a being are the most important and effective to express the emotions to users. After the different emotional visualization of the character were developed based on the selected attributes, the participants in design evaluation session were asked to map the emotion card with the current state of the character to test whether they understood what feeling character tried to express, to figure out the ambiguity among emotions and to explore other emotions that can be used to improve the emotional aspect of the design.

Emotional response from users is substantial aspect that need to evaluate in order to figure out how expressive of the design can reach the users leading to the empathy to and awareness of the machine as a being.

One method to evaluate emotional response is by visual measures whereby participants report their emotional state by picking the cards with emotional phrases or words that best match with the emotions that the product has aroused on them at particular time [18].

Another method to evaluate emotional attachment is called Tech Break Up method introduced by Gerber [12]. This method is similar to love-break up letter where users of the product express their emotion and experience through a letter addressing to an actual technological entity. Tech Break Up method takes it further by having users perform a conversational break up with a video camera in combination with the break up letter. The camera, in this scenario, is regarded as a technology that the user is breaking up with. This method gives the designer insights on how user becomes detached from certain technology by allowing a user to express strong emotions through words and gestures.

7.2 Spatio-Temporal Designs

Interactive user experience develops from interactional trajectories relies heavily on 4 factors; space, time, roles, and interfaces.

In this case, space is the laundry area which covers from each washing machine space to a whole laundry room. A laundry experience is considered a combination of different time frame ranging from interaction time in which laundry users interact with the washing machine to perceived time in which they describe their perceptions of the whole experience. In term of role, laundry users who directly interact with the washing machine is considered a user, while the others in the laundry area are either spectators or bystanders depending on whether they observe the user or not. The interface in this thesis refers to a tablet screen that receives input from the laundry users and provide output accordingly. Additionally, a washing machine itself also provides various tangible interface that the users can interact with such as machine door, detergent slots, and physical knob and buttons.

Lastly, the experience with a washing machine is considered a here-recurring experience in this thesis, which means that the experience takes place in a specific area, but occurs regularly for a long period of time. To illustrate, laundry user normally interacts with a washing machine located in an unchanging laundry facility either daily or weekly. Hence, the thesis will focus on temporal aspect more than spatial one.

7.3 Design Concept

The final design aims to persuade laundry user into making more sustainable laundry decision through participatory design along with emotional engagement and attachment with the main character, Wash-E. The evolution of a character and the condition of the its environment are changed based on each wash result, which is affected by combination of multiple wash options such as wash load, dirtiness level, textile type, chemical components, and so on.

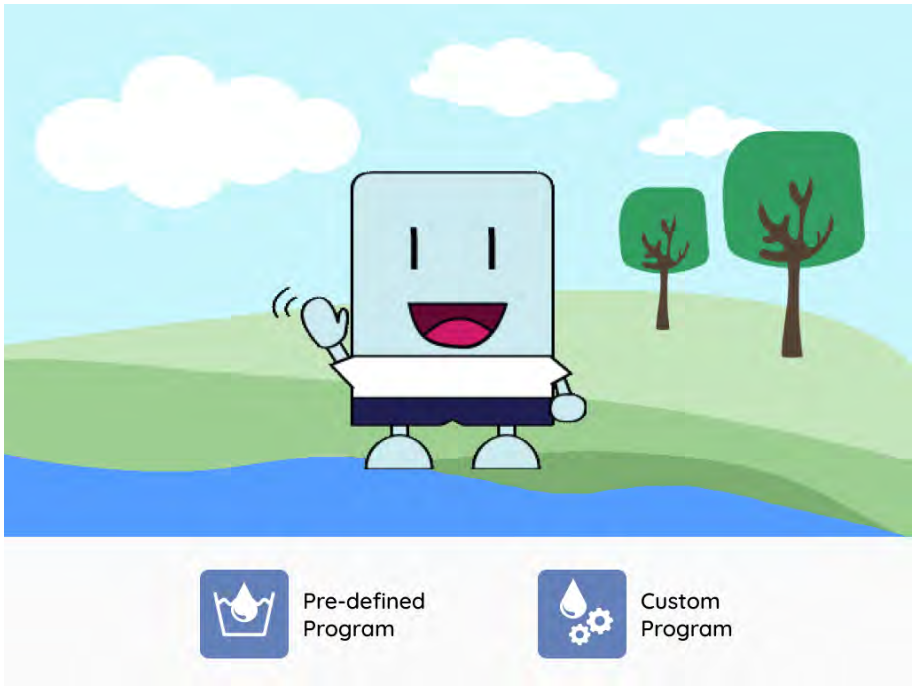

Figure 20: The first screen

7.4 Character

The main character, Wash-E, is inspired by the box-shaped traditional washing machine with additional facial expression and costume. Different user decision determines the action and health condition of Wash-E. Weight of the wash load, for instance, will affect both the character action and its appearance. In general, one wash session consumes a certain amount of energy to initiate the operation ranging from water pumping, water heating, drum rotation, and so on. Although water consumption varies partly with load for soaking clothes, a certain amount is fixed including water outside inner drum and around heating elements. Hence, the more the machine is filled, the less water and energy is used per kilogram. As a result, it is more cost-efficient to do one session of washing with full wash load.

The Wash-E character acts as a soul of each washing machine who lives in a virtual environment. Digital implementation approach of the final prototype makes the character design highly feasible to implement and flexible in term of adjusting and adding more features in the future such as additional expressive character's emotions, personalization options by changing costumes, or new environment with informative story-line related to the user.

The facial and bodily expression of the main character are designed to express mainly three levels of emotions: positive, neutral and negative. The positive emotions are designed mainly to reflect the choices of users that are sustainable and cost-efficient in particular washing session, for example, when users have full wash load, good amount of detergent and use low temperature mode. They are also designed to use to give positive feeling regardless to the choices of users, for example every time users start a new wash session, they will see the character greeting by smiling and waving its hands. Figure 21 show the list of positive facial and bodily expression. There are also a level of positiveness in each expression designed to convey how much happy or positive of the character, for example, Figure 21a) expresses more happiness than Figure 21h). The neutral ones are not mainly for expressing the emotion, but to get an attention from users, for example, Figure 22d), the character waving to the users to get an attention. Figure 22g) aim to make users stop to think about what happened and should they continue their current actions. Lastly, negative emotions are designed for giving the negative feedback to the users for their actions or washing parameters that are not sustainable and bad for the environment including when there is something wrong with the washing machine. For example, the character will express Figure 23a) when the washing machine is needed to be fixed or get a maintenance. The character will sad or cry as in Figure 23c) and Figure 23i) when users start to take particular action that bad to the environment. The evolution of the character also occurs in a negative way when the environment is getting worse. As the character is designed to be personalized and emotional engagement in mind, the negative evolution of the character is designed to make users feel bad as their own pet are changed so that its appearance looks worse, scary and pity. Figure 23 k), l), m) and n) shows the evolution of the character until it dies.

According to the feedback from user evaluation that they were focus on the information and setting of wash program instead of the character, animation of the character is taken into consideration. Getting attention from users is important as it is the first thing to make users look at the character that will guide and engage them in order to have an impact on their behavior. Not only adding animation helps draw an attention from users, but also to make the character be more realistic in the sense that it is a being, which also helps with the user evaluation as the prototype is getting more similar to reality. Hence, it should have movement of actions. It also helps to emphasize the emotion of particular actions and expressions, for example, Figure 24 shows the consecutive frames of the character that emphasizes the reality of the character sinking into dirty water. Figure 25 shows the consecutive frames of the character that it is very happy so that it jumps with big smile which emphasizes how happy it is, compared to the static version in Figure 21a). Therefore, in the final prototype, expressions are designed and animated from the consecutive frames in form of a GIF image.

7.5 Environment

Different background environments of Wash-E are created with the purpose of enhancing long-term user experience. Each scene is designed to reflect on the actual global environment with both fauna and flora. Trees, for instance, multiple stage based on user's selection.

The concept behind the design of environment is participatory design that the users can bring their inputs and needs, which is the selection of washing program and options, and make the consequence to the system that is shared among other users as they are participating. The design of the environment aims to simulate the real world situation in a shared-resource system like forest, water or animal that one individual's action always will more or less affect the whole resource. Although every individual might think that it is a little spoiling on the resource, but if everyone thinks the same and do it collectively, the resource will eventually deplete through their collective action.

There are 7 different environment scenes that show how good or bad the environment is. Figure 26 to Figure 32 shows the best and the worst environment scene, consecutively. Environment mainly will have an impact to the main character that will make them sad, sick, angry, mutated and eventually died. Therefore, users have to take care the environment in order to make their character happy. Figure 23 j) shows the character's expression in the polluted environment.

7.6 Menu and Sub-menu

The menu bar allows the user to navigate through laundry mode and make various selections. For Wash-E user interface in Figure 33, a menu bar is located at the bottom of the screen, while a sub-menu drawer is on the left side of the screen. The main menu bar consists of a combination of button, icon, and text display. It allows the user to navigate through wash programs in pre-defined wash mode, while browse through wash factors and options in customized wash program shown in Figure 33.

Although the main menu bar is always displayed in a fixed location, a sub-menu tab can be hidden according to user preference. On one hand, a sub-menu tab lets the laundry user select wash option based on the user's need in pre-defined wash program including prewash, heavy stain, and rapid process. On the other, it allows the user to select wash parameters corresponding to current wash load in a custom wash program.

7.7 Information Bubble

Various information bubbles are used to display messages that Wash-E character communicates with the laundry users. Each information bubble is located around Wash-E character to symbolize a conversation initiated from the character as well as to lead an attention of laundry user to the Wash-E character. Once the user tap on the bubble, information related to that particular bubble is displayed as a pop-up screen.

Information displayed on the pop-up screen are all facts and advice related to various topics. These messages range from laundry tips, machine condition, usage statistics to weight and chemical component measurements. As illustrated in Figure 35, each information bubble is distinguished by

an icon. In this case, a t-shirt icon represents clothes weight in kilogram in which an information screen in Figure 36 will show up when the user tap on the bubble. A measuring spoon symbolized chemical measurement using detergent spoon which correspond to an information screen in Figure 37 that provide information about suitable amount of detergent. A light bulb icon indicates a laundry tips and facts which are display as in Figure 38. A heart icon represents character's health which symbolized machine condition and maintenance status. Hence, an informative message regarding machine condition is display when user tap on the bubble as in Figure 39.

