

Product Opportunity Document

No Eggscuse

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Table of Contents

1.	DESIGN CONCEPT.....	3
1.1.	<i>Overall architecture.....</i>	5
1.2.	<i>Interaction design.....</i>	6
2.	BACKGROUND RESEARCH	11
2.1.	<i>Research methods.....</i>	11
2.2.	<i>Interpretation and findings</i>	14
2.3.	<i>Competing alternatives.....</i>	15
3.	EMBEDDED DESIGN.....	18
3.1.	<i>The base</i>	18
3.2.	<i>The eggs</i>	19
3.3.	<i>Possible developments.....</i>	19
4.	PROGRESSIVE WEB APP DESIGN	21
4.1.	<i>Sitemap</i>	21
4.2.	<i>Web app architecture.....</i>	22
5.	VIABILITY AND POTENTIAL IMPACT	24
5.1.	<i>MVP and market demand testing.....</i>	24
5.2.	<i>eCommerce business model.....</i>	24
5.3.	<i>Products, pricing, costs & revenue projections</i>	25
5.4.	<i>Marketing and future possibilities</i>	27
6.	PUBLICITY AND LICENSE.....	29
	REFERENCES	30

1. Design Concept

NoEggscuse is a product designed for families to help coordinate household tasks. Organizing cleaning and other daily tasks at home can often be stressful and create unnecessary arguments between household members. The delegation of chores often requires constant negotiation between family members. Even then, someone is usually left with the feeling of inequality, when it comes to the distribution of household chores. NoEggscuse offers a fun way to address this problem with a new way of communication. The product utilizes lights to visualize the progress of completed tasks while the delegation of tasks is done through a mobile app.

The value proposition of NoEggscuse is to

make the delegation of house chores easy and fun while nudging each house member to contribute in an equal amount.

The product consists of two parts: a physical IoT device and a web app that users can access through their mobile phone. The physical product features a number of egg-shaped objects, one for each household member. The physical form of the product is illustrated in Figure 1. The eggs sit on top of a dock, which represents a nest. The product concept revolves around an egg theme, since eggs are associated with family. Eggs are something precious, something you want to protect and take care of.

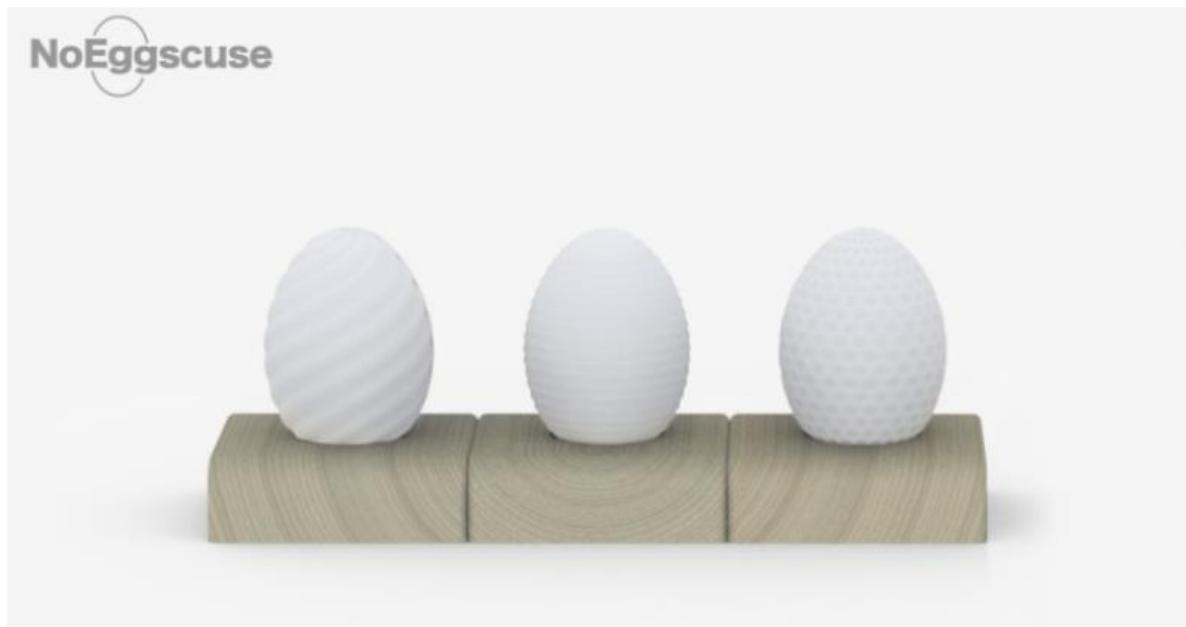


Figure 1. Physical form of the product.

Each person in the household has an egg which represents them, and that they are responsible for taking care of. Users are able to distinguish their eggs by their surface, which are offered in multiple different kinds of patterns. The physical product is designed to be placed in a common area in homes, such as kitchen or living room, where it is visible for everyone.

How it works

The idea of the physical product is to offer the household members a possibility to track the completion of chores, and to see at a glance, how much everyone has been contributing. The eggs are illuminated with gradient lighting from red to blue (Figure 2). The colors communicate the amount of chores completed by each person in the household. In the beginning of the week, everyone's eggs are red. Red color indicates that the person responsible for the egg has not done any chores yet or has done very little so far. When the egg is completely blue, it indicates that the person has done their part for the ongoing week. The eggs will gradually change color from red to blue as the person in charge of the egg completes tasks. This way the eggs act as a physical reminder for everyone to do their part and motivates them to keep up with others.



Figure 2. The eggs glow in shades of red and blue and the device is placed in a common area.

In addition to providing feedback with the colored light, people can also interact with the eggs directly. The eggs can be picked up from the base and placed anywhere in the house where cleaning is needed. For example, in a situation where only one of the eggs is still bright red, and a certain task needs to be completed, other house members are encouraged to pick the egg place it near the place that needs cleaning. This would send a stronger signal – something needs to be done, and the person who has contributed the least should be the one to take care of it. Noticing the missing spot in the base, the person in charge of the missing egg would be led to find their egg and complete the task, before allowed to return their egg to the base.

The web application helps household members to coordinate the delegation of household tasks. Through the web application, users can access more detailed information about the current status of completed and uncompleted tasks. The app features a shared list of weekly tasks that need to be completed in order to keep the house clean. Family members are free to choose which tasks they want to do. Once a person has completed a task, such as vacuumed the house, they can mark it done as their achievements. The egg of that person will respond accordingly by turning slightly bluer.

After buying the product, the product users are encouraged, as part of the product unboxing experience, to gather their family members together and agree on the tasks that are needed to be done, how often and to what extent, in order to maintain cleanliness and order in their house. The value of each task is also negotiated during this point. Each task is correlated with a set of reward points. Household members can choose how many points each task should be worth since for example, cleaning the toilet or taking the trash out don't require the same amount of effort and time. The amount of points needed to turn an egg from red to blue then also depends on how demanding the completed tasks are. Once the points for each task have been defined, the entire amount is divided equally for each household member. For example, if the added points amount to 30, in a three-person household each person needs to complete tasks worth of ten points, in order to turn their egg blue.

1.1. Overall architecture

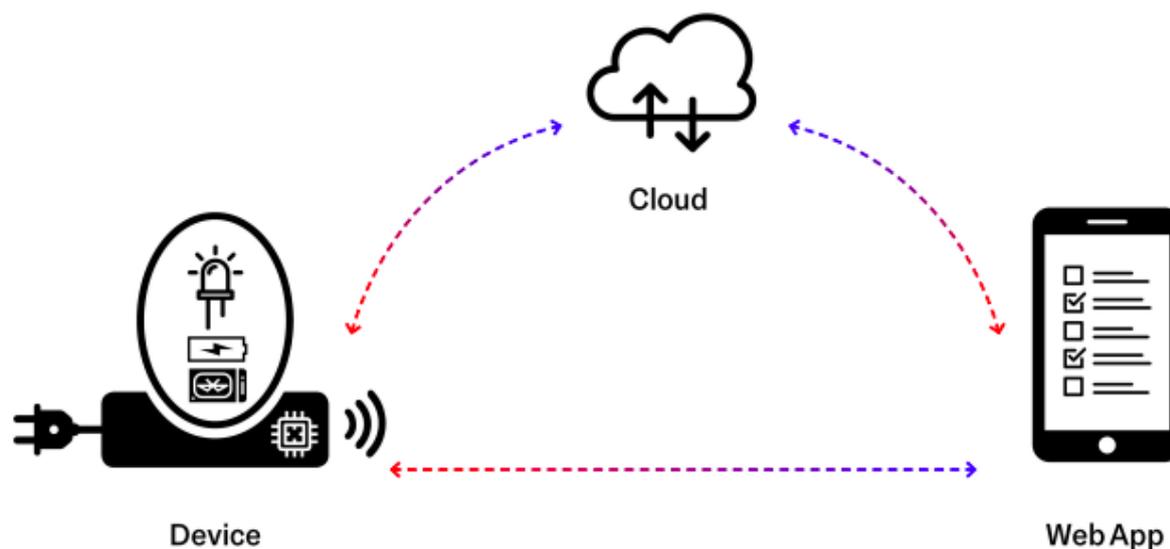


Figure 3. Overall architecture of NoEggscuse.

Figure 3 presents a visual overview of the product concept. The main elements are the embedded device and the web app, which communicate through a cloud service over WiFi. When a user interacts with the web app to mark a certain task accomplished, this information is transmitted to the device via WiFi. Microsoft Azure is used as a cloud service to collect, process and distribute data and instructions through multiple different devices.

The main components of the hardware device are the base and the egg. The microcontroller, which enables WiFi and Bluetooth connection, is located inside the base. The main components inside the egg include LED strip, a Bluetooth module and a button cell battery. Bluetooth Low Energy (BLE) is used as a means to communicate between the egg and the base. Bluetooth transmits the information about the points user has earned, and based on this information, the egg will change color.

1.2. Interaction design

1.2.1. Web app and physical device

Our product interacts with the user via two mediums: app (Figure 4) and physical output (Figure 5).

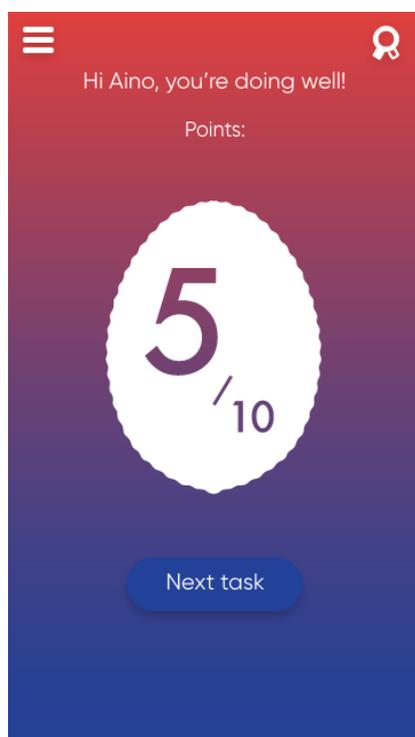


Figure 4. App main screen.



Figure 5. Physical product.

The app is focused to be used on a mobile phone, but there could also be a supportive web version with the same functions. Thus, it represents a classical point-and-click/touchscreen interface. The mobile screen is a flexible solution that allows for dynamic interfaces (Charlier, 2015). We chose it as it is the standard way of using apps, and it also easily enables the technical features that the product requires. However, the app only has three main functions in order to keep it simple and usable: seeing own process, comparing to others progress and registering new points, which includes a list of tasks that need to be done.

The visual messages of our interfaces are based in color. Both in the app, as well as in the physical product the changes between red and blue indicate process and urgency. The main page of the app tells about personal progress with the gradient division of blue and red. If the main color is blue, things are good, if red, one needs to hurry up.

The app's main screen (Figure 4) has a numeric indication of the process with collected points compared to the remaining amount. This reinforces the visual message by providing more details. Through the apps inviting "next task" button, one can access an overall list of things that need to be done in the household, shown in Figure 6. The undone tasks are shown in red so that they are more visible, urgent and "triggering", and the already done tasks are in blue, which is more harmonious, pleasing, and peaceful.

In the app one can also see an overall comparison score of the household members (Figure 7). Thus, people can easily compare their progress to others. How well the house members are currently doing,

can be seen through the amount of red, numeral indication as well as an icon of victory. Seeing a solid status should encourage and motivate people to do more.

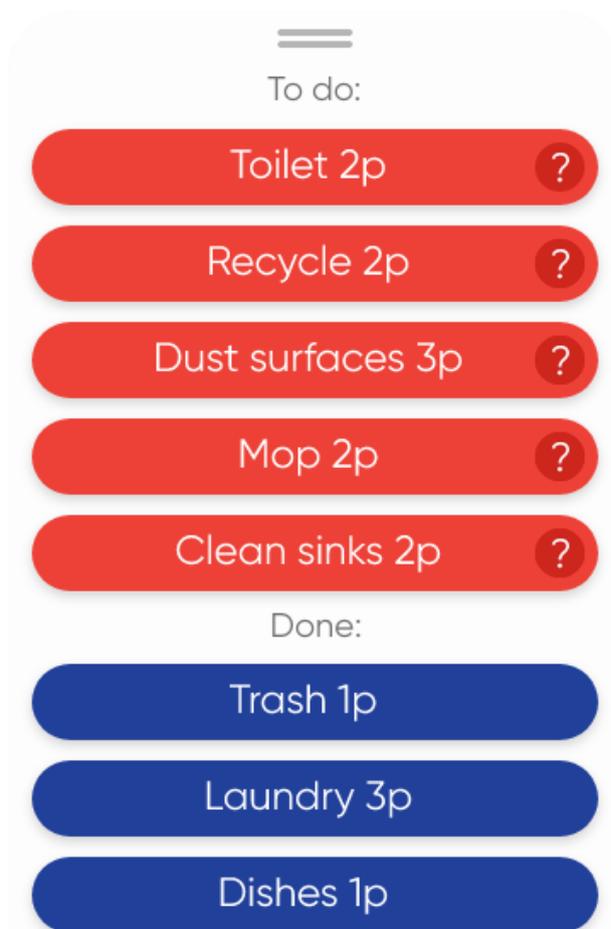


Figure 6. Overall task list.