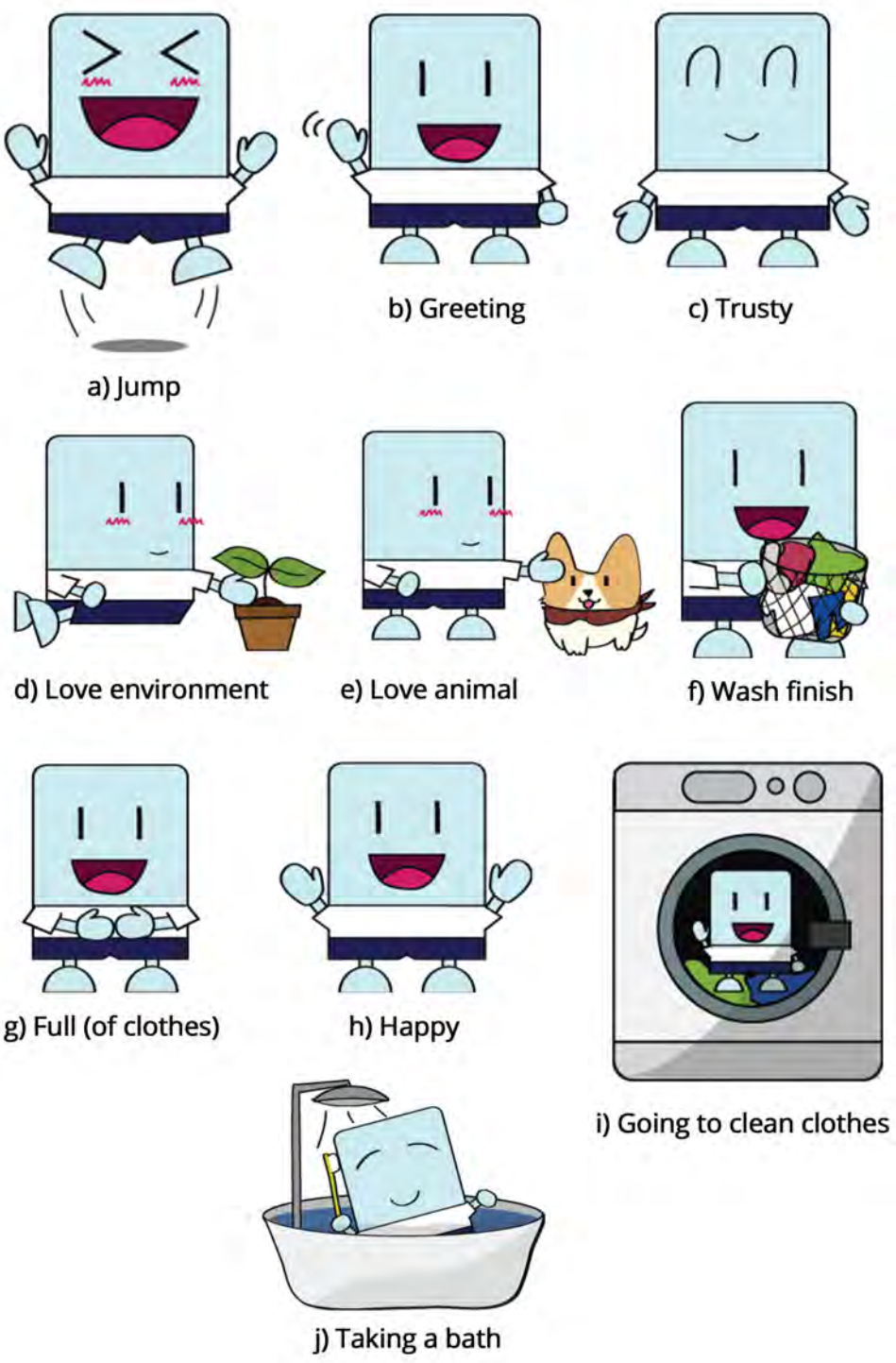

Figure 21: Positive emotions of the main character

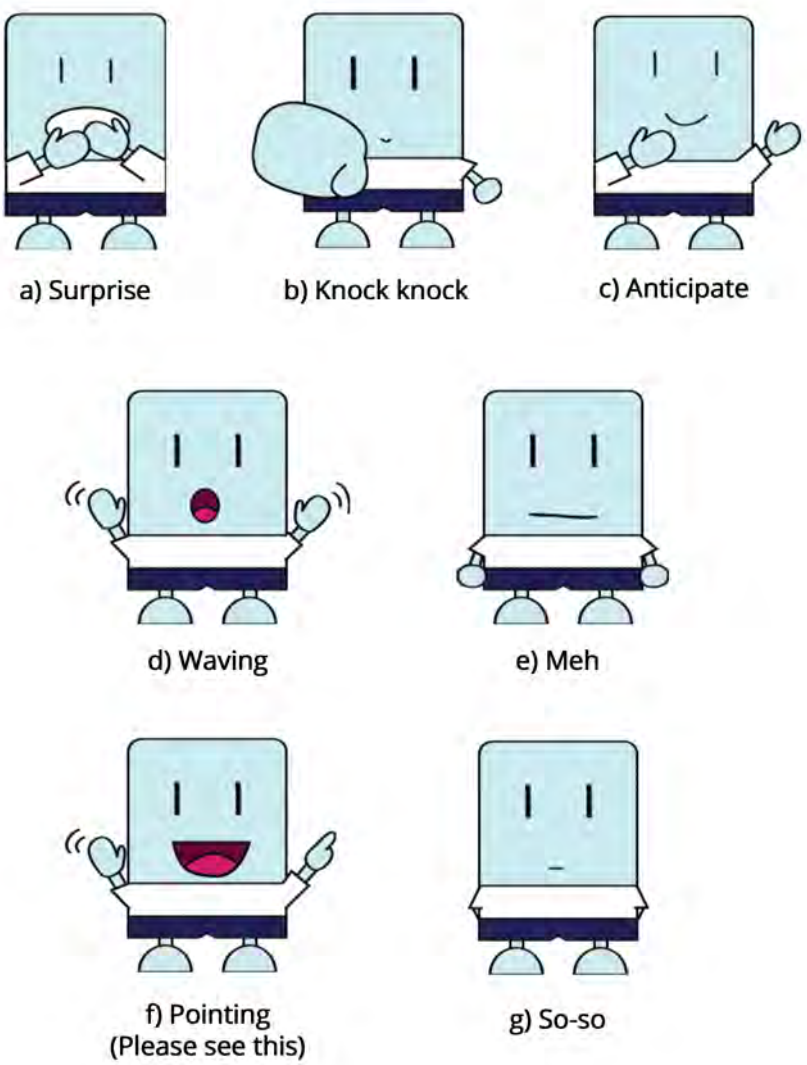

Figure 22: Neutral emotions of the main character

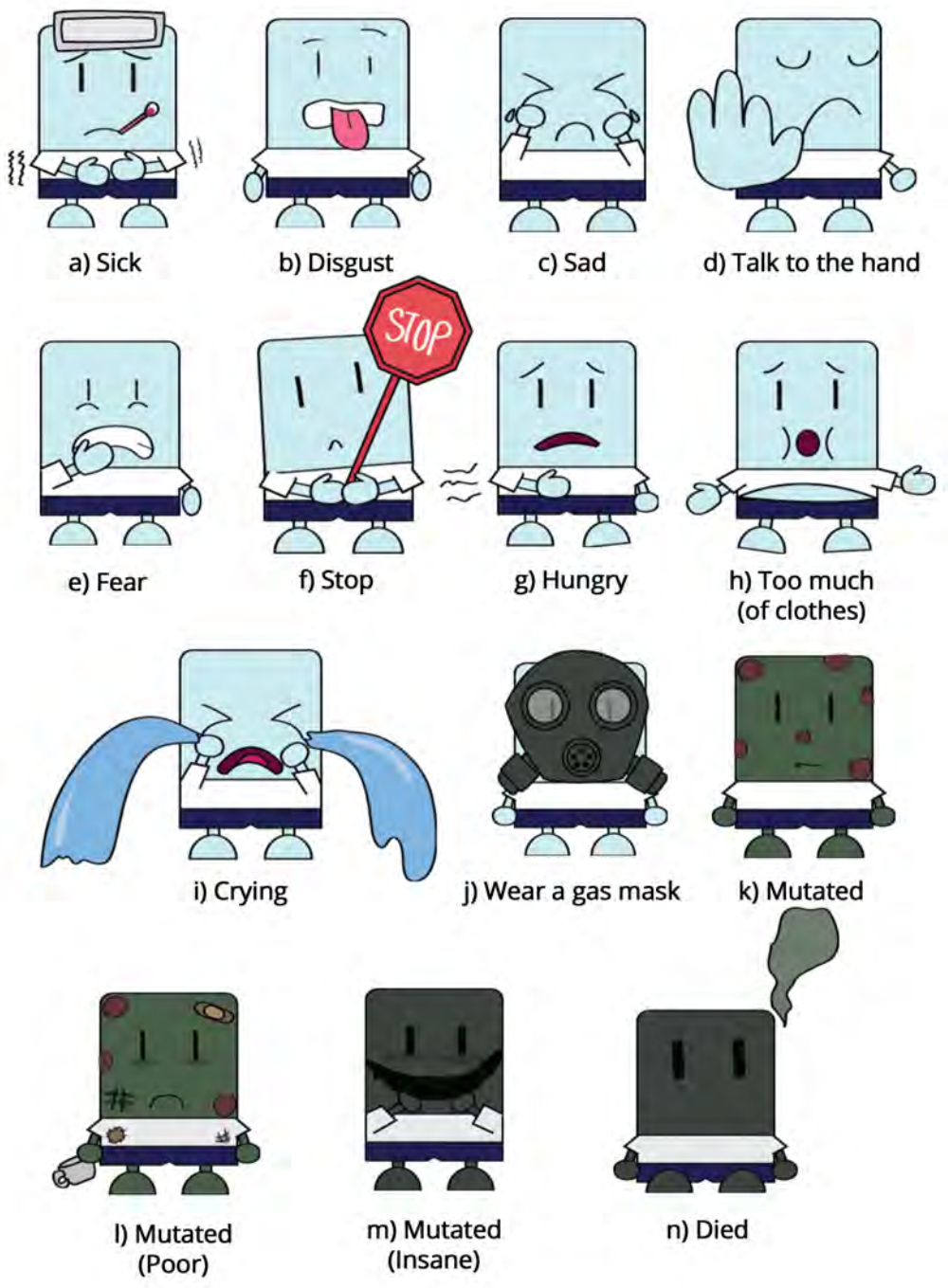

Figure 23: Negative emotions of the main character

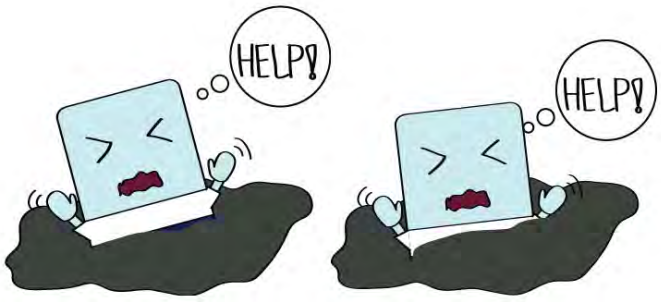

Figure 24: GIF image frame of the main character sinking into the polluted water

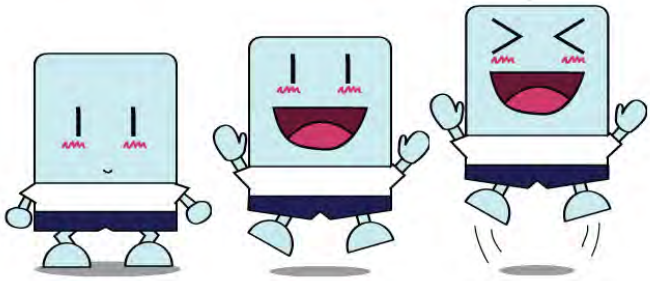

Figure 25: GIF image frame of the main character happily jumping

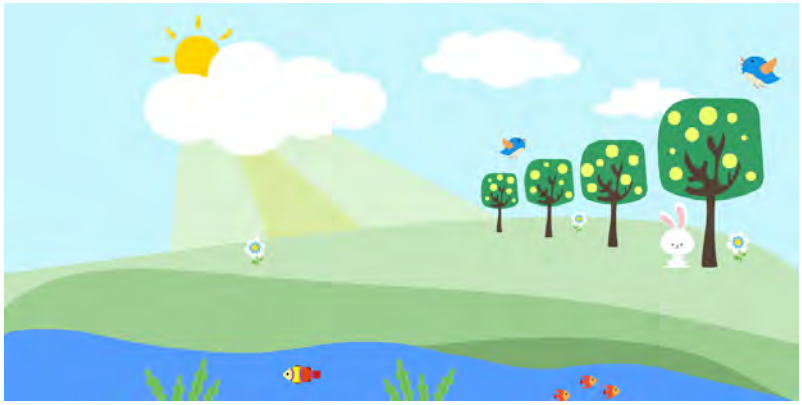

Figure 26: Environment: Flourish

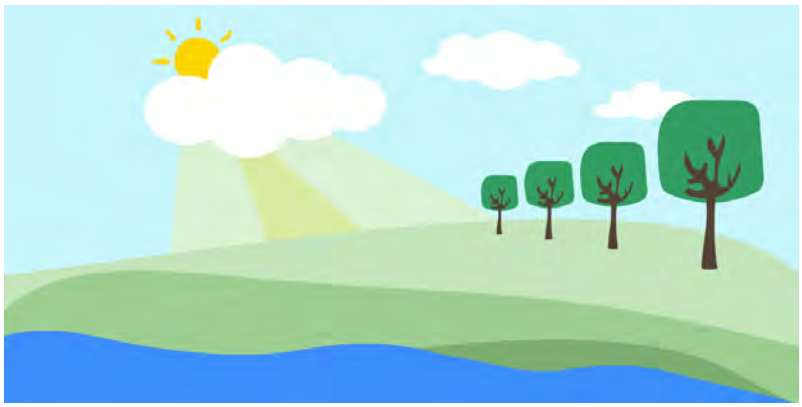

Figure 27: Environment: Sunshine

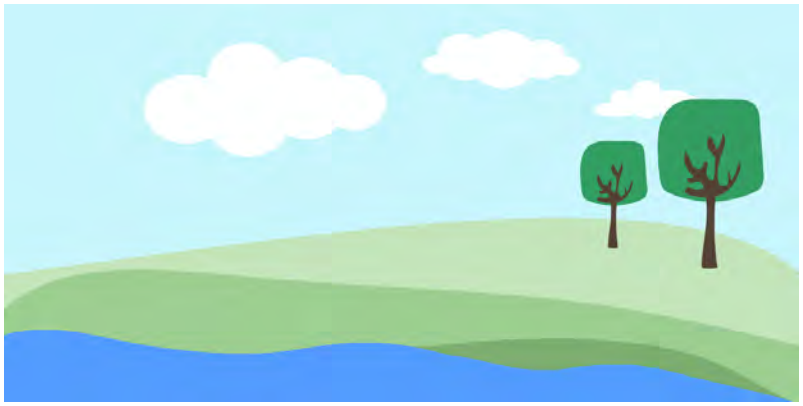

Figure 28: Environment: Good

Figure 29: Environment: Dull

Figure 30: Environment: Falling

Figure 31: Environment: Arid

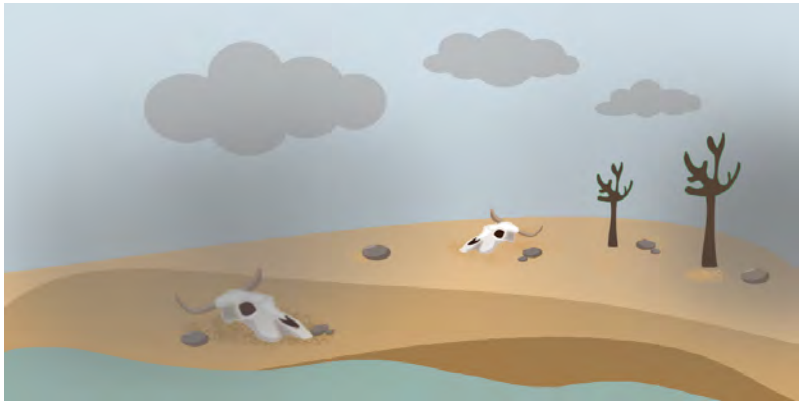

Figure 32: Environment: Polluted

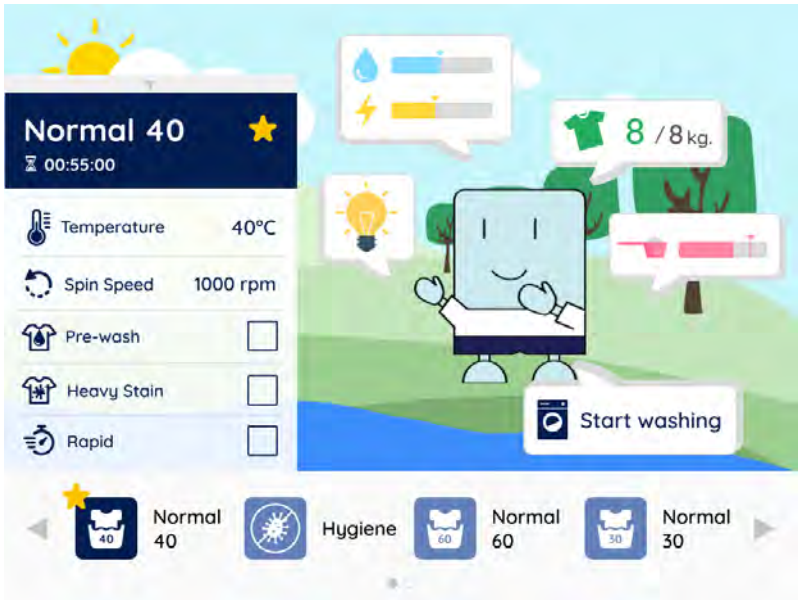

Figure 33: Pre-defined wash program selection screen

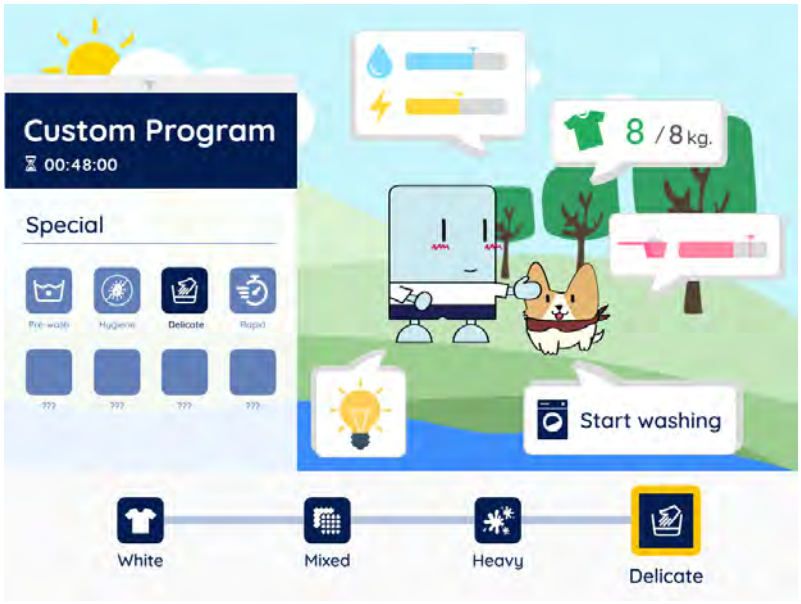

Figure 34: Custom wash program selection screen

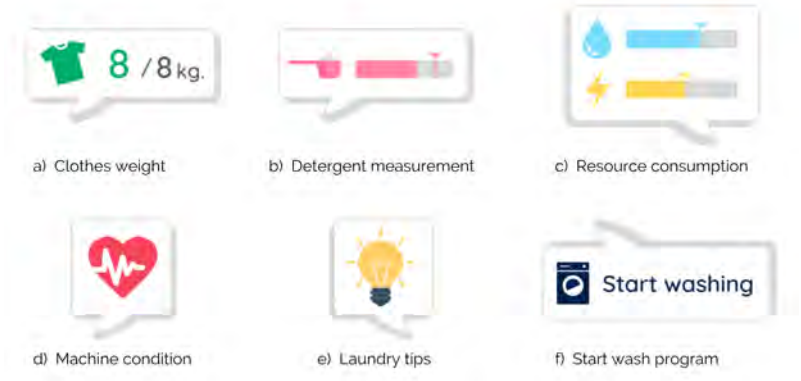

Figure 35: Various information bubbles

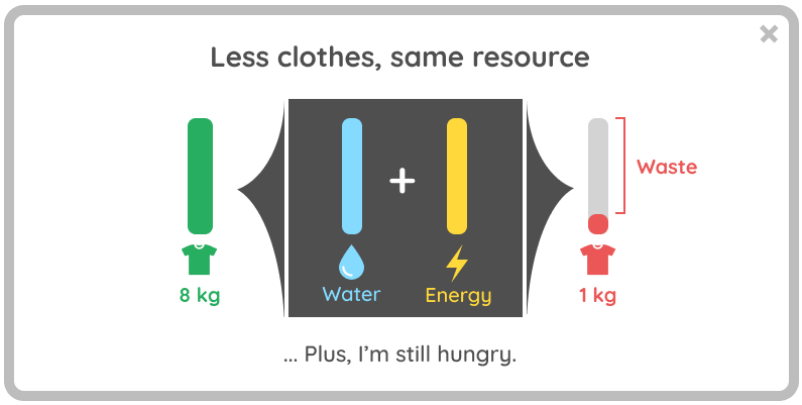

Figure 36: Clothes weight detail

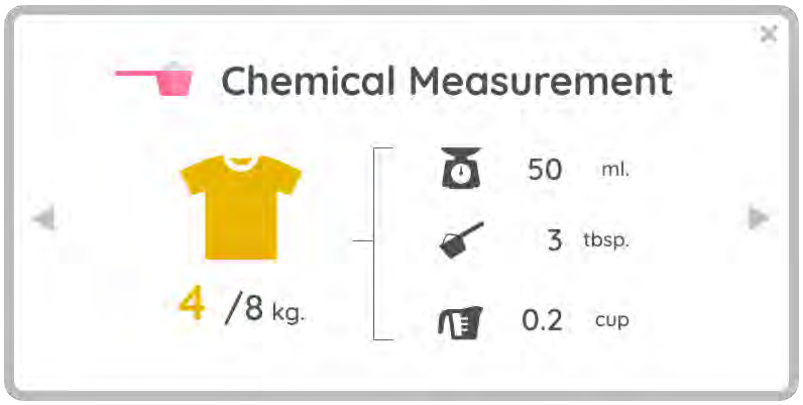

Figure 37: Chemical component measurement detail

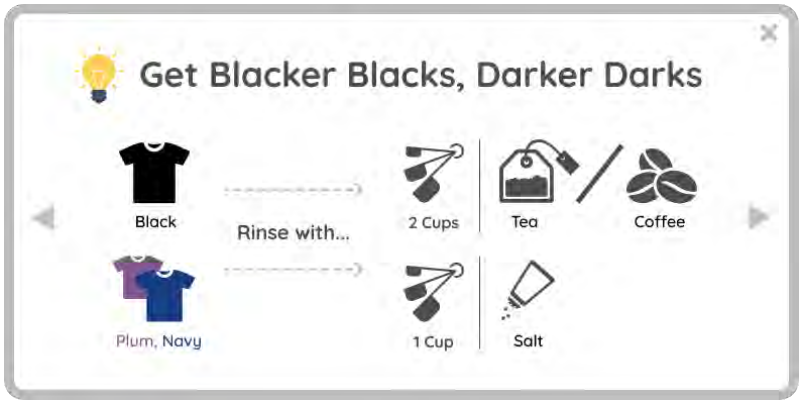

Figure 38: Laundry tips detail

Figure 39: Machine condition detail

8

Design Alternatives

This chapter summarizes alternative designs of this master thesis, including design iterations, prototype evaluations, as well as user tests.

8.1 Prototype

The result of the ideation phase inspired mainly three significant ideas that are needed to be evaluated to get the best idea for getting further designed and developed. The three ideas are considered in terms of the appearance of the character and the arrangement of components of the washing machine. All ideas are designed with the potential of extension implementation with the original model of professional washing machine from Electrolux, as seen in Figure 2, in mind. Figure 41 shows its current user interface part of the machine. Therefore, the box part of the machine is more or less be the same and the focus is surely the emotional elements and the washing interface part that connects to the emotional ones. The first idea inspired by Tamagotchi (Figure 40), is having a character as a soul inside the washing machine and using a tablet instead of the tangible buttons for the users to interact with. The second idea is making the whole washing machine itself as a character by having the eyes and mouth on the little embed screen while maintaining the existing tangible buttons. The third idea is also making the whole washing machine as a character but in more robot-liked, that it has eyes, mouth and arms to interact with users. All tangible buttons is removed and the users will interact with it by voice command.

Figure 40: Tamagotchi as an inspiration of the first idea

Figure 41: W575H's user interface

8.1.1 First Iteration: Paper Prototype

In order to quickly evaluate the concept behind these three ideas, paper prototypes are created as they are easy and fast to create and make change. Each paper prototype started with the same process of sketching particular ideas in the paper to visualize the concept, illustrate significant use cases, plan the arrangement of components, and most importantly, to make sure that two designers are in the same page and able to work as efficiently as possible. At the end, three paper prototypes were created.

For the prototype of the first idea in Figure 42, which is to digitally display a character as a soul inside the washing machine, a quick digital prototyping is also developed along with paper prototype in order to show various screen transitions and provide prompt feedback to each user action. The process of making a digital prototype is fast in the sense that the common components for each screen can be duplicated in a matter of seconds. Adding vivid color to the character instead of having black-and-white sketch highlights the character appearance.

Basically, the screen are separated into two section: The character and wash mode configuration. The character section is where the character is displayed and communicate with the users. The character, Wash-E, can freely express different emotions through the facial movements and body gestures. The character will communicate with the users through text. On the other hand, a wash mode configuration section is for the user to select wash mode and customize laundry parameters like temperature and spin speed, as well as be informed of the wash information such as clothes weight, wash duration, and suggested amount of detergent.

The prototype of the second idea in Figure 43, instead of replacing all the elements of the base prototype of the washing machine (Figure 41), the elements are the same with adjustment in the main screen and additional screen for text. For emotional elements, the main screen is adjusted to displayed the emotion as text emoticons. The washing information such as duration, the name of the program and other washing parameters is displayed on the screen below as a text instead. The washing machine will communicate or suggest through the same text screen, as well. The emoticons will change as a feedback according to what washing parameters users choose on the interface.

The prototype of the third idea in Figure 44 is the most extreme one. The arrangement of the elements and screens are changed. The whole machine is designed to become a robot-liked as seen in Figure 44. The eyes are on the top of the screen, the mouth is displayed on the front-door

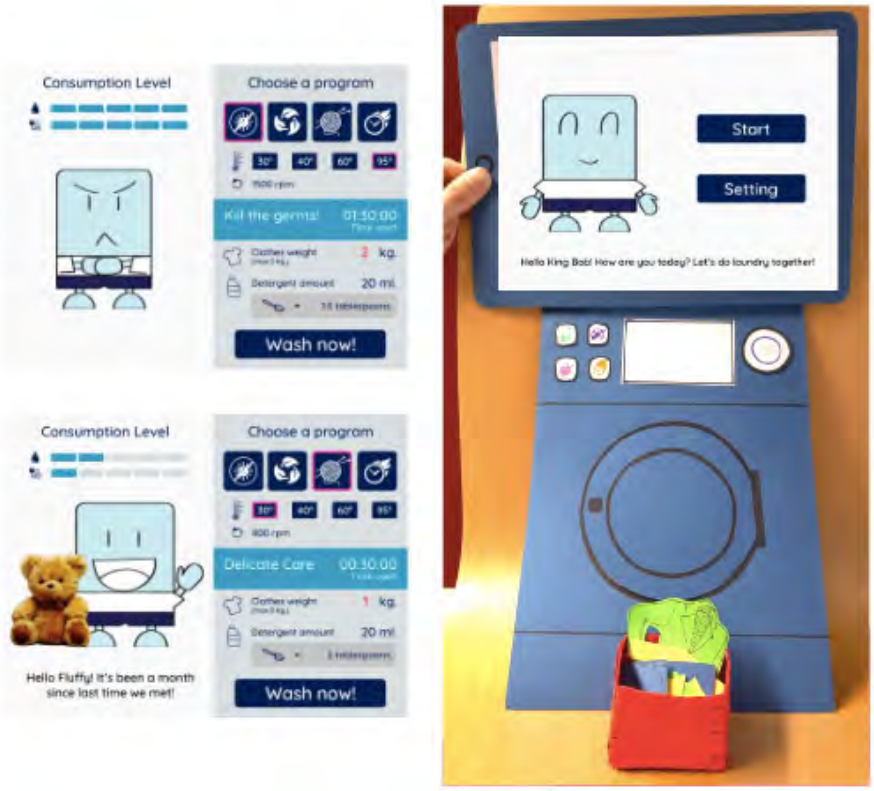

Figure 42: Paper prototype of the first idea

and there are 2 arms of the washing machine on each side. The communication is designed to be through voice command, tangible buttons and shaking hands with the machine. The washing information will be communicated to users by voice as well. The eyes, mouth and arms are the main component for expressing emotions which will be changed or moved according to users' actions.

8.1.1.1 First Design Evaluation

All three designs are evaluated at the same time for each evaluation session. The objective of first evaluation is to observe and explore the possibilities and problems of interaction between users and the washing machine with expressive emotions and to select the most interesting idea for further prototype development among these three ideas.

Criteria is defined for evaluating each prototype. There are 5 criteria for participants to give a score to: Feasibility, Attractiveness, Emotional attachment, Interactiveness and Social acceptance. Feasibility is defined as the technical possibility to implement the particular idea in 5 years as Electrolux is the main stakeholder, this criteria is needed to make sure that the idea is possible and not too difficult to develop as a workable prototype. Attractiveness is defined as how attractive the idea is in terms of its appearance, color, texture, etc. It might not be obvious to evaluate the aesthetic aspect of the idea with paper prototype. However, the main point is to get insights of the outer appearance among using tablet with character inside, small screen with face inside or turning to robot-liked machine. Emotional attachment is defined as how particular idea affects the emotion of users such as engagement, sympathy, caring, etc, that will more or less affect the behavior of users. This will help shape which kind of appearance that will create the most feeling attachment to the users, for example, when it dies or when they give negative feedback to users. Interactiveness is defined as how well particular idea provides user interaction and feedback in the

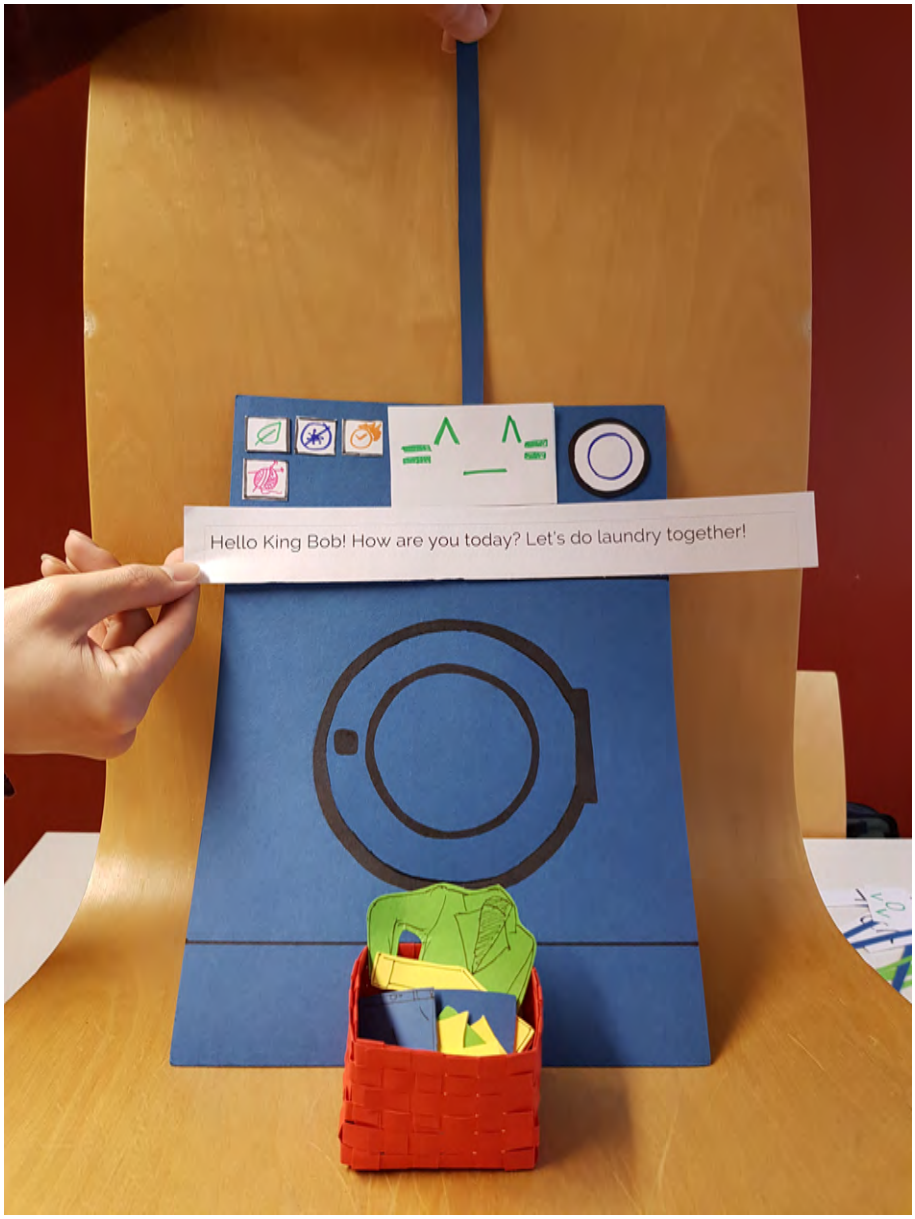

Figure 43: Paper prototype of the second idea

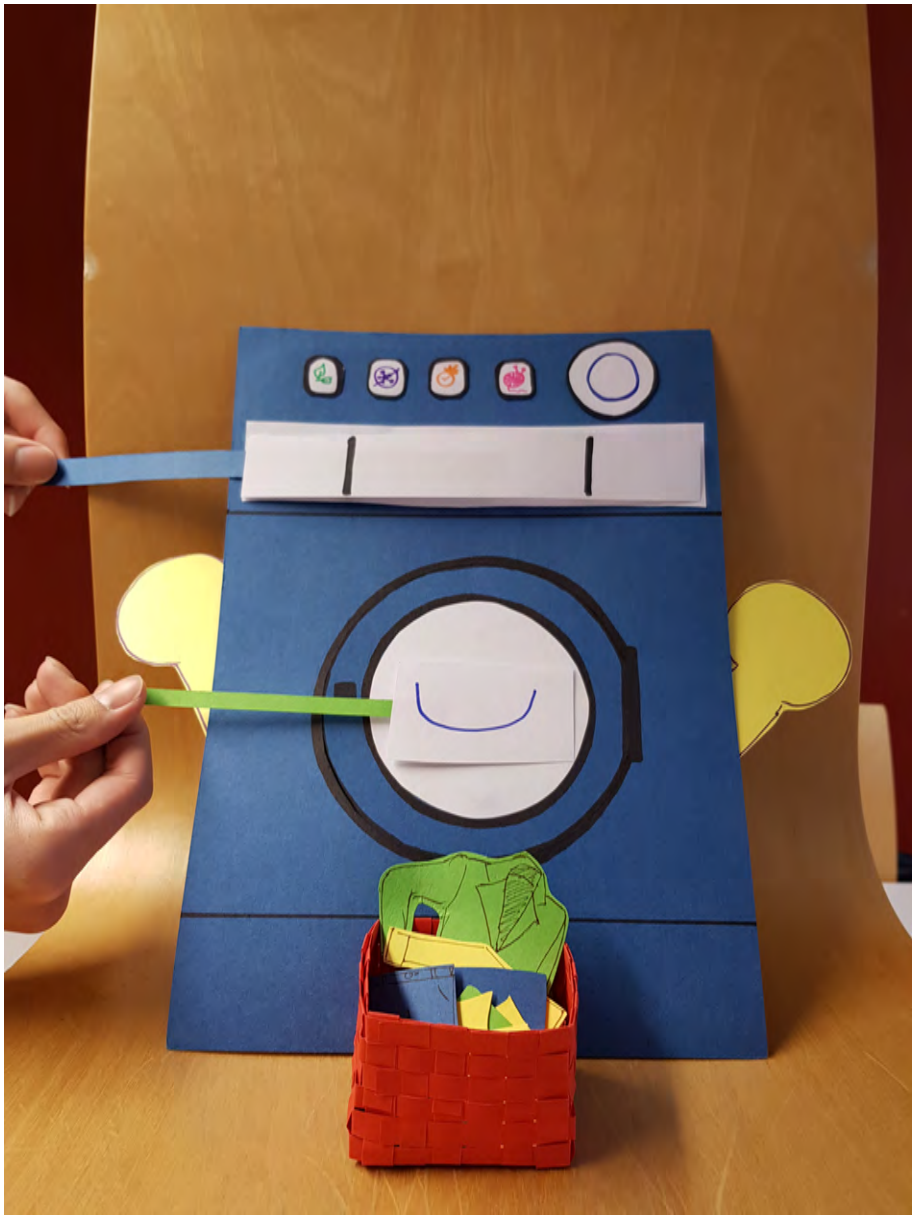

Figure 44: Paper prototype of the third idea

same features or same tasks that user typical do with the washing machine, for example, tangible feedback vs touchscreen, voice command vs button click or how users provide input to the washing machine. Lastly, Social acceptance is defined as to what extent the design is acceptable in the society imagine that the design is used in the real situation, for example, all the washing machine have arms and can talk; Does it provide uncanny feeling to the users or does it become too much human-liked?. This gives the insight and feedback to social and cultural aspects of the ideas. Figure **??** shows the form with defined criteria.

The evaluation is conducted in two different groups. The first one with three of interaction design classmates and the other with the same group of students as the design workshop. The duration of one evaluation session is planned to be around 60 minutes per one participant. The participant is asked to do three tasks for each prototype. The first task is the use case of typical wash session that is to select specified wash program or parameters and start washing. The second task is asking the participant to wash an adorable teddy bear with the suggestion from the washing machine. The third task is asking participant to play around with the long term scenario of the emotion in the washing machine, for example, when users use the same non-eco-friendly program for a long time. During the evaluation, several design evaluation methods are applied: Wizard of Oz, Thinking out loud, Interview and Evaluation form. Wizard of Oz technique is used to simulate the third prototype that will use voice command to interact with users. Every participant is informed to think out loud in order to know what they are currently thinking and what they understand and not understand when interact with the prototype on the way toward each task's objective. At the end, each participant is interviewed about potential suggestion, comments and feedback. They are also asked to fill in the evaluation form by scoring 1-5 in each criteria defined above (Figure **??**)

The result of the first design evaluation can be separated into qualitative and quantitative result. Qualitative result is summarized from feedback, suggestions and comments from participants and notes from observation and thinking out loud. There are interesting insights and feedback in both positive and negative aspects of each prototype and in general on layout of the components, interaction and the emotion of the washing machine. One significant insight from this evaluation is that the character or the emotion of the washing machine was ignored by some participants because they were focus on deciding washing program and washing options instead. Figure 45 shows the summary of qualitative insight of each prototype. Quantitative result is generated from the score given from the participant in the evaluation form (Figure **??**). The decision matrix is used to help select only one design to move on and get further improvement. Therefore, in each criteria, the weight is applied depending on how important each criteria is. Although all criteria is important, but in some of them, the design does not significantly needs to depend and focus on. Therefore, Attractiveness and Social acceptance is given weight of 1. According to the objective and requirement of the project, Feasibility and Emotional attachment are the most important so the weight of 3 is given to both. Interactiveness is also important element of the success of the design so the weight of 2 is given. According to the result of score-weight calculation is shown in Figure 46, the first prototype which is the tablet screen layout with the character as a soul of washing machine, gets highest score. Therefore, it is selected to get improved and evaluated in the next design iteration.

8.1.1.2 Half-time presentation

The three prototypes, the result of first evaluation and the plan of second iteration are also presented to Electrolux stakeholder as a half-time presentation to update the project's progress to main stakeholders and get feedback from them. There are many potential areas to be considered including:

- Different forms of interactions
- Emotional effect of the design concept

	Prototype #1 (Tablet Character)	Prototype #2 (2 Output Screens)	Prototype #3 (Physical Elements)
Positive	• Character actions • Character evolvement • Feasible to implement	• Washing machine = main character • Short and precise information • Feasible to implement	• Washing machine = main character • Innovative
Negative	• Improve screen layout • Too much information • Users focus on functions more than character	• Limited interactions • Limited inputs • Less emotional attachment	• Space issue • Unnecessary interaction
General	• User scenario needs to be revised • Increase user feedback to the system (bi-directional communication) • Rephrase text to create persuasive communication • Gamification & user achievement		

Figure 45: Summary of qualitative result from first evaluation

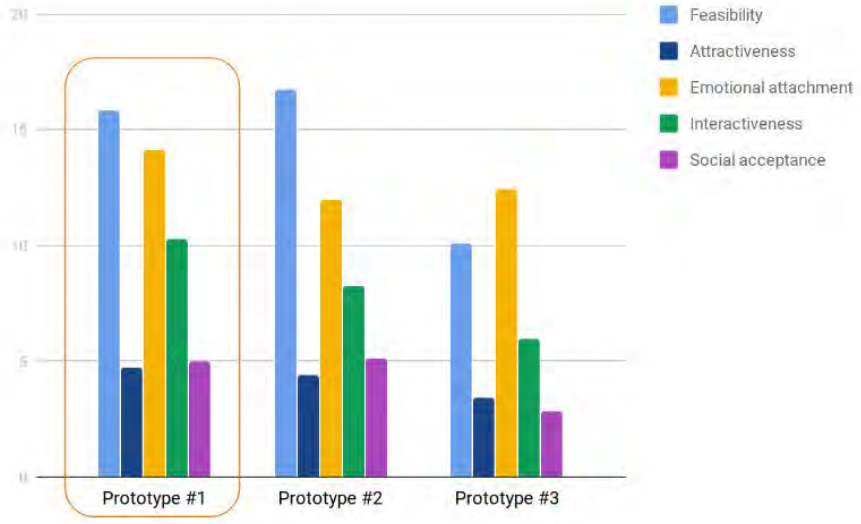

Figure 46: Quantitative result from first evaluation

- Long-term observation of user behavior
- Socio-cultural acceptance
- Gamification of the prototype
- Business-related aspect

They raised a concern regarding an unnecessary interaction that might interrupt the flow of users which is to wash their clothes, for example, unnecessary pop up dialog at the center of the screen. Together with the negative feedback for unsustainable action of users, how, when and why to give the feedback that is persuasive or constructive or even discourage, is suggested to think about because it can give too much negative feeling to users and discourage them to use this type of washing machine. From this, they also give comments about long-term acceptability and long-term effect of the design that, if possible to evaluate, will give significant insights, for example, how long users will accept this new idea of washing machine as a normal part of their laundry behavior. About social and cultural aspects, because washing machine is used everywhere in the world, the different in sociocultural aspect such as Western and Asian countries are also interesting to take into consideration, for example, one style or appearance of the character might be more suitable and effective in Asian countries than Western ones. The type of the washing machine and the culture such as shared, private and coin-op washing machine might also affect the character. The feasibility of the design and cost of the implementation are also their concern that the design should be practical.

8.1.2 Second Iteration: Digital Prototype

For the second iteration, the first idea is selected based on a user evaluation result from the first iteration to be improved and continue toward the final design. It is also started with sketching to explore various combinations within small amount of time. Figure 14 shows the sketching of various of the arrangement of layout and elements. After the sketching is done, the digital prototype is created. The digital prototype is chosen in the second iteration because at this iteration the focus of the design evaluation will be more on layouts, features, aesthetic, interactive and emotional aspects of one prototype instead of choosing and ranking the ideas and this selected prototype will be continuously developed and improved.

The design can be separately explained in three different aspects: Layout, Feature and Emotion:

- Layout - An important feedback from the first evaluation mentioned that the character and emotional elements did not catch user attention. Therefore, the layout and arrangement of elements in the user interface needed to be redesigned. From the sketch in Figure **??** and the screen design in Figure 47, the arrangement of the character and emotional aspects are moved to the center of the screen so that users will obviously see it at the beginning. Figure 48, after the washing program is selected, shows all significant parts on the screen: Menu, Washing Information and Character. The menu part shows the different choices that users can choose which in this case the pre-defined washing programs. The menu will change depending on which step it is, for example, it will change from washing program to cancel wash button when the wash process is started. Washing information part is designed to be on the left side of the character. There was an idea to display washing information on both left and right side of the character to keep the character on the center of the screen, however, it breaks the proximity of the design that related content should be placed together. Therefore, the washing information part is designed to be on one side. In addition, to solve the feedback of ignorance of the character, the button for start the washing session is placed on the same side of the character in order to force the users vision to the character side. Lastly, the character is placed on the center at the first screen and then pushed to the right

after the washing program is selected. Left-hand and right-hand people are also taken into consideration that users can switch the position of the washing information or the character to the left or right.

- Feature - The user interface for washing program and parameters is designed based on the user interface of template model of the washing machine (Figure 41), together with the observation of the machine usage in the shared laundry room. Therefore, there are pre-defined set of washing programs provided for users to select, for example, Normal program with temperature of 40 degree celcius, Hygiene mode for heavy dirty clothes and Delicate mode for washing sensitive items like doll. All pre-defined program is also be able to customize for pre-wash, heavy stain and rapid mode. Figure 48 shows the washing information and selected washing programs. At the top left, there is a clothes weight component to show the measured weight of clothes and maximum capacity of the washing machine aimed to inform users about full load wash is more energy-efficient. In addition, as the design aims to promote sustainable use, the energy and water consumption bar is added to inform the users about the consumption of particular washing parameters which will connect with the emotions expressed by the character.
- Character - The character is aimed to give the emotional engagement to the users. On this second iteration, eight primary emotions of charactars are designed based on Plutchik's Wheel of Emotions: Happy, Anticipation, Angry, Disgust, Sad, Surprise, Fear and Trust (Figure 49). Each emotion will express depending on the current washing parameters or washing program, for example, in Hygiene mode, to make the heavy dirty clothes clean, the temperature has to be high, hence, it is considered as high energy and water consumption. The character will reflect on this by expressing negative emotion to users like sad or angry. On the other hand, if users choose Normal 30 program which uses low temperature, the character will give positive feedback by expressing positive emotion as happy. For other emotions, Anticipation is expressed when the character expects users to select sustainable program or have a full load wash. Trust is expressed when everything is always good and the character trusts the users to select their washing program without any suggestions. Disgust is expressed when users wash heavy dirty clothes too many times. In addition to designing the emotions of the character, two different styles of the character, as seen in Figure 50, are created and planned to be evaluated. The first style is round-line cartoon-ish style that looks soft and playful. The other is stiff-line vector-liked style that looks more formal, digital and alike washing machine from its head.

8.1.2.1 Second Design Evaluation

In the second design evaluation, the goals are to find out how well users understand the purpose of each emotion expressed by the character, to evaluate how different style of the character affects users' perception and to get feedback on improved layout and features of the design.

To evaluate the emotions of the character, the activity called 'Emotion mapping' is presented to the participants. Participants will be separated into two groups: one to evaluate the understanding of the current designed emotions and the other to explore the various possibilities of emotions expressed to given scenario.

For the first group, the scenario is shown to the participants and they are asked to say about what happened, which type of emotions the character is expressing and why it expresses that particular emotion. The other group is given the emotion cards containing all 8 different emotions plus one blank card. The participant will be given the scenario as a text and they have to assign the emotion cards to it, for example, when there is too much clothes in the washing machine, which emotions do participants think it should express.

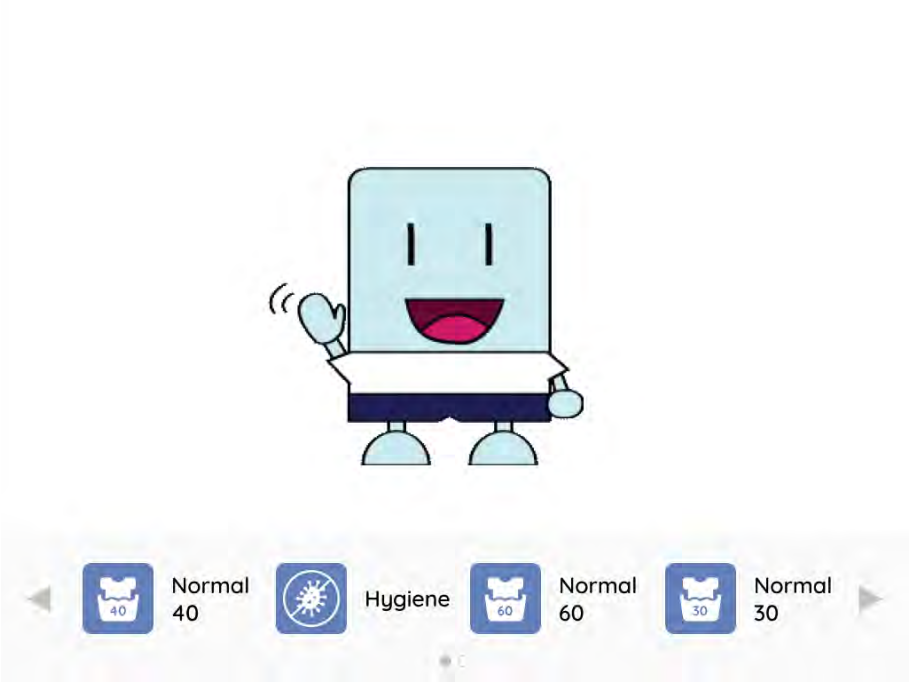

Figure 47: Digital prototype of second iteration

Figure 48: Digital prototype of second iteration

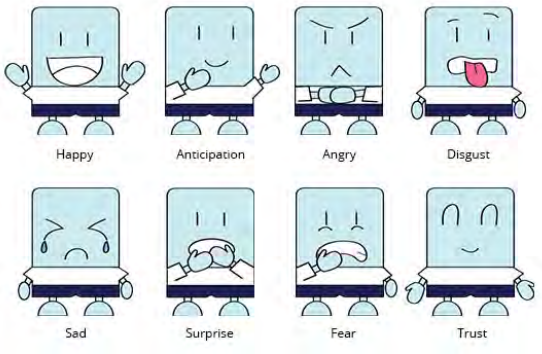

Figure 49: Eight emotions of the character

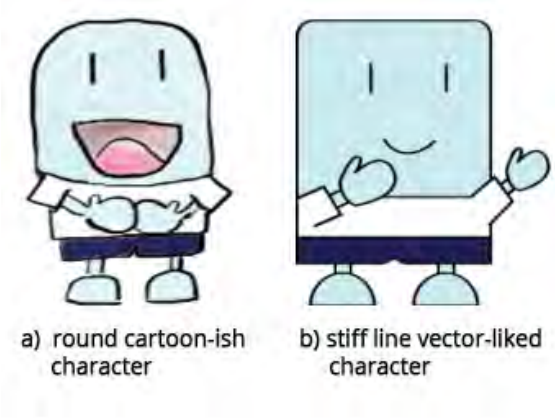

Figure 50: Two different styles of the character

To evaluate the style of the character, the objective is to find out which styles suit the best in the context of washing machine or professional appliance. Two styles are shown to participant at the same time and each participant is asked which style do you prefer and give a short reason.

Lastly, the participants are asked to think out loud and perform the task to select and configure the washing program and start washing in order to observe the problems or what is needed in the design and get feedback from the participants.

Every participant The result of the evaluation is interesting. Emotions that are clearly positive and negative are easier to understand than neutral and abstract emotion. For example, when the character is happy then participants know that they are doing something good and vice versa when the character is sad or crying. Anticipation and Trust are too abstract. Most participants interpret Trust as happy or in a good mood. They interpret Anticipation as a neutral action that the character just acts as it is presenting something. Disgust, fear and surprise are not clear whether the character is telling participants that they are doing bad or not. The result of Emotion mapping of the second group is interesting, they suggest new emotion or action from the blank card, for example, the character is dying when the washing is too unsustainable, the character get sick when there is something wrong with the machine. There is one comment that want the character to be more lovely and act like a pet that they have to take care of.

All participants choose the stiff-line vector-liked character style with the reason that it makes them feel more reliable in making their clothes clean, when using professional appliance like washing machine. The other is too playful and does not look like a professional washing guide. Another reason is that it is more suitable to the other components of the user interface.

The character is not totally ignored as the first design because the start washing button is on the same side of the character so everyone recognizes it at the end. There is significant feedback that the character can be more popped out with sound effects and animations. In addition, one participant suggests about gamification of the washing machine by having the washing score at the end of wash session or having the character living on the island and everyone needs to help taking care of the environment there or adding achievement system or sharing the character via social network. Moreover, it is also interesting to think about the type of gamification whether is competing with self, cooperative or competitive against others.

8.2 Installation and Design Demonstration

In the scope of the project, the final version of the design is needed to be developed further so that it is able to be installed at the HSB Living lab and have a design demonstration.

8.2.1 Workable Prototype implementation

From the final design as a digital prototype, the workable and interactable prototype is needed to be implemented. According to the technical requirement of the project for the design demonstration, the workable prototype can not be relied on only prototyping tool such as Adobe XD or Sketch because it is needed to demonstrate the connection with an existing washing machine to communicate and get the real value from it. Therefore, mobile application development is needed to take into consideration for workable prototype implementation. Below is the list of technical detail of tools and related information for implementing a workable prototype.