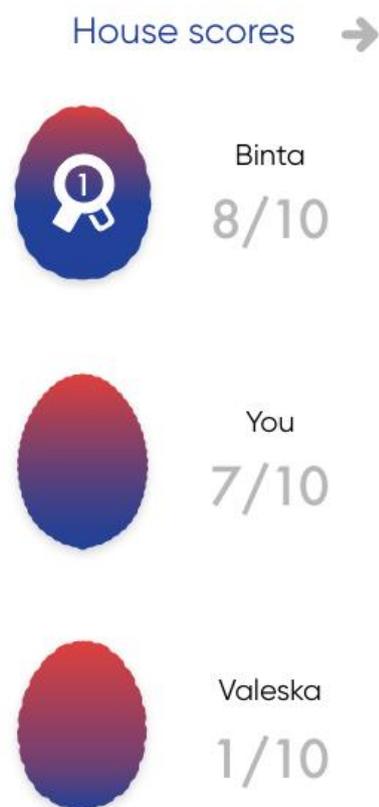


Figure 7. House score comparison.

In order to keep the physical product simple and peaceful, it does not include any screens. The product can be controlled, and more detailed information seen only through the app. The context of home is taken into consideration; families do not need anything too alarming or distracting in their common spaces. The cognitive load should not be increased, nor the amount machines to interact with. The NoEggscuse egg does not either include any physical controls, as we want it to be non-intrusive and soft. So, the interaction is based purely on light and the physical product is intended to be a beautiful addition to the home.

The physical product works in the same manner as the main screen of the app. The egg is illuminated by colored light which indicates personal progress through the portion of blue/red. The colored light offers an ambient and glanceable interface, which aims to be non-intrusive. As the blue is a calming and well-liked color and red more alarming, the household members would be able to interpret at a glance the cleaning situation (Figure 8) (Madden, et al. 2000; Elliot & Maier, 2007). Also, unconsciously people would more easily take notice when their egg is red rather than blue and be “triggered” to remember their tasks only when it’s necessary; when many things are left undone and the product glows in red hues. The product demands only a little attention, and only when needed.



Figure 8. Comparison through colors.

The physical presence also aims to motivate people as it allows the house members to see their progress compared to others, and interpret whether they should do more or simply feel good about themselves. Also, the immediate feedback of the color-changing according to points gained can act as a reward and motivate users even more. Hopefully, people would feel urged to turn their egg from red to blue and thus do their tasks effectively and in a good competition.

The physical product gives people simple feedback which is naturally understandable, and is something they don't really have to think about. as the product is supposed to be placed in a common space, it would be seen and interpreted continuously unconsciously. The light is a justifiable solution as the information the product communicates is not complex and it is supposed to be pre-attentive.

1.2.2. Ambient interface

As our surroundings get more polluted by machines and their feedback and interfaces, creating more ambient products becomes more important (Charlier, 2015). This a phenomenon NoEggscuse addresses. According Charlier (2015) ambient interfaces are: *pre-attentive, calm, universal and open*. NoEggscuse fills these requirements in the following ways:

Pre-attentive:

NoEggscuse eggs with light are glanceable and the colored messages don't require cognitive load.

Calm:

NoEggscuse is non-intrusive as the light is not an overpowering element. Additionally, due to the nonphysical form of light, the product comes one with the surrounding space, it spreads. The "decor" like design of the product is part of the interior of home. Calming blue light will reflect the "wellness" of home and people should enjoy the sensation of blue both intellectually (=everything is good) and unconsciously (=blue as a meaningful color).

Universal: As the colored light represents no language or numbers, it should be understood by all. In the app interface there are numbers, but still the visuals represent more universal information.

Open:

The egg is a simple representation tool of progress. When connected to different web app or code, it could represent something else as well. Making the eggs have only one function makes them more affordable to manufacture, but also more understandable and easier to use. This of course takes away from the flexibility of the product but suits our concept better.

According to Siang (2019) interaction design has five main dimensions: *words, visual representations, physical objects and space, time and behaviour*. NoEggscuse addresses these dimensions in the following ways:

1D: Words

Our app has minimal written language and has the few button labels carefully thought out. The amount of information is low and supported by visuals. The text mostly refers to actual tasks deemed to be done (also supported by images, Figure 9) and is therefore hard to be interpreted wrongly.

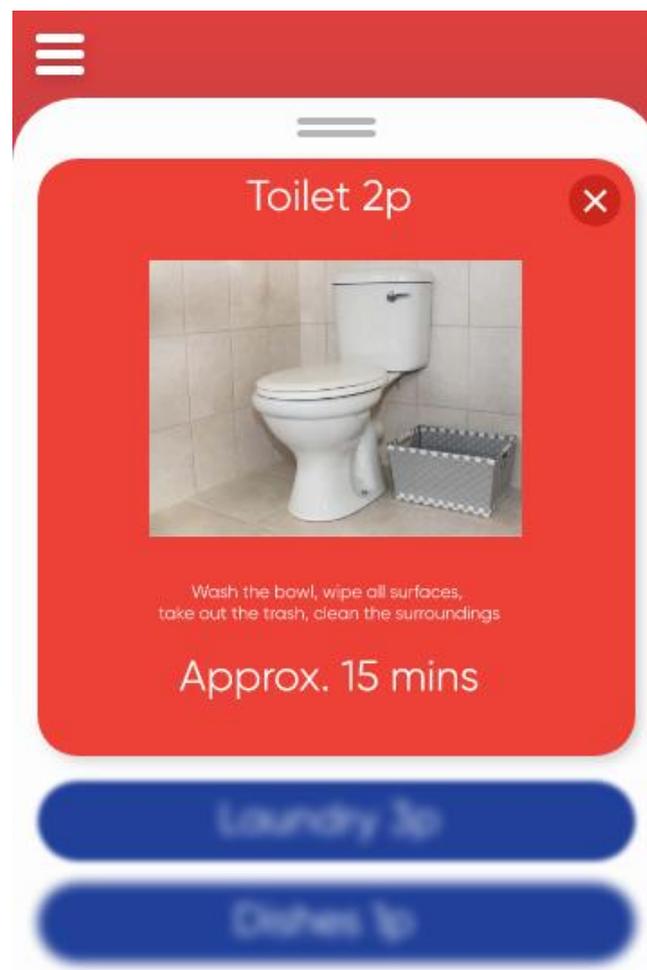


Figure 9. Images support text.