Figure 51: Demonstration setting model

- FTDI Chip - The type of chip that is inside the washing machine that the prototype needs to connect to. It provides the communication between the washing machine and the host (e.g. computer or tablet) through USB cable. They provide the drivers called D2XX drivers that is necessary for establishing the connection and communication such as get the basic information of the connected chip, configuration, send the bytes message to and read the data sent from the machine. [11].
- Android - Android platform is chosen because of implementation feasibility. Additionally, FTDI Chip has a provided library and example for Java and Android.
- React Native - A Javascript framework for developing cross platform native mobile application [31]. As this framework is based on Javascript and CSS which are the main technologies used for web development, it is considered faster to implement and arrange the user interface elements compared to build them from the native Android. This framework was selected not only because one of the authors was already familiar with this framework -which help speeding up the implementation- but also some concepts are encapsulated and handled by it.

8.2.2 Design Demonstration

After the workable prototype is ready, design demonstration is planned to setup at HSB Living Lab at Chalmers University of Technology. Figure 51 shows the model of how the demonstration will be set. The tablet would represent a potential embedded output screen that is expected to entirely replace existing one on the future machine. As there is limitation in the command sent to the washing machine, for example, it is not allowed to start the washing session from the tablet or host computer. Therefore, moderators are needed to simulate and fill the gap of this kind of actions, for example, when the users finish configure the washing program and press start button on the tablet screen, the moderators have to manually press the start button on the washing machine to actually start it. The concept of the design will also be presented during the demonstration.

9

Discussion

This chapter includes master thesis result discussion along with reflection towards design process, tools, methods, prototypes, and final designs. The chapter will be divided into several section according to the thesis phase.

9.1 User Research

As mentioned in the Methodology section, there are 3 methods that the team used to conduct user research: questionnaire, interview, and observation. Each methods has its own pros and cons depending on the context of use and information the team need from the research.

9.1.1 Questionnaire

Questionnaire is the first method that the team used to obtain quantitative data. Since the focus of the thesis is already defined, it is quite easy to design the scope of questions. The perks of doing an online questionnaire is that the responses come from many different locations in the world. This piece of data gives us a valuable insights on cross-cultural preferences along with diverse perspectives towards laundry and a washing machine. Furthermore, answers from open-questions such as user's envision of futuristic washing machine and laundry process strongly inspire and influence our final design concept and prototype.

However, the process of data cleansing is quite complicated and time consuming since short text answers rely heavily on the interpretation of the thesis authors. A wrong interpretation may affect the whole quantitative data. To prevent this problem, the team ask for second and even third opinion from other team members to interpret ambiguous answers.

9.1.2 User Interview

In addition to a questionnaire, the team uses interview as an extra method to get a deeper understanding of laundry user. As mentioned in the Methodology Section, the interviews was conducted with 2 different user group: business owner and general users. Result from both interviews are considered qualitative, which provides detailed information instead of just numbers. It is very helpful during design phase since the team needs to analyze diverse user requirements and consider

all assumptions, expectations, constraints, and limitations. With the interview result, the team is able to solidify the design concept and proceed in the right direction.

The most challenging aspect when conducting an interview in authors' perspective is question preparation and session management. Since the interview is conversation-based, it is quite easy for both interviewer and interviewee to slip out of the focus area and get lost in a conversation. A semi-structured interview with some pre-defined questions becomes extremely helpful since it not only guides the interviewer through the session, but also allows the interviewer to ask additional questions when unexpected interesting topic comes up.

9.1.3 Observation

It is rather convenient for the team to observe laundry user since both of the authors use multi-housing laundry room. Based on our opinion, observation method requires nothing but time since each laundry session may last for 2-3 hours. The advantage of observation method is that the authors found many unexpected laundry interactions and sequences, which become quite useful when creating different prototypes and preparing a user test session like a machine size, the location of washing machine elements, how detergent is measured, how clothes are categorized, and wash priority.

Nevertheless, there are several limitations for us to carry out an observation. One of the limitations is that the access to laundry room is time limited, meaning that an access is granted during reserved time only. Another limitation is that both of the authors live in a student apartment, therefore only user group that is available for observation are students with a few small family. As a result, total number of laundry users that the team observed in the beginning is not large. Yet, it is enough to get a general idea of regular laundry sequence and how laundry users interact with current machine. Additionally, the team got an access to HSB living lab to study an actual W575H washing machine during the second design iteration. It was also another good opportunity to observe laundry user within the lab. In general, every users have quite limited interaction with the washing machine. They do not hesitate to leave the machine once the program starts and rather spend laundry waiting time on other activities outside of the laundry area.

9.2 Design Process

This section discusses about the origin of our design concept along with overall design process from the initial divergence phase to the final convergence phase.

9.2.1 Ideation

Brainstorming session and design workshop are extremely helpful in term of collecting ideas and potential problem related to futuristic washing machine. It seems like a good ideas to have at least a specific focus before starting conducting any ideation methods. In this case, the topic of brainstorming session was social aspect and design of futuristic washing machine. The trade off of having such a defined topic is that ideas may not be varied and may even run out fast. The team dealt with this issue by referring to the topic as an idea guideline instead of idea scope. Therefore, ideas that are not completely related to the focused topic are also welcomed. The team also arrange the session by having several short breaks within 30 minutes session so that we got

to explore ideas on the table and build up on them once the session continues. With this solution, the team was not pressured by the time limit and was able to come up with more useful ideas for the later phase.

Once brainstorming session was over, ideas are categorized into categories using affinity diagram method. Each group of ideas gives us insights on design alternatives and how each team member understand and visualize the focus topic. Thus, these idea pool not only provides the team with starting point for design phase, but also initiate a discussion regarding futuristic washing machine and thesis scope. The main challenge of this process is the conflict between related ideas, feasibility of the implementation, and machine limitation. Since the main task the team received from Electrolux Professional Laundry is to modify existing machine with some form of prototype, it is necessary for the team to properly manage the scope and come up with a design concept that can be implemented withing given time duration.

The design workshop is useful and fun to do it. It gives interesting insights especially when the design space is new and wide, for example, the design of futuristic items, because of less constraints and less focus on impossibility. Only designers in the project might not be enough to explore many aspects in the design space. Therefore, with the help of other people, especially with different background, the new spots are emerged in the design space which can be applied and developed further. However, there are some difficulties in conducting the design workshop. The time spent by the participants in the workshop can be difficult to plan. In this workshop, some participants spent more time than expected because of the difficulty of the question. To balance between keeping the scope of the workshop within the context of the design goal by giving constraints and allowing more freedom and wild ideas, is also one aspect to think and plan about. Lastly, to convince people to participate can be hard because it took some time from them. Although, in this case, all participates are author's friends and colleges, having some rewards after the workshop is one way to get help from people.

9.2.2 Design Iterations and Evaluation

Once the concept is solidified, the team conduct a couple of design iterations throughout the transformation and convergence phase. Each design iteration helps the team understand and envision potential problems and possible solution, leading to multiple design improvements in later iterations. For instance, the team realized that some laundry users perceive interactions with the character as unnecessary ones due to the fact that they do not want to prolong laundry duration. The team then received a suggestion regarding gamification and screen layout so that the user feels more comfortable and attracted to the character. Based on these comments, the team feels like more design iteration will definitely provide fruitful feedback and suggestions necessary for the final design concept.

Apart from that, the number and the variety of participants is also another thing that the team needs to considered during each iterations. Since the team is located in Gothenburg, Sweden, most of the participants in design workshop and user test session have similar laundry experience since they use multi-housing laundry facility. Most of them are also students since arranging a session for employed workers or a family will require time and space to setup the session. Hence, the team might be able to obtain even more useful and valuable data if the team encounters more diverse laundry users or the duration of the project is extended.

9.3 Design Concept

The final design relies heavily on the user interaction and emotional attachment with a character called Wash-E. This character is intended to represent a spirit or a soul of each W575H washing machine. Besides the evaluation results that the team obtain from early design iteration evaluation, there are several other reasons why this prototype becomes the final concept includes its feasibility to implement, rich interactive feedback, and its mobility which allowed easy extension and improvement. By implementing the design on a digital screen, the prototype provides rich animation and has a potential to provide variety of feedback including character and its environment animations, screen transitions, haptic feedback, and audio. The installation, cost, and logistic are also smaller and less complicated than building tangible parts.

Potential misleading aspect of the final design may come from the presentation of Wash-E character. The team went for a prototype with external character in a touchscreen instead of modifying an actual washing machine. As a result, laundry user may see the character as an individual that is completely separated from the machine. Thus, the machine itself stays an object to the user instead of a social machine. Moreover, the users may feel uncomfortable with this extra character who pursue them to change their laundry routine in which they have been doing for their whole life. The user could feel pressured and bothersome by the character's suggestion and decided to ignore them. In worst case, users may even perceive the whole interaction as unnecessary. Consequently, emotional attachment to the character may be lessen, thus increase a chance of perceiving such interaction as unnecessary.

9.3.1 Balancing Positive and Negative Feedback

Changes in character action and condition along with depleted environment may be perceived as a negative feedback. On one hand, negative feedback may motivate some laundry users to try to fix the behavior and improve the virtual world. However, some user may be discouraged by such negative feedback and decided to give up or completely ignore the character and its environment. In this case, the long-term goal of changing user behavior is unlikely to be achieved.

Additionally, there is a possible case of laundry users having to use high resource-consuming washing programs or configuration of washing parameters for unavoidable reason. While showing the wash result as unsustainable action and cause the degradation of the environment, it seems unreasonable for the user who have no choice but to proceed with the wash. Therefore, the team needs to find a good balance in displaying negative information for such inevitable action. For instance, the score and changes in environment can be calculated based on the ratio of environmental-friendly program usage frequency and non environmental-friendly one. This solution will prolong the degradation of character condition and its environment if the frequency of using environmental-friendly programs exceeds the non environmental-friendly ones.

9.3.2 Intensity of Persuasive Aspect

There are many methods that can be used to integrate a persuasive aspect into the design concept including gamification, rewarding system, and critical design approach.

Gamification is an interesting area to consider for creating more persuasive effect to the design. It is the concept of finding the fun in non-game contexts things that people have to do. This can be simple aspects, for example, points, badges and leaderboards [29]. In the gamification aspect of

the Wash-E design concept, the main idea is to ask users to perform sustainable actions in order to make their Wash-E happy and its shared environment clean and flourish as an incentive through the points that users can get in each wash session. However, the gamification of the persuasive system might be able to create unintended outcomes [29] which is also reflected from evaluation of the final prototype and the feedback collected from potential users. The author came across various cases regarding potential misuse of the prototype. One possibility of the misuse of the prototype is users try to redo or configure on what gives them the best points to their Wash-E and environment, for example, re-wash clean clothes, resulting in the unsustainable outcome. Another possibility is users do bad things to explore the result, for example, do all the unsustainable ways of washing clothes because it is virtual world and gamified and it is fun to explore in that opposite way as well.

Moreover, from the final evaluation and feedback collected, some of gamification elements could be taken into consideration such as leaderboards and achievements to add more competitive and incentives for users to act sustainably as the intention of the design. It is also interesting to explore more game mechanisms to the Wash-E, for example, storytelling, feedback, difficulty and game rules [29].

The authors also consider improving the final prototype by incorporating critical design approach. Currently, Both the Wash-E character and its environment adopt an ability to evolve and transform into either better or worst shape. Hence, the user has a potential to see sick character or dying animal resulting from related action. What if these adorable animals displayed in Wash-E's environment are replaced by human characters? Seeing animated humans in various deteriorated stated could provoke uncomfortable or uncanny feeling from the user since it is much closer related. Such strong impact may potentially lead to a committed change in behavior. In contrary, this concept may raise further issues regarding target user group and social acceptance of the product.

9.4 Challenge

Challenges, mainly related to design process and concept, are discussed in this section.

9.4.1 Information Visualization in Limited Space

It is challenging to visualize the important information needed in washing machine together with emotional elements while maintaining the information that users want to see towards the goal of using washing machine. Normally, there are a lot of information on the washing machine that users have to think about, for example, washing programs, time, amount of chemical component and clothes types. Adding emotional elements as a character can create information overload that make them become unnecessary to users and get ignored by them which happened in the first design evaluation. Therefore, to find the way to present both at the same time with the same level of attention is difficult without adding every element on the screen. That's also the reason why there are a lot of elements on the screen in the final design. The washing selection interface cannot be shadowed because it is the main elements that lead users to achieve the goal of using the washing machine. Otherwise, users might get frustrated and stop using it. However, similar to the character or the emotional elements of the washing machine, it is no point of having it if it is ignored by users as clearly seen by the first design evaluation of the tablet idea that two main components (washing and emotional elements) are totally separated. Although, the current solution is to put washing elements, changes and animation on the character to draw the attention from users, it still more or less slow down the process of getting the clothes washed in the machine.

9.4.2 Unnecessary Interaction VS. Emotional Engagement

This leads to another challenge in designing and developing new ideas on something with very narrow and specific in context of functionality that has already been settled and become convention of everyday use which can infer that the additional features might become unnecessary and ignorance. It is challenging not to interrupt the users' flow of using washing machine while engaging the emotional elements to them because the main goal of using washing machine is to put the clothes in and make it clean as easy and fast as possible, not to talk or play with it. However, emotional engagement can not be created without the interaction with users. Therefore, the emotional engagement has to be presented in some ways while minimizing an unnecessary interaction. According to the prototype developed in the project, the first design prototype is the most uninterrupted one, however the character mostly gets ignore. In the consecutive version of design prototype, the unnecessary interaction is added to increase the engagement between users and character, for example, character animation before and after washing to add playfulness and the feeling of the pet helps them clean the clothes, the changes in character emotion and environment that interfere users to think about what happened and the clickable and attractive bubbles around the character inferred that it has something to tell the users. To design an emotional elements in this case, it is unavoidable to more or less interrupt the flow. It is a trade-off between these two aspects.

9.4.3 Accessibility

Because a washing machine is a typical and traditional home appliance that everyone knows about and every household needs it for cleaning clothes, this creates the diversity of users in ages, genders, cultures and/or different abilities. Obviously, it would be very difficult to include every possible users in the design. The challenge is how to optimize inclusive design so that it does not limit the possibility of ideas or making the design too bloat by adding all the sub-features to support the diversity of users, while maximizing the accessibility of the design. More user personas are also needed to be created in order to take various possible users into account when designing the features of the design. For example, using tablet with touch screen provides the flexibility for the content to be displayed and interacted, but it could be difficult for older users or users with visual impairment. In this case, adding more physical elements can be helpful but in which extent they can be included to the design. Other examples could be to include hearing impairment users, the audio feedback is then needed to be considered to the designed or to think about how users with different height can interact with the Wash-E. Machine learning and visual recognition in order to detect the differences of users can be interesting areas to explore and apply to the design. There are a lots of differences to think about if the accessibility is taken into consideration because of the diversity of users. It depends on how many users would be included into the design.

9.5 Future Work

This master thesis can be considered an initial step in investigating and visualizing the potential of integrating emotional elements into a common household appliance. The final result leaves rooms for further development and refinement in several areas.

9.5.1 Long-term Evaluation

When the workable prototype can be installed and worked on its own, the practical installation at a shared laundry room can be set. As a long-term design evaluation, participants will be asked to use the prototype for a period of time. Long term design method like UX-curve can be used to collect user experience over time [21]. Critical Incident Technique [37] is also a design method to record the moments when participants feel or encounter something extraordinary during using Wash-E in both positive and negative ways, for example, when it make them happy or when it disappointed them. In addition, participants will be asked to write a love or break-up letter to the Wash-E at the end of the evaluation period to elicit emotions regarding to Wash-E and its functionality. The result then is analyzed to see the relation and consequences between actions and emotions in long term in order to get more accurate insights and improve the design.

9.5.2 Cross Cultural/Regional Design

Because of differences in social and culture aspects between countries, for example, Western and Asian countries, how Wash-E interact with users can be different. The appearance of Wash-E, how it expresses emotions, how it say a word to user or how they interact with users can create different ways of experience, emotional engagement and changes in behavior. It might look different, more polite, adorable or strong. Another example is about an external factor such as water quality which can be different in some particular places resulting in different washing parameters, knowledge and behavior of doing laundry. The further research on cross cultural design is thus needed to understand more on how social and cultural interaction affect the behavior of users.

10

Conclusion

Wash-E is developed with a goal of having users think on sustainable usage of everyday appliance, in this case a washing machine and to find out how can the emotion element of the machine affect how they do laundry in general. User research data, inputs from design evaluations and the challenges in information overload and unnecessary interaction from the additional emotion elements, infer that it is difficult to conclude on how the professional washing machine with personalities and emotions affects the future laundry experience. At this point, the affect can be varied because of the difference in background, culture and purpose of use in mind of users. On positive side, they can get emotional attached with the Wash-e and would like it to be always happy leading them to learn how to do more sustainable laundry to make better environment for their Wash-e. On the other hand, Wash-e can be ignored and no one care about because it is redundant to their goal. This is because the fact that the effect to the accustomed behavior takes time.

Users are introduced to the washing machine with emotions and personalities that never happen anywhere before. They are used to using an existing washing machine that they use as a part of everyday life. Therefore, to change or affect the culture of using washing machine and to create an emotional engagement, it needs time. One short evaluation session to show the scenarios or give participants tasks to do and get feedback is not enough. There should be a long term setting of the evaluation that requires the participants to use the professional washing machine with emotions in the real natural setting as part of their daily life for some period of time in order to reveal the hidden part of the problems about how users accept or decline the emotional elements of the washing machine first and see how they change overtime. It is also interesting if every washing machine is already smart in the ways that they can talk or interact with the users. The perception of users when doing evaluation might be changed.

References

[1] Leonardo Angelini et al. "Towards an Anthropomorphic Lamp for Affective Interaction". In: *Proceedings of the Ninth International Conference on Tangible, Embedded, and Embodied Interaction*. TEI '15. Stanford, California, USA: ACM, 2015, pp. 661–666. ISBN: 978-1-4503-3305-4. DOI: 10.1145/2677199.2687914. URL: http://doi.acm.org/10.1145/2677199.2687914.

[2] B. M. Hanington B. Martin and Ebook Central (e-book collection). *Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions*. Digital ed., 2012.

[3] Hartmann B. "Gaining Design Insight through Interaction Prototyping Tools". In: Department of Computer Science, Standford University, 2009.

[4] Steve Benford et al. "From Interaction to Trajectories: Designing Coherent Journeys Through User Experiences". In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. CHI '09. Boston, MA, USA: ACM, 2009, pp. 709–718. ISBN: 978-1-60558-246-7. DOI: 10.1145/1518701.1518812. URL: http://doi.acm.org/10.1145/1518701.1518812.

[5] Benyon. "Part II: Techniques for designing interactive systems, Chapter 8: Envisionment". In:

[6] Jeanette Blomberg, Mark Burrell, and Greg Guest. "The Human-computer Interaction Handbook". In: ed. by Julie A. Jacko and Andrew Sears. Hillsdale, NJ, USA: L. Erlbaum Associates Inc., 2003. Chap. An Ethnographic Approach to Design, pp. 964–986. ISBN: 0-8058-3838-4. URL: http://dl.acm.org/citation.cfm?id=772072.772133.

[7] Eva Burneleit, Fabian Hemmert, and Reto Wettach. "Living Interfaces: The Impatient Toaster". In: *Proceedings of the 3rd International Conference on Tangible and Embedded Interaction*. TEI '09. Cambridge, United Kingdom: ACM, 2009, pp. 21–22. ISBN: 978-1-60558-493-5. DOI: 10.1145/1517664.1517673. URL: http://doi.acm.org/10.1145/1517664.1517673.

[8] Gabriele Civitarese, Stefano Belfiore, and Claudio Bettini. "Let the Objects Tell What You Are Doing". In: *Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct*. UbiComp '16. Heidelberg, Germany: ACM, 2016, pp. 773–782. ISBN: 978-1-4503-4462-3. DOI: 10.1145/2968219.2968285. URL: http://doi.acm.org/10.1145/2968219.2968285.

[9] Richard Coyne. "Wicked problems revisited". In: 2004.

[10] CreatingMinds.org. *Creative Tools*. URL: http://creatingminds.org/tools/tools.htm. (accessed: 14.02.2018).

[11] *FTDI Chip*. URL: http://www.ftdichip.com/. (accessed: 27.05.2018).

[12] Elizabeth Gerber. "Tech Break Up: A Research Method for Understanding People's Attachment to Their Technology". In: *Proceedings of the 8th ACM Conference on Creativity and Cognition*. C&C '11. Atlanta, Georgia, USA: ACM, 2011, pp. 137–146. ISBN: 978-1-4503-0820-5. DOI: 10.1145/2069618.2069642. URL: http://doi.acm.org/10.1145/2069618.2069642.

[13] Electrolux Group. *Laundry products*. URL: http://www.electroluxgroup.com/en/laundry-products-16670/. (accessed: 14.02.2018).

[14] IDEO.org. *Design Kit*. URL: http://www.designkit.org/. (accessed: 19.03.2018).

[15] Made by Interaction Design Foundation. *How to Conduct User Observations*. URL: https://www.interaction-design.org/literature/article/how-to-conduct-user-observations. (accessed: 20.03.2018).

[16] John Chris Jones. "Design Methods: seeds of human futures". In: John Wiley, Sons, New York, and Chichester, 1970.

[17] J.W. Frens J.P. Djajadiningrat W.W. Gaver. "Interaction Rebelling and Extreme Characters: Methods for Exploring Aesthetic Interactions". In:

[18] Gloria Adriana Mendoza Fanco Julián Covarrubias Valdivia. "Beyond emotional design: Evaluation methods and the emotional continuum". In: *Blucher Design Proceedings*. ICDHS '16. Taipei: Blucher, 2016, pp. 265–270. ISBN: 2318-6968. DOI: 10.5151/despro-icdhs2016-03_015. URL: http://doi.acm.org/10.5151/despro-icdhs2016-03_015.

[19] Lorenz Cuno Klopfenstein et al. "The Rise of Bots: A Survey of Conversational Interfaces, Patterns, and Paradigms". In: *Proceedings of the 2017 Conference on Designing Interactive Systems*. DIS '17. Edinburgh, United Kingdom: ACM, 2017, pp. 555–565. ISBN: 978-1-4503-4922-2. DOI: 10.1145/3064663.3064672. URL: http://doi.acm.org/10.1145/3064663.3064672.

[20] Katie Koepfinger and Burcum Turkmen. "Emoti-bots: A Line of Emotional Products for Automated Future Homes". In: *Proceedings of the 13th International Conference on Ubiquitous Computing*. UbiComp '11. Beijing, China: ACM, 2011, pp. 471–472. ISBN: 978-1-4503-0630-0. DOI: 10.1145/2030112.2030176. URL: http://doi.acm.org/10.1145/2030112.2030176.

[21] Sari Kujala. *Guidelines for using the UX Curve method*. URL: https://www.researchgate.net/publication/242024103_Guidelines_for_using_the_UX_Curve_method. (accessed: 30.05.2018).

[22] M. Luria et al. "Designing Vyo, a robotic Smart Home assistant: Bridging the gap between device and social agent". In: *2016 25th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*. Aug. 2016, pp. 1019–1025. DOI: 10.1109/ROMAN.2016.7745234.

[23] Matt Malpass. "Between Wit and Reason: Defining Associative, Speculative, and Critical Design in Practice". In: Design and Culture, 2013.

[24] Panos Markopoulos et al. *Evaluating Children's Interactive Products: Principles and Practices for Interaction Designers*. San Francisco, CA, USA: Morgan Kaufmann Publishers Inc., 2008. ISBN: 9780080558257, 9780123741110.

[25] Cees Midden and Jaap Ham. “Using Negative and Positive Social Feedback from a Robotic Agent to Save Energy”. In: *Proceedings of the 4th International Conference on Persuasive Technology*. Persuasive ’09. Claremont, California, USA: ACM, 2009, 12:1–12:6. ISBN: 978-1-60558-376-1. DOI: 10.1145/1541948.1541966. URL: http://doi.acm.org/10.1145/1541948.1541966.

[26] Hans Dybkjær Niels Ole Bernsen and Laila Dybkjær. *Wizard Of Oz Prototyping: When And How?* URL: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.135.2044&rep=rep1&type=pdf. (accessed: 28.10.2016).

[27] Lene Nielsen. *Interaction Design Foundation, 30. Personas*. URL: https://www.interactiondesign.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/personas. (accessed: 26.10.2016).

[28] Jekaterina Novikova and Leon Watts. “A Design Model of Emotional Body Expressions in Non-humanoid Robots”. In: *Proceedings of the Second International Conference on Human-agent Interaction*. HAI ’14. Tsukuba, Japan: ACM, 2014, pp. 353–360. ISBN: 978-1-4503-3035-0. DOI: 10.1145/2658861.2658892. URL: http://doi.acm.org/10.1145/2658861.2658892.

[29] Tobias Nyström. “Gamification of Persuasive Systems for Sustainability”. In: 2017 Sustainable Internet and ICT for Sustainability (SustainIT), June 2018. DOI: 10.23919/SustainIT.2017.8379815.

[30] R. Plutchik. “The Nature of Emotions”. In: *American Scientist* (July 2001).

[31] *React Native*. URL: https://facebook.github.io/react-native/. (accessed: 27.05.2018).

[32] RealSimple.com. *12 laundry mistakes you’re probably making*. URL: http://edition.cnn.com/2014/10/01/living/how-laundry-mistakes-real-simple/index.html?hpt=hp_c4. (accessed: 01.08.2016).

[33] Jose Rojas. *Etch A Sketch: How to Use Sketching in User Experience Design*. URL: https://www.interaction-design.org/literature/article/etch-a-sketch-how-to-use-sketching-in-user-experience-design. (accessed: 20.03.2018).

[34] Yea-Kyung Row, Chang Min Kim, and Tek-Jin Nam. “DooBoo: Pet-Like Interactive Dashboard Towards Emotional Electric Vehicle”. In: *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems*. CHI EA ’16. San Jose, California, USA: ACM, 2016, pp. 2673–2680. ISBN: 978-1-4503-4082-3. DOI: 10.1145/2851581.2892460. URL: http://doi.acm.org/10.1145/2851581.2892460.

[35] Selma Šabanović, Sarah M. Reeder, and Bobak Kechavarzi. “Designing Robots in the Wild: In Situ Prototype Evaluation for a Break Management Robot”. In: *J. Hum.-Robot Interact.* 3.1 (Feb. 2014), pp. 70–88. ISSN: 2163-0364. DOI: 10.5898/JHRI.3.1.Sabanovic. URL: https://doi.org/10.5898/JHRI.3.1.Sabanovic.

[36] JaYoung Sung, Rebecca E. Grinter, and Henrik I. Christensen. “"Pimp My Roomba": Designing for Personalization”. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. CHI ’09. Boston, MA, USA: ACM, 2009, pp. 193–196. ISBN: 978-1-60558-246-7. DOI: 10.1145/1518701.1518732. URL: http://doi.acm.org/10.1145/1518701.1518732.

[37] Made by Usability Body of Knowledge. *Critical Incident Technique (CIT)*. URL: http://www.usabilitybok.org/critical-incident-technique. (accessed: 30.05.2018).

[38] Gaver W. "What Should We Expect From Research Through Design?" In: Interaction Research Studio, University of London, 2012.

A

Appendix 1

Figures from Theory Chapter are included in this section.

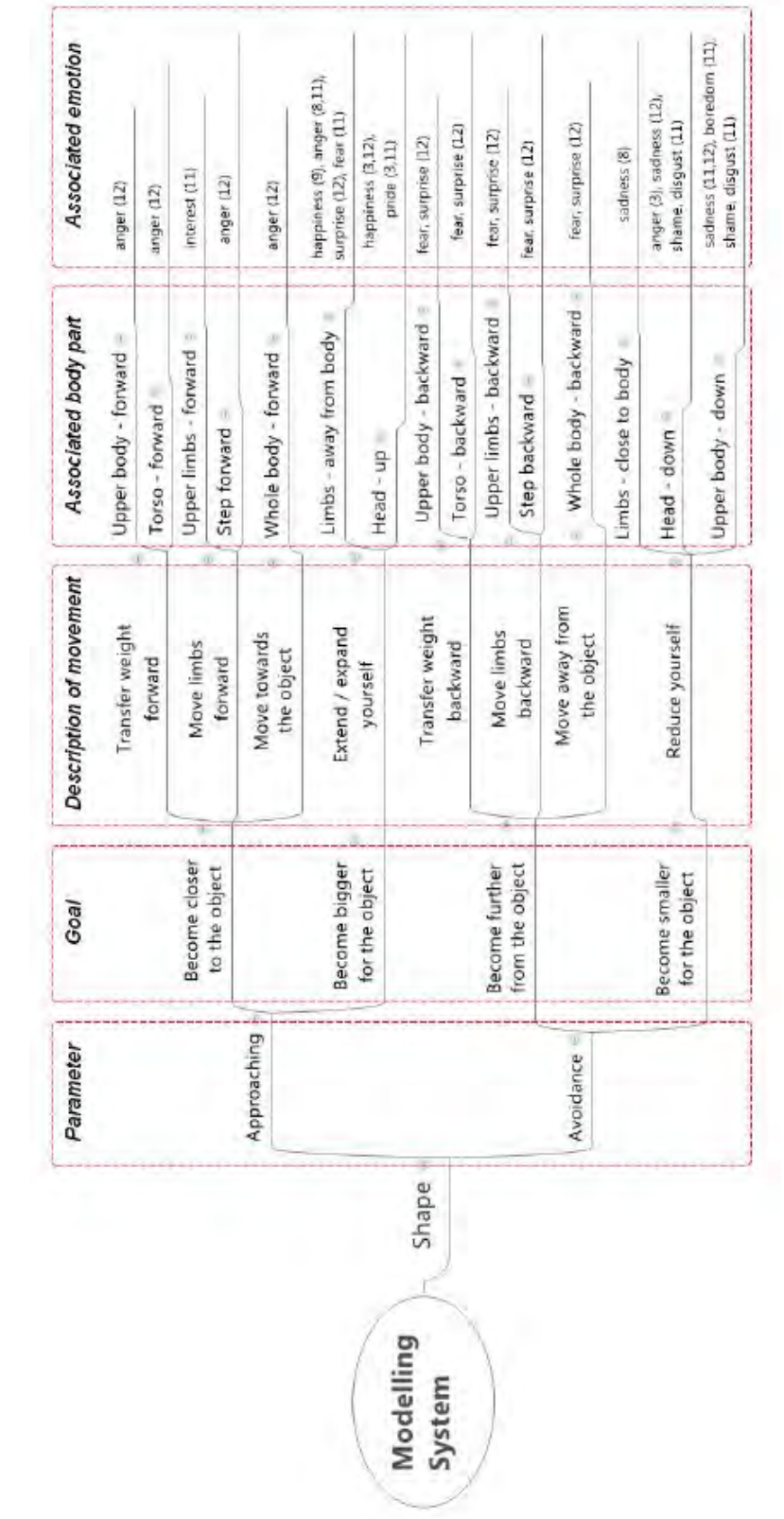

Figure 52: Novikova's emotional modelling system of Shape

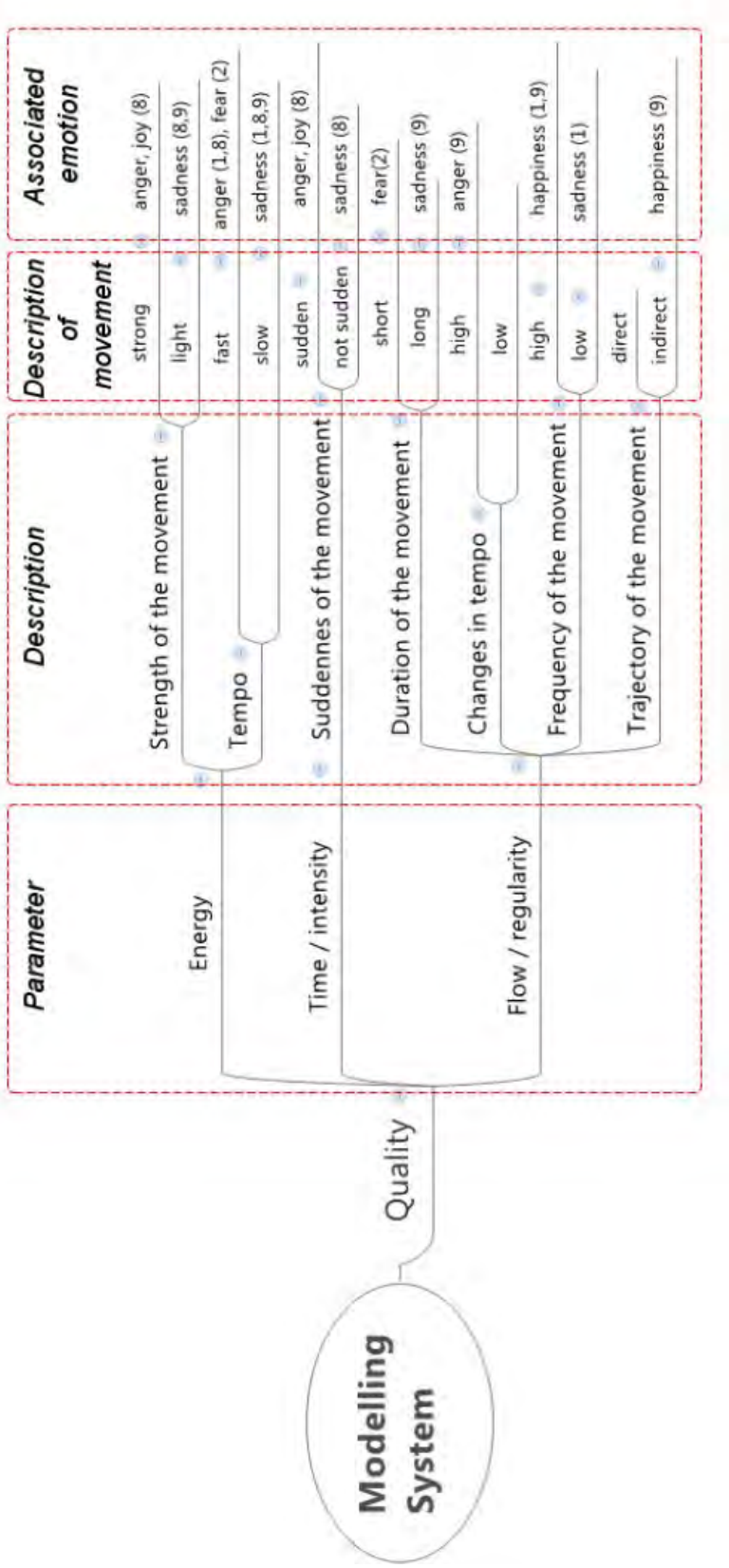

Figure 53: Novikova's emotional modelling system of Effort

B

Appendix 2

Design workshop task sheet mentioned in Final Design Chapter is shown below:

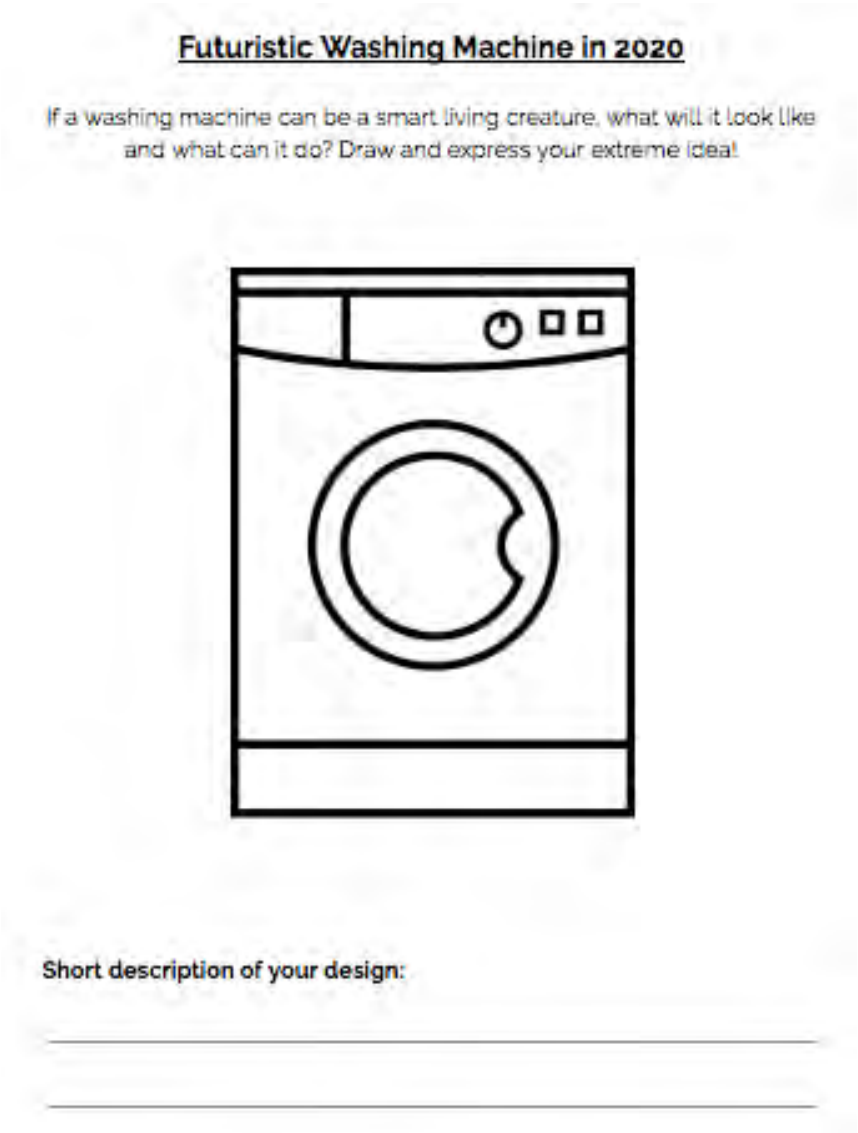

Figure 54: 'Draw it' design workshop form

C

Appendix 3

Full raw-data result from questionnaire mentioned in Final Design Chapter is included in this section.

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/23/2018 17:11:32						Few times a week	Personal laundry	1 Hour or less	Watch tv
2/23/2018 18:01:09						Once a week	Laundry service	2-3 Hours	sleep
2/23/2018 18:22:16						Once a week	Personal laundry	2-3 Hours	Play games
2/24/2018 0:52:07						Once a week	Personal laundry	1 Hour or less	Watch tv
2/24/2018 1:27:28						Once a week	Personal laundry	2-3 Hours	Doing something else e.g. cleaning, playing with cats □, surfing internet
2/24/2018 5:59:02						Once a week	Personal laundry	2-3 Hours	Read books, play with cats, and sometimes work
2/24/2018 16:22:54						Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Changing bed sheets, doing chores like dishes
2/24/2018 20:59:52						Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Reading

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
							By color	I know and have used SOME of predefined programs	Spoon	
							By color, By clothing type (e.g. separate underwears, socks and normal clothes)	I know and have used only 1 of predefined programs	◌̇◌̃just estimate	
							By color	I know SOME and have used 1-2 of predefined programs	No	
							By color, By textile	I know ALL and have used SOME of predefined programs	Used bottle cap	
							By color	I know and have used SOME of predefined programs	Yes, bottle cap	
							I don't categorize my clothes	I know and have used SOME of predefined programs	2 cup spoons of detergent, 1 cup spoon of softener that is my secret formula.	
							By color, By textile	I know and have used SOME of predefined programs	Yes, by using a deciliter measuring cup	
							By clothing type (e.g. separate underwears, socks and normal clothes), By stain type	I know SOME and have used 1-2 of predefined programs	Use cap	

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
-		Detailed info of each program (e.g. temp, time)	1	2	3	2	3	3	Audio
nope		Wash program, Countdown timer	5	4	2	3	6	1	Text, Audio
No		Countdown timer	1	2	6	5	4	3	Graphics
-		Wash program, Detailed info of each program (e.g. temp, time), Clothes weight, Countdown timer	5	6	4	1	2	3	Text
Not really but yes if provided		Wash program, Detailed info of each program (e.g. temp, time), Energy consumption, Countdown timer	1	2	3	4	6	5	Text, Audio
Well, how about energy consumption, water pollution from chemical detergent and all that jazz.		Wash program, Detailed info of each program (e.g. temp, time), Energy consumption, Countdown timer, Water level	5	4	4	4	5	6	Text, Audio
Yes, I try to fill up the machine with as many clothes as possible		Wash program, Detailed info of each program (e.g. temp, time), Countdown timer, Status like "washing", "centrifuging" etc	3	2	4	5	6	1	Text, Graphics, Animation
Yes		Countdown timer	1	2	5	6	4	3	Audio

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
6	5	6	5	6	5	6	No, I don't really need it.
1	1	1	1	6	7	1	Yes, I would like to have one!
2	3	6	4	6	5	4	Yes, I would like to have one!
5	1	1	1	2	5	4	No, I don't really need it.
1	2	6	7	3	4	5	Yes, I would like to have one!
1	6	5	5	4	7	6	Yes, I would like to have one!
7	3	4	6	5	1	2	No, I don't really need it.
7	1	7	2	7	3	7	Yes, I would like to have one!

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
2	2	3	3	3	2	-	-	-
2	2	2	2	6	1	Unload my clothes when it done	wash faster	I want Tails for my Washing Machine
5	5	4	5	5	5	Notice me when it’s done	More function	No
						Used voice command	Can camman to wash by mobile phone	
1	2	3	4	6	5	Please spare my clothes	Complete functionality e. g. wash and iron automatically	<3
5	6	4	5	6	6	Let me know when it is done, then bring the clothes out for me. *Just in case, if you do have legs and arms bring the clothes out and hang it for me. Thank you□	I put my dirty clothes in the basket and the washing machine do the full cycle job, then it puts all the clothes back in another clean basket, you know the drill.	ขอให้โชคดีมีชัย□□□
						"give me a notification on my phone when you're done"	I can put all my clothes unsorted in one container, and the machine will sort them for me, choose the correct program for each type, add the right amount of detergent, wash then dry the clothes and maybe even fold them for me.	Good luck with your thesis!
1	2	6	4	5	3	Is this alright?	The machine select the appropriate mode by asking questions from the user.	