2D: Visual representations

Visual representation include blue and red gradients both in the app as graphics, as well as in the product in light. In the app, one also finds visuals supported by text and numeric indications as well as commonly used and understood icons, as can be seen in Figure 4.

3D: Physical objects or space

As mentioned, NoEggscuse interacts with people through physical product and the immaterial app. The app and product support each other, but can be understood independently as well. The physical product spreads to its surroundings in light and atmosphere. The product is supposed to be used at home, which is seen in its peaceful spirit.

4D: Time

Time can be experienced with NoEggscuse as its colors change accordingly to executed tasks. The change can be seen as a motivator. Longer periods of red might start to bother, whereas the change towards blue rewards.

5D: Behaviour

Interactions and emotional reactions to NoEggscuse are connected to the aforementioned reactions to color. Furthermore, the social aspect also affects people's behaviour as the possibility to compare to others motivates and rewards as well. This takes the emotion on a deeper level.

2. Background Research

This section describes the background research that was conducted as a basis for creating the concept of NoEggscuse. We describe how field studies was conducted, how the materials were interpreted, our main findings as well as secondary research about competing alternatives.

2.1. Research methods

We used three types of user research methods suggested by Goodman (2015), which are asking, watching, and making (Table 1). We relied mostly on the ‘asking’ method, which means interviews, in around 70% of our user research. 20% of the research came from ‘watching’ during field visits and extra report photographs by interviewee’s experiences. ‘Making’ consists of 10% of the research, since it requires extra efforts from participants. Through different methods, we were able to gather evidence and insights about things, which cannot be verbalized as well as inspiration for possible solutions.

Table 1. Research techniques for connected products, Sanders E (cited in Goodman, 2015)

Participants...	You gather information about what people...	You learn about human conditions that are...	We suggest...
Answer questions	Say Think	Explainable	Elicitation activities, such as map-making, prompt richer and more detailed conversation
Behave normally	Do Use	Observable	Filed visits discover and document contexts of use, and provoke unexpected encounters
Make and play	Know Feel Dream	Tacit	Generative methods, such as co-design workshops, create artifacts in order to surface hard-to-articulate values, dreams and assumptions

2.1.1. Asking: Interview

The most effective way to identify people’s current goals, frustrations, and pleasures is to ask them (Goodman 2015, p.176). We conducted interviews face to face during field visits as much as possible. Otherwise, we asked interviewees to fill the question document. We could get an understanding see how people say and think about the situation through their answers.

Interview subjects

We interviewed a total of five people, who lived in households of two or more members. Each interview group is different, depending on the relationship and personal distance of house members.

We interviewed people living with family members as well as friends to HOAS apartment members and housemates without personal connections;

Interviewee A (Female, 19) lives with 1 family member

Interviewee B (Female, 42) lives with 3 family members

Interviewee C (Female, 30) lives with 3 housemates from HOAS

Interviewee D (Female, 23) lives with 2 housemates, no personal connections

Interviewee E (Male, 28) lives with 1 friend from University

Questions

Interview questions were divided into five parts, starting from general facts and going into deeper personal and emotional areas. Thus, interviewees could feel comfortable to describe pain points and emotional aspects related to possible problematic situations. The interview questions were structured as follows;

1. General, background:
Introduce, living situation, lifestyle...
2. Current situation:
How do you organize / divide, who sets the rules, habits...
3. Pain points & problems:
Any problems, annoyances related to coordinating chores, what do you wish...
4. Feelings & emotional aspects:
Personal stories, previous experience, ideal mood...
5. Communication in general:
How do you communicate, what kind of tools are used...

2.1.2. Watching: Field visits



Figure 10. Interviews at field visits.

We conducted three field research trips to capture beyond what people can verbalize (Figure 10). We could see how people behave facing the problem or what kinds of tools or solutions they were using currently. In fact, lots of people we observed tried different attempts to gentle communication with house members. For instance, one adopts a weekly task list and point system, the other posts a tiny notice with emoji or puts HOAS cleaning regulation document on the kitchen table, as illustrated in Figure 11. Later, this inspired us when we designed the web application.

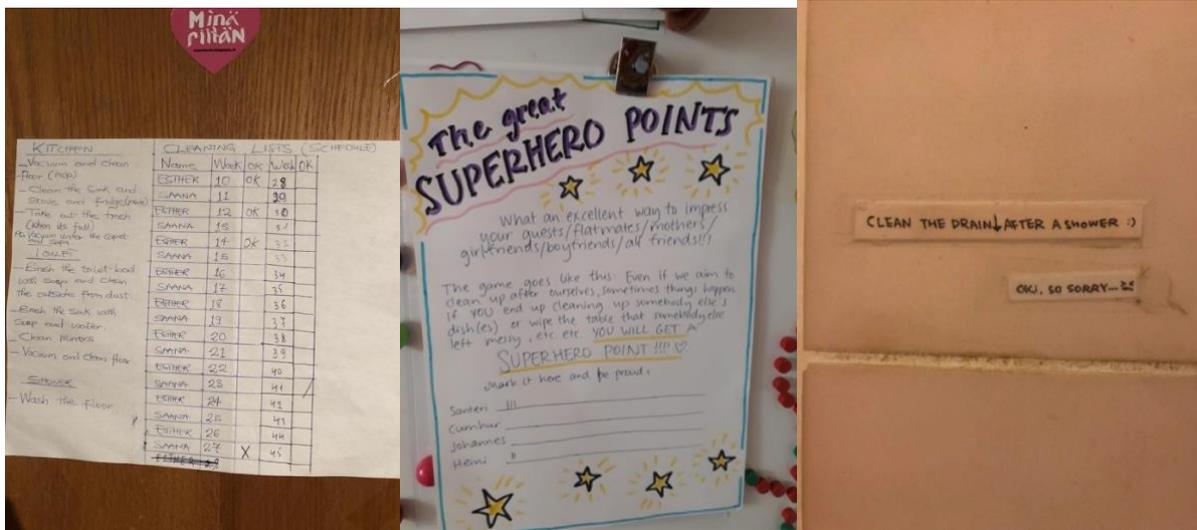


Figure 11. Different attempts to gentle communication with house members

2.1.3. Making: Co-design workshop

During field visits, interviewees participated in generative methods, or so-called co-design workshops. In the early stages, generative methods help investigate everyday needs. Co-design workshops are semi-structured sessions in which professionals ask potential users to design new products and services by themselves, for themselves (Goodman 2015, p.177). We prepared a white canvas and pens for users to draw their 'magical solution' (Figure 12). This allowed us to better understand people's pain points and to how see how they dream to solve the problems they identified.