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/24/2018 21:04:06						Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Cook, explore internet!
2/24/2018 21:09:45						Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Reading books , cooking
2/24/2018 21:10:03						Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Reading a book
2/24/2018 21:12:00						Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Gym
2/24/2018 21:12:10						Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	go chill back in my room
2/24/2018 21:13:18						Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Other activities
2/24/2018 21:13:46						Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	work on other activities
2/24/2018 21:13:47						Once a week	Shared laundry facility (in an apartment or accommodation area)	More than 3 hours	Clean my room or watch TV
2/24/2018 21:25:24						Once a week	Shared laundry facility (in an apartment or accommodation area)	More than 3 hours	Wait, play game
2/25/2018 4:46:34						Once a week	Personal laundry	1 Hour or less	Netflixing
2/25/2018 12:59:22						Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	More than 3 hours	Ironing

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
							I don't categorize my clothes	I know nothing about predefined programs	No, I just pour them in.	
							By color	I know SOME and have used 1-2 of predefined programs	Measure by eyes, according to amount of clothes	
							I don't categorize my clothes	I know SOME and have used 1-2 of predefined programs	No	
							By clothing type (e.g. separate underwears, socks and normal clothes)	I know and have used SOME of predefined programs	Nej	
							By clothing type (e.g. separate underwears, socks and normal clothes)	I know and have used SOME of predefined programs	by eye	
							By color, By textile, By clothing type (e. g. separate underwears, socks and normal clothes)	I know SOME and have used 1-2 of predefined programs	A cup	
							By color	I know ALL and have used SOME of predefined programs	No.	
							By color	I know SOME and have used 1-2 of predefined programs	Yes, measure by my eyes.	
							By color	I know SOME and have used 1-2 of predefined programs	Guess	
							By clothing type (e.g. separate underwears, socks and normal clothes)	I know SOME and have used 1-2 of predefined programs	ตักๆ ใส่ๆ ไป	
							By clothing type (e.g. separate underwears, socks and normal clothes), Temperatur	I know ALL and have used SOME of predefined programs	Washing Ball with measure	

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
Yes, I tried to load as much as I can in one batch.		Wash program, Detailed info of each program (e.g. temp, time), Clothes weight, Countdown timer	1	2	6	3	4	5	Text, Graphics, Animation
No		Wash program, Detailed info of each program (e.g. temp, time), Countdown timer	1	2	5	4	6	3	Text
No		Countdown timer	6	1	3	4	5	2	Text
Nej		Wash program, Detailed info of each program (e.g. temp, time), Countdown timer	2	2	5	5	5	1	Push notification or email
use lower temperature, try to do full load		Wash program, Countdown timer	3	2	4	4	3	1	Graphics
Yes, less water		Wash program, Detailed info of each program (e.g. temp, time), Countdown timer	6	5	4	2	1	3	Text, Graphics, Audio
no		Countdown timer	2	5	4	3	1	6	Text, Graphics
No		Wash program, Countdown timer	5	6	5	4	5	6	Animation
-		Wash program	1	3	6	5	4	2	Text, Graphics, Animation
Never		Countdown timer	2	3	4	5	6	1	Audio
Fill machine completely		Wash program, Countdown timer	1	1	1	3	1	1	Text

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
2	1	1	6	5	4	3	No, I don't really need it.
1	7	6	2	1	7	5	Yes, I would like to have one!
1	2	4	3	5	6	5	No, I don't really need it.
7	7	7	7	7	7	7	No, I don't really need it.
4	3	1	3	3	1	3	Yes, I would like to have one!
1	7	6	5	4	3	2	Yes, I would like to have one!
3	6	7	5	5	4	4	Yes, I would like to have one!
4	7	7	5	4	2	2	Yes, I would like to have one!
5	6	6	4	4	5	5	Yes, I would like to have one!
3	2	1	1	1	1	2	Yes, I would like to have one!
3	3	3	3	3	1	3	No, I don't really need it.

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
						Hurry up and please be gentle	Automatically loaded and unloaded, dried and properly folded	Nope
6	6	5	5	3	6	Suggestion about clothes and laundry	Wifi connection	No
						Can you wash my cloth carefully	It can interact with user	
						How are you	Everything is fully automated without selecting a program, but the user need to confirm	
2	1	3	1	3	1	please make sure my cloth is clean	done in 5 minutes, no wrinkle	
6	5	3	2	1	4	Please measure my clothes weight, put the correct amout of detergent and start normal program.	More automated.	This question could be revised to be a textbox: If yes, which aspects you would like to get help with?
6	6	6	6	3	3	say hi, increase/decrease level, say start/stop	interact like ok google	may be start research with qual to get insight before pipe in attributes to quant stage
5	6	6	6	6	6	How much should I put chemical?	Have interaction with users. Ex. Show expression	
6	6	4	4	5	6	Tell me when it' s done	Wash-E!!!!	
1	2	6	6	6	1	Tell me when it' s done	Catagorize and wash the clothes by itself	
						Shut up	Iron stuff	

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/26/2018 16:32:54	Male	21-30 years old	Gothenburg	Make my clothes clean	My clothes are tied together	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Do something else, working, playing, chatting
2/26/2018 16:36:37	Female	21-30 years old	Gothenburg, Sweden	Clean clothes	It's kinda boring	Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Social network, youtubing, fun stuff :)
2/26/2018 17:33:53	Male	21-30 years old	Göteborg, Sweden	Make clothes clean.	It take a lot of waiting time	Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Other activities
2/26/2018 18:10:55	Female	21-30 years old	Gothenbug, Sweden	ง่าย, ประหยัดเวลาการซักผ้าหากซักด้วยมือ	บางครั้งการซักผ้าด้วยเครื่องผ้าก็ไม่ค่อยสะอาด อาจจะเกิดจากถังซักผ้าสกปรกหรือโปรแกรมการซักผ้าเบาเกินไป, ไม่สามารถเจาะจงจุดที่ต้องการซักได้ในกรณีผ้าเลอะแค่บางจุด	Once a week	Shared laundry facility (in an apartment or accommodation area)	1 Hour or less	ทำครัว, ออกกำลังกาย, ทำงาน, เล่นคอม
2/26/2018 19:40:29	Female	21-30 years old	Gothenburg, Sweden	Fast cleaning clothes	adding detergent every time to use	Once a week	Shared laundry facility (in an apartment or accommodation area)	More than 3 hours	house chores

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
Not applicable	2	3	4	Not applicable	5	6	By clothing type (e.g. separate underwears, socks and normal clothes)	Temperature	Yes	By my estimation and also number of clothes in each wash
1	2	4	3	Not applicable	5	6	By color (e.g. black, white, light color, dark color), By clothing type (e. g. separate underwears, socks and normal clothes)	Wash duration	No	i kinda guess that... hahahaha
Not applicable	2	3	4	5	6	7	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Temperature	Yes	Using a measuring cup.
2	3	7	4	5	6	8	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes), By stain type (e.g. dirt, food, animal fur, blood, etc.)	ความแรงของการซัก หมุนถี่ ผ้าขยับเยอะ จะรู้สึก(เอง) สะอาดกว่า หมุนน้อย ผ้าขยับน้อย (เช่นในโปรแกรม delicate)	Yes	Briefly calculating from amount of clothes and amount of water, then using detergent's spoon or a cup with approximate amount as I wish.
Not applicable	1	1	1	8	1	2	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester)	Temperature	No	

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
Yes	Not use too much chemical components (Detergent, Softener, Bleach, etc)	Wash program, Detailed info of each program (e.g. temp, time), Countdown timer	6	4	5	1	3	2	Graphics (e.g. pictures, graphs, icons), Animation (e.g. animated, graphics, GIF, short video clips)
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Detailed info of each program (e.g. temp, time), Countdown timer	2	3	6	1	4	5	Audio, Animation (e.g. animated, graphics, GIF, short video clips)
Yes	Not use too much chemical components (Detergent, Softener, Bleach, etc)	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	6	5	2	3	1	4	Text, Graphics (e.g. pictures, graphs, icons), Audio
No		Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	1	2	4	5	6	3	Graphics (e.g. pictures, graphs, icons), Animation (e.g. animated, graphics, GIF, short video clips)
No		Detailed info of each program (e.g. temp, time), Countdown timer	4	2	6	3	5	1	Text, Graphics (e.g. pictures, graphs, icons)

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
5	5	1	1	4	4	1	Tell you when you have to do laundry
4	5	5	2	4	2	2	Sing a cool song!
1	5	5	4	3	3	2	If it is a private washing machine, it should have a big tank for detergent and softener. When I put the clothes in, the machine wil release the appropriate amout of detergent and softener corresponding to the clothes weight.
1	5	5	5	2	3	4	Have a physical feedback of the weight of clothes e.g. aero-swelling of machine body. Interact with users in emotional ways.
1	4	4	1	3	5	5	deliver clothes

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
4	5	6	1	3	2	Hi! we meet again	Automatically wash your clothes when it's time.	Pilot testing by Heart
1	2	3	6	5	4	Clean my clothes please.... pretty please <3	A washing machine WITH FUR and super cute and fluffy!!!	IT'S DONE!!! MWAHAHAHA HAHAHA XD
6	5	2	4	1	3	Send me a message when the wash is done.	More smarter. Combine both Washing machine and dryer together. My role should be only put the clothes and wait.	This question could be improved: What is your normal laundry sequence? (Please rank by order from 1-8 or select 'Not applicable') I guess most people will answer the same.
3	2	4	5	6	1	Hej! Are you tired? Thank you for your working-hard :D	มีจอที่สามารถดูหนัง,ฟังเพลง, หรือทำงานควบคู่ไปด้วยได้ระหว่างรอผ้าที่ซัก, มีระบบโทรหรือส่งข้อความแจ้งเตือนไปยังผู้ใช้งานเมื่อผ้าซักเสร็จแล้ว, สามารถซัก/อบ/รีด ในเครื่องเดียว โดยใส่ผ้าสกปรกเข้าไปแล้วผ่านกระบวนการซัก/อบ/รีด ออกมาเป็นกองผ้าที่รีดและพับแล้วอย่างเรียบร้อย, อยากให้เครื่องซักผ้าบอกอารมณ์ได้ และมีรูปร่างแตกต่างไปนอกจากทรงสี่เหลี่ยมแบบปกติ เช่น ตัวถังกลมๆมีขามีแขน	นึกไม่ออกแหะ (-_-'\) สู้ๆนะ (√°3° √)
6	5	3	2	4	1	do it faster	reduction in time consuming	

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/27/2018 14:31:15	Female	21-30 years old	Gothenburg, Sweden	Easy to clean clothes	Nothing	Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Work
2/27/2018 14:31:48	Male	21-30 years old	London, United Kingdom	Convenience	tangled clothes	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	working, cooking, watching series, exercising, browsing internet, etc.
2/27/2018 14:33:00	Female	21-30 years old	Leicester, United Kingdom	Comfortable	Dirty	Once a week	Coin-operated/coin-payment laundry	2-3 Hours	Watching TV
2/27/2018 14:39:26	Male	21-30 years old	Malmö, Sweden	Washing a large amount of clothes in short period of time	If each cycle takes too long time, for example slow programs or making me wait ebcause of weighing the clothes before cycle starts.	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	More than 3 hours	Netflix
2/27/2018 14:40:24	Male	21-30 years old	Nonthaburi, Thailand	Convenience and cleanliness	Power hungry, noisy, expensive to procure	Everyday	Personal laundry	2-3 Hours	Do other things aside from watching the spinning clothes
2/27/2018 14:49:29	Female	21-30 years old	○Bangkok, Thailand	convenience	loud noise and sometime shaking	Few times a week	Personal laundry	2-3 Hours	watch TV or reading stuff on Facebook or books
2/27/2018 14:51:13	Male	21-30 years old	Bangkok, Thailand	Preset	Sound Noisy	Once a week	Personal laundry	1 Hour or less	checking the phone

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
Not applicable	1	2	3	4	5	6	By clothing type (e.g. separate underwears, socks and normal clothes)	Temperature	Yes	Based on a feeling
3	4	5	6	7	8	2	I don't categorize my clothes	Temperature	Yes	guessing
2	4	3	5	6	7	8	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Temperature	Yes	The suggestion from the detergent package
Not applicable	2	3	4	Not applicable	5	6	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Temperature	No	
Not applicable	2	3	4	5	6	7	By color (e.g. black, white, light color, dark color)	Wash duration	Yes	Standard practice (check dosage from the detergent label)
6	1	2	3	Not applicable	4	5	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester)	Wash duration	No	
Not applicable	2	3	4	Not applicable	5	6	By color (e.g. black, white, light color, dark color)	Wash duration	No	

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Detailed info of each program (e.g. temp, time)	4	1	5	2	3	6	Text
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	6	5	4	2	3	1	Text
Yes	Not use too much chemical components (Detergent, Softener, Bleach, etc)	Countdown timer	3	2	6	4	5	1	Text
Yes	Not use too much chemical components (Detergent, Softener, Bleach, etc)	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	1	3	6	5	4	2	Text, Animation (e.g. animated, graphics, GIF, short video clips)
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Detailed info of each program (e.g. temp, time), Clothes weight, Amount of chemical input, Energy consumption, Countdown timer	1	6	2	3	4	5	Text
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	2	1	4	5	6	3	Text, Graphics (e.g. pictures, graphs, icons)
No		Countdown timer	3	2	5	6	4	1	Graphics (e.g. pictures, graphs, icons)

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
1	1	1	1	1	1	1	Fill the needed washing powder themself
1	1	5	3	5	5	3	Choose the most suitable wash program for the clothes
1	3	2	1	1	1	1	Talk to me
4	5	5	1	1	2	2	Identify type of clothes and wash it accordingly by choosing correct temperature and amount of detergents needed.
1	1	1	1	1	1	1	Knows how to wash each clothes thoroughly without fucking it up
1	3	4	3	5	2	3	calculate amount of chemical input
3	2	2	2	2	5	4	make cloth smooth

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
1	2	6	5	4	3	Nothing	I load the wash and specify the temperature. The machine does the rest with choosing an environmental friendly washing program	
1	6	5	2	3	4	Be gentle with the washing.	Load its own detergent and fabric softener based on the measured weight	
1	2	5	3	4	6	Hello	Function	
2	1	6	3	5	4	How's it going?	Tell the user when the laundry is done, to minimize waiting time and also predict detergents temperature based on type of clothes.	Nope
1	6	2	3	4	5	Hurry the fuck up.	Energy efficiency and thorough cleaning.	This survey is interesting as fuck. You better sell this to Electrolux, Beko, and such.
3	6	4	1	5	2	tell me when the laundry is done such as " your laundry will be done in ... minutes	use strong material, easy function to use with any type of clothes	-
2	1	4	5	3	6	machine set program ,start	I have no idea	

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/27/2018 14:53:28	Female	21-30 years old	Thailand	Easy	take too long	Once a week	Personal laundry	1 Hour or less	Internet
2/27/2018 14:54:45	Male	21-30 years old	Gothenburg, Sweden	* It feels good to be "doing something", while really the machine is doing work _for_ me. * I appreciate the smell of a finished washing machine, sooo niiice! :3	The sound, it could always be more quiet... Also, hanging the clothes for drying afterwards...	Once every 2 weeks	Personal laundry	1 Hour or less	Most often sleep, our washing machine has a delay function so I can basically set it to be finished when I've eaten breakfast.
2/27/2018 14:54:47	Female	21-30 years old	♡Bangkok , Thailand	Easy and save to time. No need to use man power	Destroy the cloth including color and shaping	Once every 2 weeks	Coin-operated/coin-payment laundry	2-3 Hours	Watch TV or play game
2/27/2018 14:57:44	Female	21-30 years old	Bangkok, Thailand	Fast	None	Few times a week	Personal laundry	2-3 Hours	Watching tv
2/27/2018 14:59:28	Male	21-30 years old	Cambridge, MA, USA	Fast and clean	Sometime the cloth are getting shrink	Once a week	Personal laundry	2-3 Hours	Work and checking emails
2/27/2018 15:01:52	Male	21-30 years old	London	Automatic program for different types of clothes	Putting detergent and conditioner manually	Once a week	Personal laundry	1 Hour or less	Working, Watching movie, Social media

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
1	3	3	3	2	3	3	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes), By stain type (e.g. dirt, food, animal fur, blood, etc.)	Wash duration	Yes	Guess by 1 cap for 1 basket
Not applicable	1	2	2	2	3	4	By color (e.g. black, white, light color, dark color)	Temperature	Yes	I sometimes weigh my clothes to be washed, and most often approximate based on experience. I have volume measures for detergent and softener.
Not applicable	1	2	3	3	4	5	By color (e.g. black, white, light color, dark color), By clothing type (e. g. separate underwears, socks and normal clothes)	Temperature	No	
Not applicable	2	3	4	5	6	7	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester)	Wash duration	Yes	Previous experience
2	6	8	8	8	8	8	I don’t categorize my clothes	Temperature	No	
Not applicable	1	2	3	Not applicable	4	5	I don’t categorize my clothes	Recommended clothing type	Yes	Machine recommend

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
No		Countdown timer	2	4	3	5	6	1	Text, Audio
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Detailed info of each program (e.g. temp, time), Countdown timer	4	1	3	6	5	2	Text, Graphics (e.g. pictures, graphs, icons), Audio, Animation (e.g. animated, graphics, GIF, short video clips), Something that makes the experience more enjoyable, while not being irritating! Hard, right? ;)
No		Detailed info of each program (e.g. temp, time), Countdown timer	2	3	6	4	5	1	Text, Graphics (e.g. pictures, graphs, icons), Animation (e.g. animated, graphics, GIF, short video clips)
No	Full load of clothes (maximum washing machine's capacity) for each wash	Detailed info of each program (e.g. temp, time)	2	1	5	3	6	4	Text
No		Predefined wash program	6	5	2	4	3	1	Text
No		Predefined wash program, Detailed info of each program (e.g. temp, time), Clothes weight, Amount of chemical input, Countdown timer	1	3	4	5	6	2	Text, Graphics (e.g. pictures, graphs, icons)

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
1	3	5	2	4	5	5	only load the clothes then everything automatically
1	5	5	1	1	3	1	It should be able to tell me the weight of my clothes, as well as useful so called "nudging" to make me wash clothes in a more environmental-friendly way.
1	5	4	2	4	4	5	Seperate the color and texture of clothes automaticly
1	3	4	4	3	4	2	Automatic seperate clothes type
1	5	5	5	2	3	3	Notice that the process is done
1	1	1	1	1	1	1	Automatic program selection by analysing the clothes

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
2	3	4	5	6	1	Thanks for helping us	Fucction with all automatic	No ka :)
4	2	3	6	5	1	Remember to wash your hands before you touch my clothes.	More and more environmental-friendly, quieter, neater, and with a funnier display.	ONE question had the ranking in reverse to all the others, c'mon!..
						It will be rain or not? If I start washing now , my cloths will dry or not?	Mutifunction including ironing and drying. Have sceern which can play like smartphone.	I will look forward to see your new washing machine
3	4	5	1	6	2	Keep doing it	Smartphone can control all function in washing machine	
6	5	4	3	2	1	Start my process	Wash itself by people just leaving the cloth there.	Awesome idea and looking forward on what your team will bring us an innovation
1	4	5	2		6	Nothing	Wash without crease	

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/27/2018 15:08:51	Male	21-30 years old	Sweden, Gothemburg	While being troublesome due to heavy work, it's better than washing by hand. Like that it's quick.	It's annoying to pre-sort clothes (Perhaps the machine could do this?)	Few times a week	Personal laundry	2-3 Hours	Normally anything since I have a personal one. It dosen't bother me waiting or leaving clothes in the washer but it could be nice with a notification on your phone when it's done or have a timer or similar reminding you.
2/27/2018 15:10:41	Male	21-30 years old	Gothenburg, Sweden	Relatively easy and low effort	Not measuring my detergent for me; Takes too long to wash	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Using the dryer in between batches of clothes
2/27/2018 15:12:16	Prefer not to say	21-30 years old	Gothenburg, Sweden	I don't have to do it by hand.	I can't use it for everything.	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	More than 3 hours	Play computer games, do chores, study, grocery shopping...
2/27/2018 15:16:35	Male	21-30 years old	Göteborg	That it clean my clothes	That it takes time to go downstairs and also takes time to clean. Boring to wait on clothes dry	Once a week	Shared laundry facility (in an apartment or accommodation area)	More than 3 hours	Playing computer games
2/27/2018 15:19:36	Male	31-40 years old	ไทย	ประสิทธิภาพที่ ดี ความสะอาด	ใช้งานยาก	Few times a week	Personal laundry	2-3 Hours	ยูทูป

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
Not applicable	1	2	3	Not applicable	4	5	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes), By stain type (e.g. dirt, food, animal fur, blood, etc.)	Just want the clothes to be clean for use and not damaged.	No	
Not applicable	1	3	2	Not applicable	4	5	By color (e.g. black, white, light color, dark color)	Wash duration	Yes	I estimate based on the amount of clothes I put in (I rarely stay for the weigh in process of the machine)
2	3	4	5	6	7	8	By color (e.g. black, white, light color, dark color), Temperature 40C or 60C.	Temperature	Yes	It says on the package of the detergent how much to use depending on weight and type of water (hard/soft).
Not applicable	1	2	3	4	5	6	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester)	Temperature	Yes	no, just put some in, lol
Not applicable	2	3	4	5	6	7	By color (e.g. black, white, light color, dark color), By clothing type (e. g. separate underwears, socks and normal clothes)	Wash duration	No	

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
Yes	While acknowledging it i don't do anything about it.	Predefined wash program, Countdown timer	5	4	1	2	3	6	Text
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time), Clothes weight, Countdown timer	6	1	4	2	3	5	Graphics (e.g. pictures, graphs, icons)
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer, Centrifugation RPM	2	3	4	6	5	1	Text, Graphics (e.g. pictures, graphs, icons), Audio
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	1	2	6	5	4	3	Text, Graphics (e.g. pictures, graphs, icons), Audio, Animation (e.g. animated, graphics, GIF, short video clips)
No		Predefined wash program, Detailed info of each program (e.g. temp, time)	1	2	3	4	6	5	Graphics (e.g. pictures, graphs, icons), Animation (e.g. animated, graphics, GIF, short video clips)

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
1	5	1	1	1	3	1	Alert you if you misplaced an item / reckognize items somehow.
1	5	5	1	1	1	1	It should somehow be connected to my apartment so I drop off my clothes into a box, the clothes get sent to the machine, the machine washes them (adds perfect amount of detergent etc) and then dries them and returns them to me in some sort of cabinet. Basically, eliminate the physical contact between human/machine.
2	5	4	1	5	5	5	Wash all types of clothes.
1	2	1	1	1	4	4	Clean my clothes without me involved
5	5	1	1	5	5	1	ประหยัด ไฟ และซ่อมแซมได้เอง

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
4	5	1	2	3	6	Time left would probably be the only thing i would ask for.	Can tell you if you misplaced an object or if a clothing item has something in its pockets still,	
3	2	4	6	5	1	I'd treat it as a chatbot (e.g. Cleverbot)	I think my answer on the "smarter washing machine" section applies here. The process should be automated.	Personally, I hate doing laundry and I just want it to be done as soon as possible, adding some sort of animated avatar wouldn't make me want to stay during the actual laundry period. I basically would like my laundry done as if my mother did it haha! (aka not me doing it.)
6	4	3	2	1	5	Please don't ruin my clothes!	Hopefully capable of washing all of my clothes without ruining them!!	
3	1	6	4	2	5	are the clothes dirty? is it too heavy? have you been working out? ;)	One word - Robots. https: //imgflip. com/i/25dynu	
2	3	5	6	1	4	นวดบ่าเป็นมั้ย	สามารถรีดและพับเก็บได้ในขั้นตอนเดียว	

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/27/2018 15:21:49	Female	21-30 years old	Gothenburg, Sweden	Different options for different types of clothes etc. Easy and convenient: you put the clothes etc in the machine, and then get it out when it's done	Time estimate being incorrect (mostly only a problem with dryers though). That I kind of have to fill it, otherwise it's bad for the environment. Things get tangled, and small things like socks often go inside and hide in ex. linens/bedcloth es	Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Clean the laundry room, hang the clothes that I washed before while the second "round" is in the washing machine, or dry them in a dryer
2/27/2018 15:24:37	Male	31-40 years old	Bangkok	Comfortable	เสื้อพันกัน	Few times a week	Personal laundry	1 Hour or less	I can do everything, except going out.
2/27/2018 15:30:25	Female	21-30 years old	Bangkok, Thailand	Convenient	Sometimes, it ruins my clothes	Once a week	Personal laundry	2-3 Hours	Cleaning house
2/27/2018 15:32:36	Female	21-30 years old	Sweden	Faster and less of an effort	When it doesn't clean everything and you have to start it again	Once a month	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Relax, study, clean my apartment etc
2/27/2018 15:32:45	Female	21-30 years old	Bangkok	Clean, quick, quite	Noise	Once a week	Personal laundry	2-3 Hours	Do something else
2/27/2018 15:40:37	Female	31-40 years old	BKK	Save my energy	Sometimes it damage my clothes	Few times a week	Personal laundry	More than 3 hours	Do other houseworks
2/27/2018 15:42:23	Female	21-30 years old	Ho Chi Minh City, Viet Nam	Convient, fast.	Sometimes, clothes are not clean as demand	Once a week	Personal laundry	2-3 Hours	Play game or reading news

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
Not applicable	2	4	3	Not applicable	5	6	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes), I mainly categorize by color, but sometimes by textile (jeans) and type (hoodie with print) since I manage them differently	Temperature	Yes	I look at the package (and I asked mom when I moved out), and make a guess
6	3	Not applicable	2	Not applicable	1	5	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester)	Spin speed	No	
Not applicable	2	3	4	Not applicable	5	6	By color (e.g. black, white, light color, dark color)	Wash duration	Yes	Bottle cap according to the instructions
Not applicable	1	2	3	4	5	6	By color (e.g. black, white, light color, dark color), By recommended temperarute (40 and 60)	Temperature	No	
Not applicable	1	2	3	Not applicable	4	5	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Wash duration	Yes	Follow product instructions
1	2	1	2	1	2	1	By color (e.g. black, white, light color, dark color), By clothing type (e. g. separate underwears, socks and normal clothes)	Wash duration	Yes	Guess base on amount of clothes
2	3	5	4	Not applicable	6	7	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester)	Temperature	Yes	It depends on quantity of clothes and their instruction of usage

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	3	2	4	5	6	1	Text, Graphics (e.g. pictures, graphs, icons), Audio
No		Predefined wash program, Energy consumption, Countdown timer	5	6	3	4	2	1	Audio
No		Predefined wash program	1	2	5	4	6	3	Text, Graphics (e.g. pictures, graphs, icons), Audio
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time)	1	2	5	4	6	3	Text, Graphics (e.g. pictures, graphs, icons)
No		Predefined wash program, Detailed info of each program (e.g. temp, time), Clothes weight, Countdown timer	2	1	4	5	6	3	Text, Graphics (e.g. pictures, graphs, icons)
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Detailed info of each program (e.g. temp, time)	6	1	5	3	4	2	Graphics (e.g. pictures, graphs, icons)
Yes	Low noise	Clothes weight, Countdown timer	1	5	3	2	4	6	Graphics (e.g. pictures, graphs, icons), Animation (e.g. animated, graphics, GIF, short video clips)

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
1	1	1	1	1	1	1	Tell how much detergent etc is needed
1	1	4	1	1	5	3	Automatic choose the washing mode.
2	1	4	5	3	1	1	Auto categorize color
1	2	3	1	1	2	3	Sort the cloths by color and temperature by it self, calculate the chemicals automatically and then provide the chemicals
1	5	4	4	4	4	3	รีดผ้า
2	5	3	3	3	4	4	Separate clothes itself before washing
1	4	3	3	2	5	3	Chosing the most suitable program by detecting the cloths in machine

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
3	2	6	4	5	1	"Nice, I'll be back in about 40 minutes. And please do not eat my socks this time, <insert machine's name>!"	Less noisy, can help with amount of detergent etc. (and NOT being a living creature!!)	This reminds me that I need to stop being lazy and book a laundry room soon...
1	6	4	3	2	5	Thank you.	ซักเสร็จ พับให้ด้วย	
1	2	6	4	5	3	Please don’t ruin my clothes	Fully automated operation	Love to see smarter washing machine in future <3
1	2	3	5	6	4	How is the washing going?	Laundry basket becomes the washing mashine and washes the clothes emmidiatly and then drys and fold them	
2	1	3	4	5	6	Clean yourself when you feel you are dirty	Use Less energy, less water, less noise, clean itself, remote control	
4	2	5	3	6	1	Hurry and keep clean	Functions such as clothes can be dry after finish washing, washing machine able to separate different clothes	
1	5	3	2	4	6	Chosing some interesting subjects to discuss	More functions, having interaction with user if needed. Detected error or function which is not worked and inform user	

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/27/2018 15:47:26	Female	21-30 years old	Floda, Sweden	Just put the clothes in turn it on and wait. No hard work.	Strange clothes with difficult washing instructions. Noisy.	Once a week	Personal laundry	1 Hour or less	Since I'm at home, anything really.
2/27/2018 15:47:32	Female	21-30 years old	Patumthanee, Thailand	Convenience, not tired	Sometimes, there is some dust from the machine.	Few times a week	Personal laundry	1 Hour or less	Watching movies
2/27/2018 15:47:58	Female	40-50 years old	Baltimore, USA	Cleans a lot of clothes at once.	When it leaves a detergent film on my clothes	Once a week	Personal laundry	2-3 Hours	Other housework, watch tv, exercise
2/27/2018 15:50:11	Female	21-30 years old	Brescia, Italy	The good aroma of the just cleaned clothes	The time spent doing laundry	Once a week	Personal laundry	2-3 Hours	Household cleaning
2/27/2018 15:52:34	Male	31-40 years old	bangkok, Thailand	save time and effort	electricity bill	Once a week	Personal laundry	2-3 Hours	take rest or doing other chores
2/27/2018 15:55:29	Female	21-30 years old	bandkok, thailand	ซักผ้าให้โดยไม่ต้องเปลืองแรง ผ้าก็เกือบแห้งตากแป๊ปเดียวก็ใส่ได้อีก ต้องใช้น้ำเย็นซักผ้าไม่เสียไม่พังสีไม่ตก	บางทีสีตก / ซักไม่สะอาดเท่าขยี้ ไม่สามารถเลือกซักเฉพาะจุด บางโปรแกรมของเครื่องซักผ้ากิใช้ยาก ไม่ตอบโจทย์ ราคาแพง	Few times a week	Personal laundry	1 Hour or less	fill in detergent, softener
2/27/2018 15:57:25	Male	21-30 years old	Bangkok, Thailand	convenient	noisy	Once a week	Personal laundry	2-3 Hours	Continue with usual business

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
Not applicable	1	2	3	4	5	6	By color (e.g. black, white, light color, dark color)	Wash duration	Yes	Has a measure cup, fill to the line
2	3	4	5	6	7	8	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Type of cloth	No	
Not applicable	2	1	3	7	4	5	By color (e.g. black, white, light color, dark color)	Amount of water	Yes	They come in pods. I use one per load no matter how dirty things are
Not applicable	1	2	3	4	5	6	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Temperature	Yes	Habit/routine
Not applicable	1	2	3	4	5	6	By color (e.g. black, white, light color, dark color), By clothing type (e. g. separate underwears, socks and normal clothes)	Wash duration	Yes	as suggested on the product box
Not applicable	1	2	3	4	5	6	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Temperature	Yes	read from the bottle
Not applicable	1	2	3	4	5	6	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester)	Wash duration	Yes	Instruction from the detergent box

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	1	2	6	5	4	3	Text, Graphics (e.g. pictures, graphs, icons)
No		Predefined wash program	1	2	3	4	5	6	Text, Audio
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time), Clothes weight, Extra rinse	2	1	3	6	5	4	Text
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Detailed info of each program (e.g. temp, time), Countdown timer	6	1	3	4	5	2	Graphics (e.g. pictures, graphs, icons)
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	2	1	6	5	4	3	Text, Graphics (e.g. pictures, graphs, icons)
No		Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	3	1	4	5	6	2	Text, Graphics (e.g. pictures, graphs, icons), Audio
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Countdown timer	2	3	4	5	6	1	Text

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
3	2	4	2	3	2	2	See what clothes are in it, and select appropriate program itself.
1	4	4	1	1	5	2	Folding clothes as well
3	4	5	5	5	1	2	Determine how dirty clothes are and choose its own amount of detergent. Also one machine to wash and dry that works well!
1	1	1	1	1	1	1	Tell me if I'm doing something wrong, like wash white and red clothes together
1	5	4	4	1	3	2	auto load cloths from basket
1	3	4	1	2	5	1	เลือกโหมดได้เองจากเนื้อผ้า น้ำหนัก ใส่น้ำยาตามที่ต้องใช้ได้เลยโดยไม่ต้องเทเองทุกครั้ง ถ้าเป็นไปได้แยกผ้าให้ด้วยเลย ไม่ต้องคิด
1	5	3	4	1	5	3	Send push notification to a smart phone

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
1	2	5	4	3	6	Hey, how close is my laundry to being done? What should I do with this stain? Can I wash this fabric with this?	Can help a lot more with deciding whay to do. Looks a lot like now, but smarter and with voice commands/AI.	The question about it becoming alive was weird.
1	2	3	4	5	6	Make it cleanest & fast	Can make clothes dry within an hour	
3	1	4	2	5	6	Do your job.	Intuitive cleaning with minimal energy expenditure.	
1	4	5	2	3	6	Call me when you're done	Almost the same as today	
2	1	4	3	5	6	wash it well	sync with smart home devices	
3	1	5	4	6	2	เริ่มซักเลย, อีกนานไหมกว่าจะเสร็จ	ai + เลือกโหมดซักจากเนื้อผ้า	ยาวมากจ้า ไม่รักไม่ทำให้นะ 555
5	2	3	4	6	1	basic operation, includes start, pause, ...	Optimize the washing cycle towards the textile, stain, detergent, dirtiness	

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/27/2018 16:27:00	Female	21-30 years old	Phetchabun, Thailand	This would be a weird answer, but in a cold night, I like to use washing machine so that it keep my room warm without using a heater!	Loud noise	Once a week	Coin-operated/coin-payment laundry	2-3 Hours	Using phone, playing games, cooking food, cleaning room
2/27/2018 16:27:54	Male	21-30 years old	Gothenburg, Sweden	Filling it with laundry	Entering the commands	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	More than 3 hours	Nothing really
2/27/2018 16:45:10	Female	21-30 years old	Helsinki, Finland	save time	cleaning part is complicated	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	take a walk
2/27/2018 16:57:31	Male	21-30 years old	Bangkok	Easy	Not Clean	Once a month	Laundry service	1 Hour or less	Play mobile
2/27/2018 17:02:37	Female	21-30 years old	Bangkok	Can clean clothes using less effort for big volume	For automatic one, clothes not clean	Once a week	Personal laundry	1 Hour or less	Watch TV
2/27/2018 17:06:09	Male	31-40 years old	Hat Yai, Thailand	Time saving and cleanliness.	It could damage some type of your clothes.	Everyday	Personal laundry	1 Hour or less	Cleaning up the house.
2/27/2018 17:08:59	Female	21-30 years old	Bangkok, Thailand	Easy, save time and energy	Long process	Everyday	Personal laundry	2-3 Hours	Work or relax
2/27/2018 17:25:46	Male	21-30 years old	Bangkok	Convenient	need to take out the cloth and dry it	Once every 2 weeks	Personal laundry	1 Hour or less	watch tv

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
Not applicable	2	3	4	5	6	7	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By stain type (e.g. dirt, food, animal fur, blood, etc.)	Spin speed	Yes	Reading from package of detergent and estimate amount of load.
Not applicable	1	2	3	Not applicable	4	5	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes), By recommended temperature	Temperature	No	
2	3	4	Not applicable	Not applicable	5	6	I don’t categorize my clothes	program is fixed	Yes	instructions on products' containers
Not applicable	2	3	4	Not applicable	1	6	By color (e.g. black, white, light color, dark color)	Wash duration	No	
1	3	4	5	6	7	8	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester)	Amount of water	Yes	10 pieces for 1 spoon
2	3	4	5	Not applicable	6	7	By textile (e.g. cotton, wool, jeans, polyester)	Wash duration	Yes	Estimate from amount of loaded clothes.
6	1	2	3	4	5	7	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester)	Amount of water	Yes	Find out from a detergent’s package.
Not applicable	2	3	4	5	6	7	I don’t categorize my clothes	Wash duration	No	

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
No		Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	1	2	4	6	5	3	Graphics (e.g. pictures, graphs, icons)
No		Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	3	1	5	6	4	2	Text, Audio
No		Detailed info of each program (e.g. temp, time), Countdown timer	6	2	3	4	5	1	Graphics (e.g. pictures, graphs, icons), Audio
No		Countdown timer	4	3	2	5	6	1	Graphics (e.g. pictures, graphs, icons)
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	1	2	3	4	5	6	Graphics (e.g. pictures, graphs, icons), Audio
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Predefined wash program, Countdown timer	1	3	4	5	6	2	Graphics (e.g. pictures, graphs, icons), Audio
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Predefined wash program	1	2	3	4	5	6	Graphics (e.g. pictures, graphs, icons)
No		Detailed info of each program (e.g. temp, time), Countdown timer	4	2	5	6	3	1	Text

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
1	4	5	3	4	4	3	Automatic determine which washing program suit for my load
1	4	5	1	3	5	2	Give me status updates via my phone or some sort of website so I might know which part of the program it is currently doing and time left until completion
1	3	3	2	2	3	3	save water/energy
1	5	4	3	4	3	1	fold clothes after finished
5	2	1	3	4	4	4	Check stain / dark spot on your clothesline
1	3	4	1	1	5	4	Automatically detect type of cloths and select the best washing program.
1	3	2	3	4	5	2	I don’t need to set a program. Just press start then it runs everything.
1	4	5	1	5	5	1	fold the cloth

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
1	2	4	6	5	3	Let me know when you're done	Function, probably fold all the clothes after dry	Washing clothes is fun. The most boring part is folding!
6	3	4	5	2	1	I don't know, what program to do	A combined washer and dryer	No
3	6	1	2	5	4	i would not talk to it	combination of all clothing functions; wash, dry, iron, dry clean, ...	
4	3	2	5	6	1	Pls make sure its cleaned	Folding by itself	Enjoy Sweden!
1	2	4	5	6	3	How to remove the stain	More smart design and support functions to reduce effort and time of user, wifi connect to set the starting time from remote and tell what is the modt efficient amount for detergent and stain check	
2	3	4	5	6	1	Start, continue, change or stop the program.	All in one washing machine. Wash, dry and iron the clothes in one program.	Washing machine with touch screen and app enable would be a great idea.
1	3	2	4	5	6	Quickly. I need to take a nap. Lol	Become a smart washing machine. Can program it by voice like smart phone.	I want it to do everything - wash, dry, iron and fold or hang.
4	2	5	6	3	1	please keep spinning	all in one for laundry [wash - dry - fold - hang in the closet] sorry i'm quite lazy	I bought a washing machine with Wi-Fi, it's pretty dope. Hope u design a better futuristic machine for us. Cheers

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/27/2018 18:00:46	Male	21-30 years old	Göteborg	Shortest possible time spend with it.	Going back and forth to it to empty it and start a new wash.	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	More than 3 hours	Cooking, running, studying, watching a movie, cleaning the house – anything basically.
2/27/2018 18:08:25	Female	21-30 years old	Thailand, Bangkok	ไม่เหนื่อย	เปลืองไฟ	Once a week	Personal laundry	1 Hour or less	แล้วแต่
2/27/2018 18:27:32	Female	21-30 years old	Thailand	Quick	It's height, not convenience to bring clothes out.	Once a week	Personal laundry	More than 3 hours	Reading books, cooking, cleaning
2/27/2018 19:20:56	Female	21-30 years old	Paris, France	I get my stuff all clean!	It is slow and noisy sometimes	Few times a week	Personal laundry	2-3 Hours	Housechores
2/27/2018 19:31:08	Female	21-30 years old	City	It makes it for me. So i don't have to go down to the river as in the old days.	Mostly that it's something that you have to do (along with cleaning and do the dishes). Apart from that, that each run takes about one hour.	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Not sure if I understand this question correctly. But while the clothes are being washed, I maybe study or watch TV
2/27/2018 19:43:07	Female	31-40 years old	Country	Convenient and clean	Taking the cloth in and out	Everyday	Personal laundry	More than 3 hours	Housework, washing tv

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
Not applicable	1	3	2	4	5	6	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Temperature	Yes	Reading instructions on detergent.
3	4	5	5	4	5	3	By clothing type (e.g. separate underwears, socks and normal clothes)	Spin speed	No	
Not applicable	1	4	2	3	5	6	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester)	Amount of water	Yes	Approximate by the spoon
Not applicable	1	2	3	4	5	6	By color (e.g. black, white, light color, dark color), By clothing type (e. g. separate underwears, socks and normal clothes)	Wash duration	Yes	Amount of clothes, dirtyness
1	3	3	3	2	4	3	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester)	For now temperature since I want to follow the advice from the clothing company. But have heard about future washing machines that could wash in cold temperatures and still get the fabrics clean. So with these future machine, I would instead go for the amount of water or detergent being used (more environmentally friendly)	Yes	I try to think of how dirty the fabrics are, and how much fabrics in each wash. So if there's a lot fabrics, I will use more detergents. I'm trying to use the amount recommended on the package of the detergent.
7	2	3	4	Not applicable	5	6	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester)	Temperature	Yes	1 cup detergent 1cup softener

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
Yes	Low temperature & long washing time	Predefined wash program, Detailed info of each program (e.g. temp, time)	1	2	5	4	3	6	Text, Graphics (e.g. pictures, graphs, icons)
No		Detailed info of each program (e.g. temp, time)	5	1	6	4	3	2	Animation (e.g. animated, graphics, GIF, short video clips)
No		Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	6	2	3	5	4	1	Graphics (e.g. pictures, graphs, icons), Audio, Animation (e.g. animated, graphics, GIF, short video clips)
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Predefined wash program, Detailed info of each program (e.g. temp, time)	6	2	3	4	5	1	Text, Graphics (e.g. pictures, graphs, icons)
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	2	1	5	4	3	6	Text
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program	3	2	4	5	1	6	Text, Graphics (e.g. pictures, graphs, icons)

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
1	5	2	1	1	1	1	My goal: Use least amount of time on laundry. So it should basically do everything from getting my clothes from my laundry basket to fold it and place it in my closet.
1	3	4	2	2	5	5	เอาเสื้อไปแขวนในตู้เองได้
1	5	4	5	4	5	3	Help match clothes like stylist, help fix torn clothes or buttons
1	5	1	1	5	5	5	Advice about the right washing program
1	5	4	2	3	4	3	dose the detergent needed for the amount of clothes (think some washing machine already able to do so, but find it to be important). Have an app to your smartphone, so you for example can start the machine on your way home from work so it's ready to dry when you come home.
5	1	2	5	3	4	4	Drying and ironing

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
1	2	3	4	5	6	Nothing – why should I talk with my washing machine?	Nobody wash their clothes anymore. Clothes is thrown in the laundry basket and reappears in the closet automagically in a short amount of time.	Think holistic – not just about the washing machine itself.
2	3	6	4	5	1	ไม่มี	เป็นมิตรต่อสิ่งแวดล้อม	
2	3	4	5	1	6	Keep my clothes clean and in shape.	Becoming a mother who help with cleaning and ironing and match clothes for you	
3	2	1	5	4	6	I want my clothes clean please!	Silent, less consumming and a washing machine that can understand your voice	Good luck!
2	1	5	4	3	6	How much detergents is appropriate to add?	It will be more different, defined program for different kinds of fabrics. You can change settings with your phone. It will be much more environmentally friendly and not consuming so much heat, water, or detergents while running.	
2	3	4	5	1	6	I don't know .	More functioning	