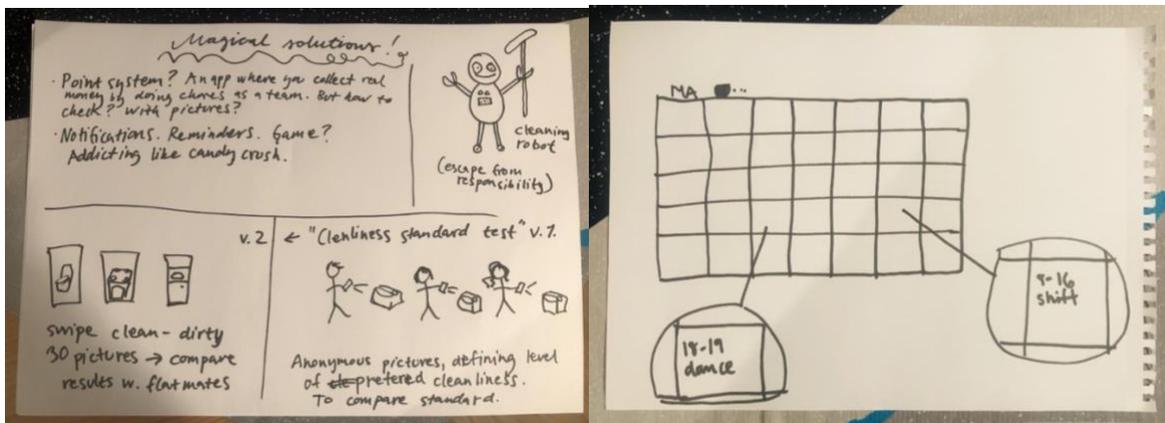


Figure 12. Interviewees' 'magical solutions' form co-desing workshops

2.2. Interpretation and findings

In interpretation the research data, all of the material was gone through and the most interesting and relevant information was highlighted. At this stage, the goal was to identify the most relevant pieces of information related to our research context. Based on the initial findings, the final analysis of the interview data was done during a workshop involving the entire design team. We used affinity mapping as a tool, to find links between different insights and to group the findings into larger themes. The identification process is illustrated in Figure 13.

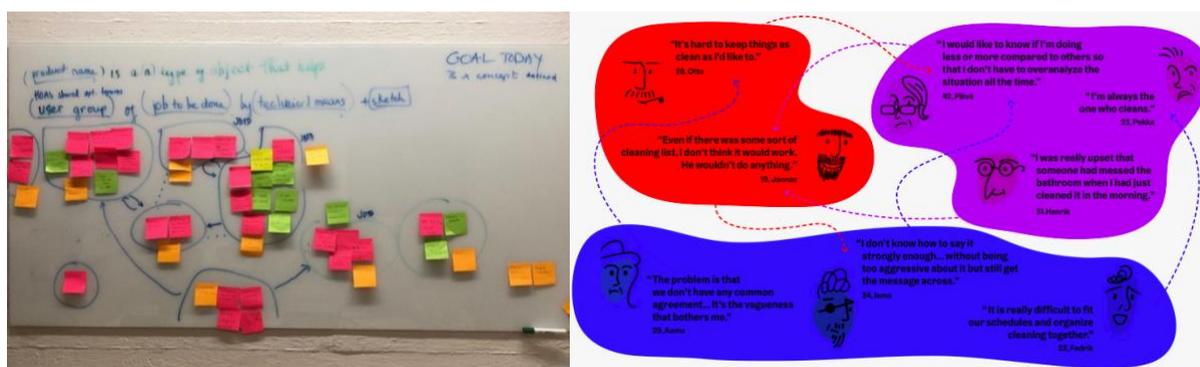


Figure 13. Identification of clusters and correlations in internal team co-design workshop

Based on the research, we identified three aspects of interest, that we wanted the solution to address;

- **Fairness.** Inequality in the distribution of chores was a major cause of annoyance.
- **Motivation.** Postponing cleaning work is a common problem.
- **Communication.** Agreeing on a common standard, and delegating tasks effectively is not easy.

Through our analysis we found that the participants faced a lot of similar pain points, and many of the problems were highly interconnected. For example, setting a common cleaning standard has to do with fairness as well as communication, and the lack of it could often cause frustration and even lack of motivation to do one's own part. The closeness level of house members also affected the way different problems would appear. For some people living with roommates, asking another house member to do a certain task could be hard, because they didn't want to seem too demanding. In families, a lack of agreement about who is responsible of what, would more easily led to open arguments, but too tight cleaning schedules weren't still thought to be the best solution. This way, the underlying themes of fairness, motivation and communication were all present regardless of the living situation. Table 2 summarizes the key findings were uncovered in our research and provides some example quotes from the interviewed participants.

Table 2. Interview findings

Insight	Findings	What participants said
Fairness	<ul style="list-style-type: none"> • Sense of inequality causing build up tension & arguments • Wanting to know much each person contributes • Too close to set strict rules 	<p>“I’m always the one who cleans.”</p> <p>“I would like to know if I’m doing less or more compared to others so that I don’t have to overanalyze the situation all the time.”</p>
Motivation	<ul style="list-style-type: none"> • Wanting to keep house clean but not motivated • Lack of interest in cleaning when living in a temporary living situation • House chores are boring and unpleasant 	<p>“It’s hard to keep things as clean as I’d like to”</p> <p>“Even if there was some sort of cleaning list, I don’t think it would work. He wouldn’t do anything.”</p>
Communication	<ul style="list-style-type: none"> • Not communicating about chores, relying on “silent agreement” • How to communicate “soft” but “hard”? • Afraid to confront • Tired of asking others to complete tasks • Afraid of (digital) miscommunication • Different schedules, don’t see each other often to discuss 	<p>“The problem is that we don’t have any common agreement...It’s the vagueness that bothers me.”</p> <p>“I don’t know how to say it (“please do this task”) strongly enough, to get the message across but without being too aggressive about it.”</p> <p>“Agreeing about a common cleaning standard would be the most important thing.”</p>

2.3. Competing alternatives

In our secondary research about competing alternatives, we did not find any products that had a physical device similarly as in the concept of NoEggscuse. The most prominent alternatives for NoEggscuse are mobile apps in the field of cleaning and house organization. There are a variety of apps available related to this context, taking slightly different approaches to incentivizing people to clean and coordinating tasks between people. Some of the products focus on the coordination aspect, offering calendar-like solutions, while others focus on motivating kids to take part in household chores with reward systems. The following three apps were found to be most notable competing alternatives, when it comes to attaining similar goals as NoEggscuse.