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/27/2018 19:48:01	Male	21-30 years old	Bangkok, Thailand	All in one, finish all the methods in one command or click	Sometimes consumes too much water and electricity , and yes... too loud	Once a week	Personal laundry	2-3 Hours	Random stuff, mostly watching some news or YouTubing
2/27/2018 20:09:06	Male	21-30 years old	Hawaii, USA	Clean, Fast, and mild to clothes.	Make the severe damage to my clothes.	Once every 2 weeks	Personal laundry	2-3 Hours	I do my homework.
2/27/2018 20:46:31	Female	21-30 years old	Gothenburg, Sweden	I like it. It's better than hand washing, thanks God!	Waiting time.	Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Housework or other kinds of work, sometimes, I take a short nap.
2/27/2018 22:12:26	Female	21-30 years old	Alexandria, United States	It is very convenient and time-saving	It’s power consumption	Once a week	Personal laundry	2-3 Hours	Watching TV, cleaning, listening to music
2/27/2018 22:56:08	Female	51 years or older	Camp Hill, PS USA	Clean clothes	Nothing	Once a week	Personal laundry	2-3 Hours	Clean house
2/28/2018 0:29:56	Female	21-30 years old	Göteborg	It cleans the clothes	It some Times make hole in clothes	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	More than 3 hours	Clean
2/28/2018 1:34:45	Male	21-30 years old	Bangkok	Cleaning	Setup	Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Nothing
2/28/2018 3:18:30	Female	21-30 years old	Bangkok, Thailand	Automatic clothes washing!	Hard to clean	Once a week	Personal laundry	More than 3 hours	relax and wait

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
2	3	3	3	3	3	3	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Spin speed	No	
Not applicable	2	3	4	Not applicable	5	6	I don't categorize my clothes	Wash duration	Yes	The cover of my detergent.
2	3	4	6	5	7	8	By color (e.g. black, white, light color, dark color), By clothing type (e. g. separate underwears, socks and normal clothes)	Temperature	Yes	My sense estimation always works!
7	6	6	6	5	7	7	I don't categorize my clothes	Temperature	No	
8	3	1	2	Not applicable	4	5	By color (e.g. black, white, light color, dark color)	Temperature	Yes	Instructions on detergent
Not applicable	1	2	3	Not applicable	4	5	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Temperature	Yes	Aproximatly Two tblsp
5	1	2	3	3	4	Not applicable	I don't categorize my clothes	Wash duration	No	
1	2	3	4	5	6	7	By clothing type (e.g. separate underwears, socks and normal clothes)	Wash duration	Yes	Instruction from detergent products

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	5	3	1	2	6	4	Text, Graphics (e.g. pictures, graphs, icons), Animation (e.g. animated, graphics, GIF, short video clips)
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Countdown timer	2	5	3	4	6	1	Text
No		Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	1	2	5	6	4	3	Text
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Detailed info of each program (e.g. temp, time)	4	2	6	3	1	5	Audio
No		Predefined wash program	1	2	4	3	6	5	Audio
No		Predefined wash program, Countdown timer	4	5	3	2	6	1	Text, Graphics (e.g. pictures, graphs, icons)
No		Countdown timer	3	5	1	4	2	6	Graphics (e.g. pictures, graphs, icons)
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time), Amount of chemical input, Energy consumption	6	1	2	3	4	5	Text, Graphics (e.g. pictures, graphs, icons)

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
1	1	3	1	1	1	1	Mobility connected
5	1	1	1	1	1	1	Calculate the amount of detergent and time by clothes' weight.
1	1	1	1	1	5	1	Faster washing
4	5	4	4	4	5	5	Fold clothes
1	1	1	1	1	1	1	Wash and dry with no wrinkles
5	1	3	2	3	1	4	Warnings for wrong sorted clothes, able to select program by it self by what's in the machine
1	4	4	4	2	5	5	Automatic categorize to seperate color of cloths
3	5	4	3	2	4	3	Calculate suitable water level and quantity of detergent by itself

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
6	5	4	3	2	1	Like Siri, well-rounded assistant	Smaller, more powerful and gone green	
2	5	3	4	6	1	How much should I put detergent in?	Robot laundry that can deliver and fold clothes to you.	I'm George from SIIT. Hope you are doing fine. Wish you success in your study, career, life.
						I don't want to talk with it	It can catagorise, fil in washibg chemical, load, and unload my clothes itself. Also, if possible, it should have 2-in-1 function such as an ability to dry my colthes respectively without changing the machine.	
6	2	5	4	1	3	Play music	Can fold clothes and put them where it needs to be	
1	4	3	2	6	5	Let me know when you are done.	Nothing new really	No
1	3	4	5	6	2	Don't destroy my clothes please	Faster, better for the clothes. Maby a new technique that don't need warm water to remove bacteria.	
6	5	2	3	1	4	How many underwear i put in	Small but stroger and smarter coming up with dry and folding function	I love you
2	5	4	1	3	6	Be strong! little wingy man	Do laundry by itself	Nothing

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/28/2018 9:20:02	Female	21-30 years old	Bangkok	It made me feel comfortable to do my washing.	Some machine don't have the dry function then I don't like it because I want to do like all in one processing.	Few times a week	Personal laundry	2-3 Hours	Try to find something to watch during waiting
2/28/2018 9:46:25	Female	21-30 years old	Bangkok, Thailand	Automatic clothes washing!	Hard to clean	Once a week	Personal laundry	More than 3 hours	relax and wait
2/28/2018 10:02:58	Female	21-30 years old	Newcastle, England	Time Efficiency	Damage to clothing	Few times a week	Personal laundry	2-3 Hours	Non-specific
2/28/2018 13:57:56	Female	21-30 years old	Bangkok, Thailand	Automatic clothes washing!	Hard to clean	Once a week	Personal laundry	More than 3 hours	relax and wait
2/28/2018 14:35:14	Male	21-30 years old	Bkk, Thailand	Convenient	Take time.	Everyday	Personal laundry	1 Hour or less	Sleep
2/28/2018 17:30:47	Male	21-30 years old	Bangkok, Thailand	Convenience	-	Few times a week	Personal laundry	1 Hour or less	Internet

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
5	6	7	7	7	5	5	By color (e.g. black, white, light color, dark color), By clothing type (e. g. separate underwears, socks and normal clothes)	Wash duration	Yes	I think it depend on amount of clothes
1	2	3	4	5	6	7	By clothing type (e.g. separate underwears, socks and normal clothes)	Wash duration	Yes	Instruction from detergent products
6	8	7	4	4	8	8	By color (e.g. black, white, light color, dark color), By stain type (e.g. dirt, food, animal fur, blood, etc.)	Wash duration	Yes	I don't - I just take a rough guess.
1	2	3	4	5	6	7	By clothing type (e.g. separate underwears, socks and normal clothes)	Wash duration	Yes	Instruction from detergent products
Not applicable	1	2	3	4	5	6	I don’t categorize my clothes	Wash duration	Yes	2 scoop
Not applicable	1	2	3	4	5	6	I don’t categorize my clothes	Spin time	No	

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	3	6	1	5	2	4	Animation (e.g. animated, graphics, GIF, short video clips)
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time), Amount of chemical input, Energy consumption	6	1	2	3	4	5	Text, Graphics (e.g. pictures, graphs, icons)
No		Detailed info of each program (e.g. temp, time), Countdown timer	6	5	3	1	2	4	Text, Graphics (e.g. pictures, graphs, icons), Audio
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time), Amount of chemical input, Energy consumption	6	1	2	3	4	5	Text, Graphics (e.g. pictures, graphs, icons)
No		Predefined wash program, Amount of chemical input, Countdown timer	2	3	5	4	6	1	Audio
No		Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	2	3	6	4	5	1	Text, Graphics (e.g. pictures, graphs, icons), Audio, Animation (e.g. animated, graphics, GIF, short video clips)

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
1	5	3	2	2	4	1	Having the message to send the status of the process of the machine.
3	5	4	3	2	4	3	Calculate suitable water level and quantity of detergent by itself
1	5	5	1	1	1	4	Eject clean load and auto re-load dirty clothing - after specific (programmable) weight is reached
3	5	4	3	2	4	3	Calculate suitable water level and quantity of detergent by itself
5	4	4	1	5	1	1	Measure the amount of water and chemical being use for each particular wash
1	4	4	2	3	5	1	-

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
3	6	1	5	2	4	I can ask about likes when it will finish or what is the process that they work it on now.	Can communicate with the user, Can set the amount of chemical input by themselves.	
2	5	4	1	3	6	Be strong! little wingy man	Do laundry by itself	Nothing
6	5	3	1	2	4	what is the weather forecast today?	function - as previously stated. appearance dependant on evolution. Material - light weight but durable?. Interaction - no interaction. Just top-up clothing and collect when notified by mobile application?.	
2	5	4	1	3	6	Be strong! little wingy man	Do laundry by itself	Nothing
1	2	4	5	6	3	Hey, “Siri”	To be tiny and take less space.	
						do like you used to do	-	

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
2/28/2018 17:35:21	Male	21-30 years old	Bangkok, Thailand	Automatic process	Too many options	Few times a week	Personal laundry	2-3 Hours	Watching TV
2/28/2018 18:09:42	Female	21-30 years old	Nuremberg, Germany	Clean clothes	Hanging clothes, door too small	Once a week	Personal laundry	2-3 Hours	Anything
3/1/2018 2:01:10	Female	21-30 years old	Bangkok, Thailand	Wasing cloth fast	Lots of water usage	Once a week	Personal laundry	2-3 Hours	Do homework
3/1/2018 4:35:45	Female	21-30 years old	Bkk, Thailand	Easy and convenient	Nothing	Few times a week	Personal laundry	1 Hour or less	Watching Tv, surfing the internet, etc.
3/1/2018 8:41:38	Male	31-40 years old	Bangkok, TH	Easy, Fast and Good function	Unclassify the color of clothes	Few times a week	Personal laundry	2-3 Hours	Do my business
3/1/2018 12:30:08	Male	21-30 years old	Gothenburg, Sweden	Washing Clothes	It takes lots of time	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	More than 3 hours	Do things on computer

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
6	1	3	2	Not applicable	4	5	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Proper program	Yes	From suggested scale
Not applicable	1	2	3	4	5	6	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Temperature	Yes	Pods or instructions in bottle
Not applicable	2	3	5	4	6	7	By textile (e.g. cotton, wool, jeans, polyester)	Wash duration	Yes	
1	3	3	3	2	3	2	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e. g. separate underwears, socks and normal clothes)	Amount of water	No	
8	1	3	2	4	5	7	By color (e.g. black, white, light color, dark color), By clothing type (e. g. separate underwears, socks and normal clothes)	Wash duration	Yes	Depends on the number of clothes
Not applicable	1	2	3	4	5	6	By color (e.g. black, white, light color, dark color)	Temperature	No	

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
Yes	Low noise	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	1	2	5	4	6	3	Push notification
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Detailed info of each program (e.g. temp, time), Countdown timer	6	3	5	1	4	2	None
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Countdown timer	4	3	6	2	5	1	No feedback
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Predefined wash program, Detailed info of each program (e.g. temp, time)	5	6	4	2	1	3	Graphics (e.g. pictures, graphs, icons)
Yes	Low noise	Predefined wash program, Detailed info of each program (e.g. temp, time), Amount of chemical input, Countdown timer	1	2	4	3	6	5	Text, Graphics (e.g. pictures, graphs, icons)
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Clothes weight, Countdown timer	2	3	4	6	5	1	Text

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
1	4	3	4	4	5	1	Smart home integrated, voice command, push notification, self cleaner, multi sensors, AI on washing program
5	5	5	5	5	5	5	Calculate amount of washing powder
1	1	3	1	1	1	4	Alert the finish time
1	3	2	1	1	1	1	We can order from smartphone like when we're out
1	1	5	5	4	4	3	Estimate the quantity of the chemical fluid and able to clean black-white and color clothes simultaneously
1	2	5	2	2	1	5	Give suggestions or help if something is wrong

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
1	3	5	2	6	4	Do best to my clothes abd tell me when you're done.	Material and dirt Scanning, wash by pressuring while maintaining. Ironing. Finish in less than 10 minutes	Why washing machine is only for clothes? It should be as its name, to wash. No matter the objects or materials are, be smart enough to know and wash properly. Also know what and where to wash which can save a lot of time rather than just wash with pre-define program. Good luck bro :)
3	6	5	2	4		-	-	-
4	3	6	2	5	1	Wash	Automatically use bleach and softener like printer	Thank you
5	6	4	3	2	1	Thanks a lot	Can talk with people	
1	2	6	3	5	4	Hurry up!!	Recalculate the suitable program every single using. Standard function should be in every laundry machine like washing, steaming and ironing	Hopefully the futuristic laundry machine exists.
2	3	4	6	5	1	Not sure	All in one, basically washing/drying etc doing everything	

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
3/1/2018 14:02:38	Male	21-30 years old	Gothenburg, sweden	It cleans my laundry	Going down to the basement to load the machine. That I have to put the laundry in a dryer in order for it to dry.	Once a week	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Going on with my life in my apartment
3/1/2018 15:43:34	Male	21-30 years old	Sweden	Easy to use, fast, many programs	Keeping track of the time. Also sometimes it takes longer than it says on the screen	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	More than 3 hours	Various tasks, always go back home though while waiting.
3/1/2018 17:53:48	Female	21-30 years old	Thailand	สะดวก ไม่ต้องซักเอง	รอผ้านาน	Once a week	Shared laundry facility (in an apartment or accommodation area)	1 Hour or less	ทำงานอย่างอื่น
3/1/2018 18:01:06	Male	21-30 years old	กทม.	สะดวก	ขยี้ไม่ได้ ผ้าขาวไม่สะอาด	Once a week	Coin-operated/coin-payment laundry	1 Hour or less	ขึ้นมารอที่ห้อง แล้วเผลอหลับ ตื่นมาอีกทีผ้าเหม็น ซักใหม่
3/1/2018 22:32:37	Female	21-30 years old	Gothenburg, Sweden	That I can see my clothes getting washed	That I don't know how much detergent to put or which program is best	Once every 2 weeks	Shared laundry facility (in an apartment or accommodation area)	2-3 Hours	Go to my apartment and work
3/2/2018 3:59:57	Male	21-30 years old	Chiba, Japan	Save time and labor (able to do something else while washing)	Filling detergent and softener	Few times a week	Personal laundry	1 Hour or less	Internet, exercise
3/4/2018 9:41:05	Female	21-30 years old	Bangkok, Thailand	Convenience	When it's broken	Everyday	Personal laundry	1 Hour or less	Other house chores
3/5/2018 3:45:39	Male	21-30 years old	China, Shanghai	Can clean clothes without touching cold water	Clothes get tangled after washing, which may damage delicate ones	Few times a week	Personal laundry	1 Hour or less	As washing machine is installed in my home, I stay home with doing other things.

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
Not applicable	1	2	3	Not applicable	4	5	By color (e.g. black, white, light color, dark color)	Wash duration	No	
7	1	2	3	4	5	6	By color (e.g. black, white, light color, dark color), By textile (e.g. cotton, wool, jeans, polyester), By clothing type (e.g. separate underwears, socks and normal clothes)	Temperature	No	
1	2	3	4	5	6	7	By color (e.g. black, white, light color, dark color)	Wash duration	Yes	ใช้ฝาตวงตามที่ฉลากบอก และก็กะๆเอา
Not applicable	2	3	Not applicable	Not applicable	4	5	By textile (e.g. cotton, wool, jeans, polyester)	Wash duration	Yes	ดูจากฉลากข้างซองเช่น 1 ฝาต่อผ้า 20 ชิ้น
2	3	4	5	6	7	8	By type of clothes (delicates, normal clothes, blankets and sheets, etc)	For which type of clothes	Yes	I measure with the lid but I'm never sure if it's the correct amount
Not applicable	2	1	3	Not applicable	4	5	By stain type (e.g. dirt, food, animal fur, blood, etc.)	Amount of water	Yes	Specified by the chemicals and use their caps for measurement
8	1	2	3	4	5	7	By color (e.g. black, white, light color, dark color)	Wash duration	Yes	ask mom
Not applicable	1	6	3	4	5	7	By textile (e.g. cotton, wool, jeans, polyester)	Amount of water	Yes	There is instruction on the label of components bottle.

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Predefined wash program, Countdown timer	2	5	6	4	3	1	Text
No		Predefined wash program, Countdown timer	5	1	6	3	4	2	Text, Audio, Animation (e.g. animated, graphics, GIF, short video clips)
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	1	2	6	4	5	3	Text
No		Detailed info of each program (e.g. temp, time)	1	6	4	5	2	3	Animation (e.g. animated, graphics, GIF, short video clips)
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Detailed info of each program (e.g. temp, time)	6	2	4	1	3	5	Graphics (e.g. pictures, graphs, icons)
Yes	Full load of clothes (maximum washing machine's capacity) for each wash	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer, Current and remaining processes (wash, rinse, dry, etc.)	3	4	2	5	6	1	Text, Audio
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	3	1	6	4	5	2	Graphics (e.g. pictures, graphs, icons)
No		Predefined wash program, Detailed info of each program (e.g. temp, time), Countdown timer	3	2	4	5	6	1	Text, Notification on smartphone especially when it's finished.

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
1	2	5	4	3	4	1	Fill the laundry on its own, determine how much washing powder is needed, dry the clothes in the same machine without human interaction
5	1	2	3	2	1	1	Put my clothes in to the drying machine :) And notify me when the machine has completed washing
1	5	4	1	3	2	1	ซักผ้า อบแห้ง และทำให้ผ้าเรียบได้เลยโดยไม่ต้องรีด
5	1	2	3	5	4	4	เอาของออกจากกระเป๋าเพราะชอบลืม, ส่งข้อความมาที่มือถือว่าซักเสร็จแล้ว
1	5	4	2	1	2	1	Guide me through the washing process
1	4	2	1	4	1	1	Adjust program (water amount, chemicals amount) based on the clothes inside
1	4	4	2	3	5	3	advise which program we should use for this wish
1	5	5	2	4	5	3	Connecting with smartphone or home appliance to collaborate with others.

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
5	6	4	3	1	2	Do my laundry	I think it will be able to do do the laundry on its own.	
4	5	6	3	2	1	Please make sure to remove all the stains :)	Faster, support bigger loads, connected to the internet	Good luck :)
1	2	4	3	6	5	ซักเร็วๆหน่อย เอาให้สะอาดๆด้วย	ทำให้ผ้าสะอาดแบบพร้อมใส่ได้ภายในเครื่องเดียวและในเวลาอันรวดเร็ว	ถ้าเครื่องซักผ้าซักแมวได้จะดีมาก
6	1	2	3	5	4	ปั่นมากๆ ระวังมีนนะ	ซักเสร็จแล้วก็แขวนไม้แขวนเสื้อให้พร้อมตากเลย	-
6	2	3	1	4	5	How can I use you correctly	Social machine like Wash-E haha (I am super bias about this question so I won't answer : P)	You are the best <3
2	5	1	4	6	3	Wash them quick and clean, thanks.	Tanks for the chemicals for storing them and automatically releasing them; we just refill when they are empty (like printer's ink)	Fabulous if it can also hang the clothes for me :)
1	2	6	3	4	5	sing me a song	able to identify kind of material and automatically select the wash program for us	
1	4	2	3	6	5	Thank you for washing clothes.	Connecting with other devises.	

Questionnaire Summary

	Section 1					Section 2			
Timestamp	Gender	Age	Where do you live? (City, Country)	What do you like about using a washing machine?	What do you hate about using a washing machine?	On average, how often do you do laundry?	What kind of laundry facility do you often go to?	How long do you spend on doing laundry per session? (1 session = washing + drying clothes in laundry facility)	What else do you do while the clothes is being washed?
3/7/2018 4:45:27	Female	31-40 years old	Tsukuba	Its easy steps.	It damages clothes sometimes.	Everyday	Personal laundry	1 Hour or less	anything like using smart phone

Section 3										
What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Clean washing machine]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Load clothes]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Fill in chemical components]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Select program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Adjust program?]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Start laundry program]	What is your normal laundry sequence? (Please rank by order starting from 1 or select 'Not applicable' if it does not apply to you) [Unload clothes]	How do you categorize your clothes? (You may select multiple answers)	Which laundry factor is the most important to you when choosing laundry program?	Do you measure chemical components (Detergent, softener, bleach, etc.) for each wash?	If yes, how do you know how much do you need for each wash?
Not applicable	2	3	4	5	6	7	By color (e.g. black, white, light color, dark color)	Amount of water	Yes	just one cup

Section 4		Section 5							
Have you ever considered sustainability aspect when doing laundry? (e.g. energy consumption, chemical usage, waste, etc.)	If yes, which aspect do you consider the most important one?	What information is "currently displayed" on washing machine screen?	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Predefined wash program]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	What information "should be displayed" on washing machine screen? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	What kind of feedback would you like to receive from the washing machine?
Yes	Use not too much chemical component (Detergent, Softener, Bleach, etc)	Detailed info of each program (e.g. temp, time), Amount of chemical input, Countdown timer	2	6	3	5	4	1	Audio

Section 6							
If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Hair/Fur]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Eyes]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Mouth]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Nose]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Ears]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Arms/Hands]	If the washing machine becomes a living creature, what should it have? (Give a score from 1-5 to each feature; 1 is the lowest and 5 is the highest score) [Legs/Feet]	If an ordinary washing machine becomes smarter, what do you think it should be able to do?
5	1	3	4	2	4	2	wash, dry, fold all by itself

If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Wash program]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Detailed info of each program (e.g. temp, time)]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Clothes weight]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Amount of chemical input]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Energy consumption]	If the washing machine can help you with laundry, which aspects you would like to get help with? (Please rank; 1 = the most important, 6 = the least important) [Countdown timer]	If you could have a conversation with the washing machine when doing laundry, what would you say to it?	What is your idea about the future of washing machine in the next 10 years? (Function, appearance, material, interaction)	Anything else you want to share or let us know?
4	2	5	3	6	1	Could you make it faster?	wash, dry, fold all by itself	no