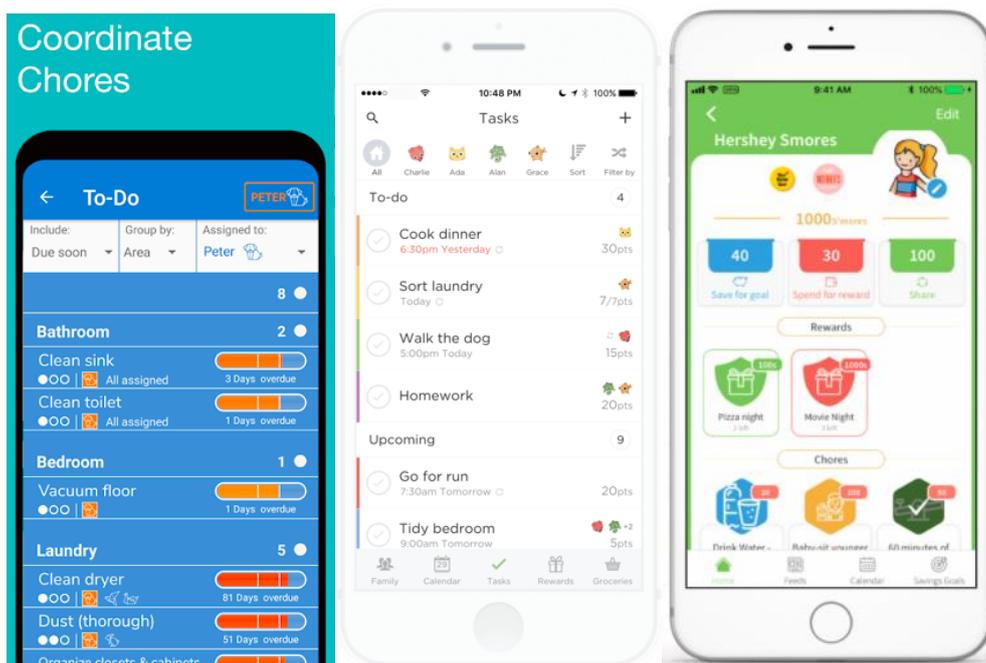


Figure 14. Competing alternatives: Tody (2019) – OurHome (2019) – S'moresUp (2019).

Tody

Tody is the most popular cleaning app on iOS. The app aims to motivate its users to clean by optimizing cleaning and making the process smarter. The app creates a list of tasks by room and estimates the priority and frequency needed for each task. This way it encourages users to clean just enough, not too much or nor too little. Tody also enables users to track their progress by visualized feedback. The app offers a possibility for sharing tasks and responsibilities by syncing different devices, but this is offered only as a premium feature. The app is free to download and in app purchases cost between 0.99 and 4.99 euros. (Tody 2019; Tran, 2019)

OurHome

OurHome is an app tailored for families. The app includes a task system, collaborative calendar and a point system which aims to motivate kids to take part in chores. The app also allows families to create shared grocery lists. By assigning tasks to a single person or multiple people on a rotating basis, the app promises to help household members to get everything done without needing to verbally ask anyone. In addition, users can send reminders and messages as well as stay in sync across multiple devices. The app is free to download and use. (OurHome, 2019; Tran, 2019)

S'moresUp

S'moresUp is an app that works as a tool for parents to manage chores and organize their family life. At the same time, the app aims to teach kids to be responsible and help them to self-manage. Using the app, parents are supposed to assign tasks for their kids as well as set rewards of their own choosing. The app works as communication tool between house members and offers them a way to track the completion of tasks. S'moresUp is free to download and use. (S'moresUp, 2019)

Compared NoEggscuse, most of the competing alternatives take more of a task management approach. Their interfaces include a lot of detailed information and are more complicated, as illustrated in Figure 14. With these apps, users need to take time to learn how the system works, as

well as figure out how to incorporate the tool as a part of their cleaning process. Since NoEggscuse has a physical product that is placed visible for everyone, it is unignorable and truly motivates users to do their part. NoEggscuse focuses on more on the social and emotional aspects of taking care of chores by nudging people to contribute equally. The app interface of NoEggscuse is also designed to be simplistic and not to require significant time spent on the app, unlike most of the competing alternatives.

3. Embedded Design

The hardware part of NoEggscuse consists of a modular base and an egg-shaped device, that make one unit. While the base parts are supposed to remain at their fixed location, the eggs that sit on top of each base should be movable. As described, it is an important aspect of our design concept to move the egg in certain situations to gamify and motivate users to play with the product. We need to think about components that enable a working connection and power supply in case an egg is removed from its home base aka. nest.

At this point we want to state that we understand the possible challenge of fitting required parts into the egg-shape. We commonly decided to go with the title of this document and therefore state preferable product opportunities. However, we take the professional feedback we received very seriously. Should we come to the conclusion that our envisioned hardware set up is definitely not feasible, we would have to adjust the whole concept as such. Until then and for the sake of limited time, we will go on with the use case we presented at the final gala.

Each modular base has a dimension of 75x75mm. The egg is planned with a diameter of 60mm. To fabricate the base and egg shapes we suggest rotational moulding. This way we can avoid seams. Used materials would be 0.5mm hard opal white plastic for the eggs and 1.5mm hard white plastic for the base. Our premium version would have a base made of carved birch wood. The plastic version of the product is estimated to weigh 150 - 200grams, while the wood version remains unknown. The weight of the product should encourage a feel of durability, since it can be the case, that a user drops the egg on the floor.

3.1. The base

Our product would also work with one unit only, but it should be possible to connect additional units for flexible adjustment of needs. The base parts would then form a row. Separate units are connected with magnets, so that power is supplied to the following units from the first one that is plugged in. The main components for the base are AC adapter plug and ESP32. The device is running on DC with voltage at maximum of 6V. Hence, the base is designed so that the AC adapter plug could be removable, for example as indicated in Figure 15.



Figure 15. Base should allow AC adapter plug to be removed (De.dhgate, n.d.)

At the heart of our product is the micro-controller ESP32. ESP32 plays an important part in connecting and receive data from the server to signal the LED strip in the egg to light up through WiFi. The aim of placing ESP32 at the base but not in the egg is due to the high power consumption of WiFi connection. Hence, by connecting it directly to the power supply, the connection through WiFi is maintained. It is estimated that the package of data per one transaction ranges from 0.5 - 1 KB, which often includes ID of the device, points value, standard points to compare.

3.2. The eggs

We envision the electrical components of the egg to be placed in the bottom of the egg. The opal white translucent egg-shaped shell will be put over to cover the parts as well as diffuse the light evenly. The main electric components in the egg include the battery compartment, battery cell, Bluetooth module NRF52810 and RGB LED pipe/strip. As the LED strip has high energy consumption, we decided to use ESP's Bluetooth Low Energy (BLE) function as a way of communication between eggs and their base. One of the main reasons for this is that it's optimized to receive data only whenever needed, which reduces the amount of energy consumption. In addition, "BLE is aimed at peripheral devices which operate on batteries, and don't require high data rates, or constant data transmission" (Sparkfun, n.d.). BLE has a minimum range of 50 Meters, which is more than enough for our indoors use. Additionally, the estimated data stream meets BLE's requirements. We don't have any sensors or other components that frequently send high volumes of data. Instead, the only information that needs to be transmitted are user points, based on which the egg's color will change on demand. The chosen Bluetooth module NRF52810 uses BLE 4.2 connection which is compatible with ESP32 micro controller in the base (esp32.net, n.d.). It also has electric pins for LED connection to light up. The module size is relatively small, 21 x 25 mm, which fits perfectly inside the egg (Banggood, n.d.).

Because we envision the egg to be moved from time to time and placed in areas that need cleaning, such as kitchen counters, we plan the eggs and base to be rated with IP54. With IP54 the components will be protected from limited dust ingress and water spray from any direction. To aim for a higher coverage in the IP ratings would come with a higher price as well. We see no need for higher coverage because the product is limited to indoor use only.

At the moment, we aim to supply energy for the egg by using two main sources: direct current from the base and a battery inside. When the egg is placed at the base, there will be a tip of the micro USB charging cable to power the egg. This resembles a setup how phones are commonly charged when displayed at a retail store. When the egg is removed, battery is in use to keep the egg running. Hence, battery compartment should be placed at the very bottom of the structure for easy replacement. Due to the limit of time and scope of education, the design of such circuitry has not been investigated thoroughly. However, there are solutions for such circuitry at the moment, for example using the capacitors as a switch. One other option could be to use a phone battery. This is convenient in terms of development, however, adds more cost to the product as a whole.

3.3. Possible developments

One of the suggestions we got, was to change the product design so that the base and the egg would be attached. This indeed makes the product development process more straightforward; however, such change affects the whole concept, and may reduce the market competitiveness of the product. Also, brand design might have to be altered including the name, logo and value proposition. In addition, to save battery, the intensity of lighting could be adjusted to be low at certain time, for example at midnight or when everybody is away. This could be done by either adding photoresistor

to the base to lower the lighting intensity if it is dark outside, or by adding computing functions to the webserver to automatically signal similar function at midnight when people are likely to go to sleep. Another development path could be to incorporate the ESP32 into the egg and disregard the use of BLE. At the moment, small micro-controller ESP32 with the size of 17.5 x 25 mm can be purchased at a reasonable price in the market, which does fit well inside the egg structure. This means to eliminate the function of the base as a data hub but to remain as a charging dock. This will significantly reduce the cost of product as there is no need for a separate Bluetooth micro-controller as well as lower the effort to sync the data between 2 micro-controllers. However, it should be noted that this will stress out on how to supply energy sufficiently, since both WiFi connection and LED lights would now be within the egg.

Progressive Web App Design

3.4. Sitemap

After onboarding and unboxing of the product, the app flow starts with a personal screen for every user. This main screen helps to keep track of their progress by 2 indicators: the background of the screen represents the actual lighting status on the egg using gradient color from red to blue, and the earned points compared to the total target in the egg shape. The toggle menu on the top-left corner helps navigate users to designated places such as setting, the full agreed to-do list of the week, etc. The ribbon vector on the top-right corner links to the page showcasing the progress of the family as a whole. Within that page, users are ranked based on their achieved points. Individual progress of other users is also illustrated by the color on their eggs. A similar ribbon vector with the number “1” is displayed to highlight the winning position and motivates users to achieve that reward.

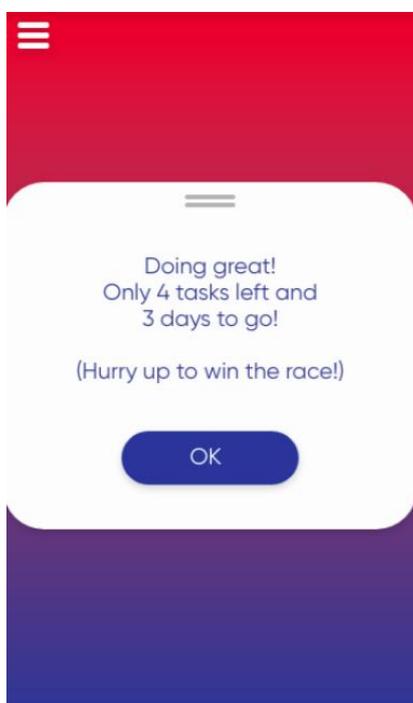


Figure 16. Pop-up window after a task is completed

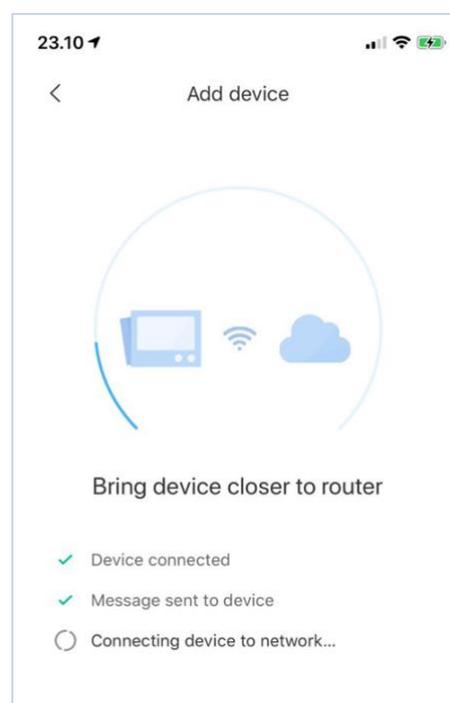


Figure 17. Possible outlook of app when setting WiFi connection

Behind the representation of the egg in the main screen, the button “Next task” triggers a float-in upwards window where all tasks are presented in two main categories: “to do” shows what has not been completed, and “done” indicates the opposite. On each item of the list, the question mark symbol is used to indicate specifically the desired activities for that task as well as an estimated time for execution in a drop-down window. This acts as a guidance and ensures the common standard of the quality of the task. Exiting this window could be done by either pressing the surroundings or the “X” button. In addition, user marks their completed task by pressing the item on the list. Red tag will be changed to blue, a “+” sign will appear to notify the points earning, and the item will be automatically moved to the lower part in “done”. User can drag the list down by using the “=” handle after interacting with it. A pop-up window will display an encouraging message, the remaining number

of tasks and days towards Sunday (Figure 16). The list disappears, leading user back to their main screen while indicating the updated points and color status of the egg. This is to create a feeling of satisfaction and achievement, which perhaps retains and generates more user's interactions with the app.

We envision the setting up of the device to be done through the app. This means to connect the base of the egg to the WiFi network, create an account, add family members, and set out the tasks as well as points for each task. An example of how the starting screen of the app for setting up could be indicated in Figure 17.

3.5. Web app architecture

The web app architecture is composed of 3 main layers, as indicated in Figure 18. The server-side platform is built on Azure provided by Microsoft. Hence, technical terminologies explained below adhere to the provision of Microsoft Azure itself. The choice of Azure is due to its support of various coding languages, clear pricing strategy to help predict the exact expense needed, and the easy integration of private or third-party platforms as compared to its competitors (Educba, n.d). It is worth to state that the upcoming structure is rather simplified due to the limitation of time and scope of the course. Further development should focus more on accommodating application architecture on IOS and Android platform for mobile devices.

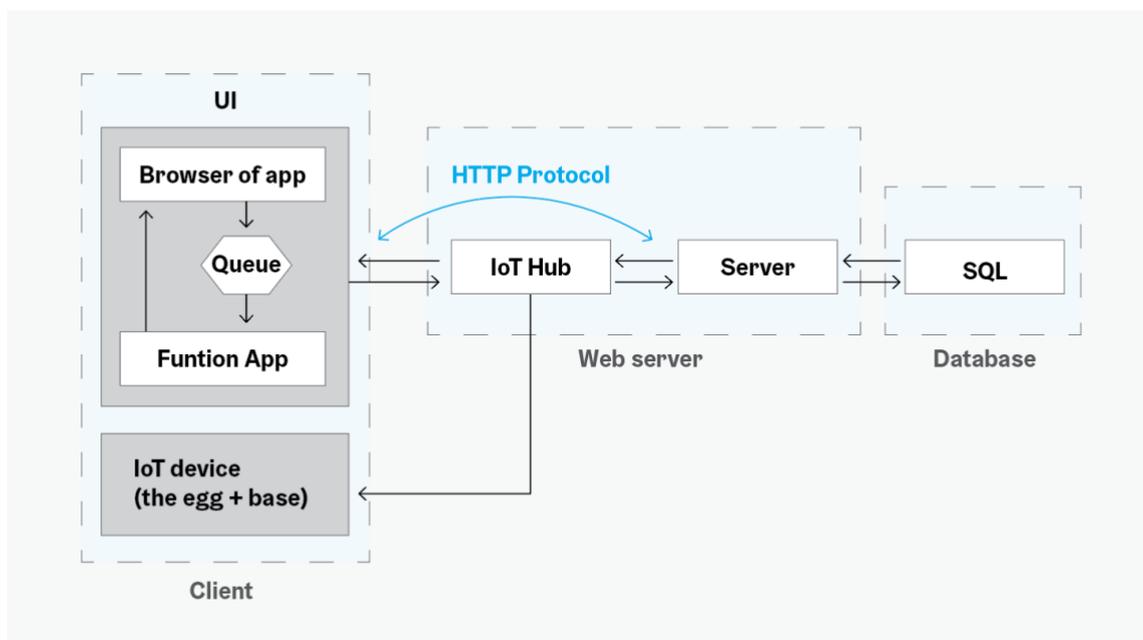


Figure 18. Pop-up window after a task is completed

The first layer is the Client's layer including two sub-layers. The first sub-layer is the user interface, i.e. web browser and application on user's device of choice. Once an interaction or a command is triggered, the Function App runs background tasks. It provides templates to get started with key scenarios, specifically with HTTPtrigger to execute the code by using an HTTP request (Microsoft Azure, 2017a). This is most important, as HTTP protocol will be mainly used to create the transaction of data between the web app and server. As many users could execute many commands at the same time, e.g. updating completed tasks to earn points, retrieving the to-do list, checking everyone's

progress, etc., or running the user interface simultaneously on different devices, the Queue function puts message on to an Azure Queue Storage, to deliver asynchronous messaging between application components. It then triggers the Function App. The remaining sub-layer is the IoT device, i.e. the base of the egg, which receives data as a signal for the LED strip to light up accordingly. We suggest HTML and CSS for creating and designing the layout, and JavaScript for running the interactive user interface as well as translate the HTTP request for data like updating the points from the server. The main reason for this is the abundance of available resources of these languages as well as the emerging open source platform GitHub. They help reduce the amount of workload for developers. If there is a need to improve latency, WebSocket could be implemented on top of the HTTP protocol to increase the speed of data transfer close to real time (Gibb, 2015).

The second layer is the Web Server layer, which acts as a hub to transfer data between all components of the whole web app architecture. As our product is used daily with a large number of devices (average 3 devices for a family with multiple hundreds or thousands of families), the use of IoT hub is crucial. Centralizing the requested messages into one hub and delivering them from one point will help manage the network of devices, secure the communication to the targeted one as the per-device authentication feature in Azure, and track or configure if such specific device is broken or encountering technical issues (Microsoft Azure, 2019). Azure IoT Hub offers the Device Provisioning Service to automatically register all devices at the same time. In addition, such service also provides the flexibility in routing a device to a desired IoT Hub location, e.g. to a near geo-location hub for lower latency with easy setup (Microsoft Azure, n.d.). IoT Hub later sends HTTP request to a Server which can be set up by the Azure Virtual Machine. For this server-side programming, Node.js is suggested to establish this layer since it is Java-based as well as will simplify the work for developers (Existek, 2018). Machine learning could be implemented in the later stage where gamification becomes more complex and trans-boundary.

The final layer of the architecture is the database layer. SQL database should be used in this context to help organize data and regulate similar structure and syntax for the ease of collaboration. Data that needs to be stored, includes personal data like name, date of birth, address, email as well as others like WiFi password to connect the device with household WiFi, a list of to-do tasks, as well as points assigned and earned for every individual. The listed ones are tentative and not limited because more data will also be stored later to develop the gamification feature of the product. JSON format is the data format for the whole communicating process. Regarding the data collection process, compliance with GDPR is crucial for our platform. Permission to collect, store, and use of data is asked when users set up the device. Terms and conditions will be carefully prepared and presented. At the moment, there is no plan to transfer data to third parties but only to further develop the service offerings for our users. Users have the right to delete or update data that has been collected.

4. Viability and Potential Impact

The product is an IoT lighting system targeted towards families, to help coordinate household tasks in an equal manner, to achieve peace and tranquility at home. We have covered some of the competing solutions previously, such as chore management apps. In addition, the product competes with other aesthetically pleasing lighting systems sold for household furnishing and atmosphere creation. To our knowledge, no other effort to combine these two solutions into one exists yet on the market. Thus, we would have to also invest in market education, and demand generation, to educate our potential customers of the value of a novel IoT solution (Rowland, 2012).

4.1. MVP and market demand testing

Before launching into a full-fledged business, we would test out the market demand for this type of product with a crowdsourcing campaign, enabling us to gather funds for initial investments without giving up equity (Newlands, 2017). The effort would help us manage the risk and get early seed investment for producing first products as well as create a marketplace for the product. Venturing out with a crowdsourcing campaign would require us to partner up with a product manufacturer and agree on terms for sold products, preferably via crowdsourcing campaign revenue split. This way, the risk would be shared. An alternative strategy would be to have a threshold in the crowdsourcing campaign, that would have to be met first in order for the campaign to succeed. This threshold value would then enable investments into manufacturing equipment.

We would present a 3 module system as well as 1 module systems of plastic and wood for the crowdsourcing campaigns as our initial conceptual MVPs.

4.2. eCommerce business model

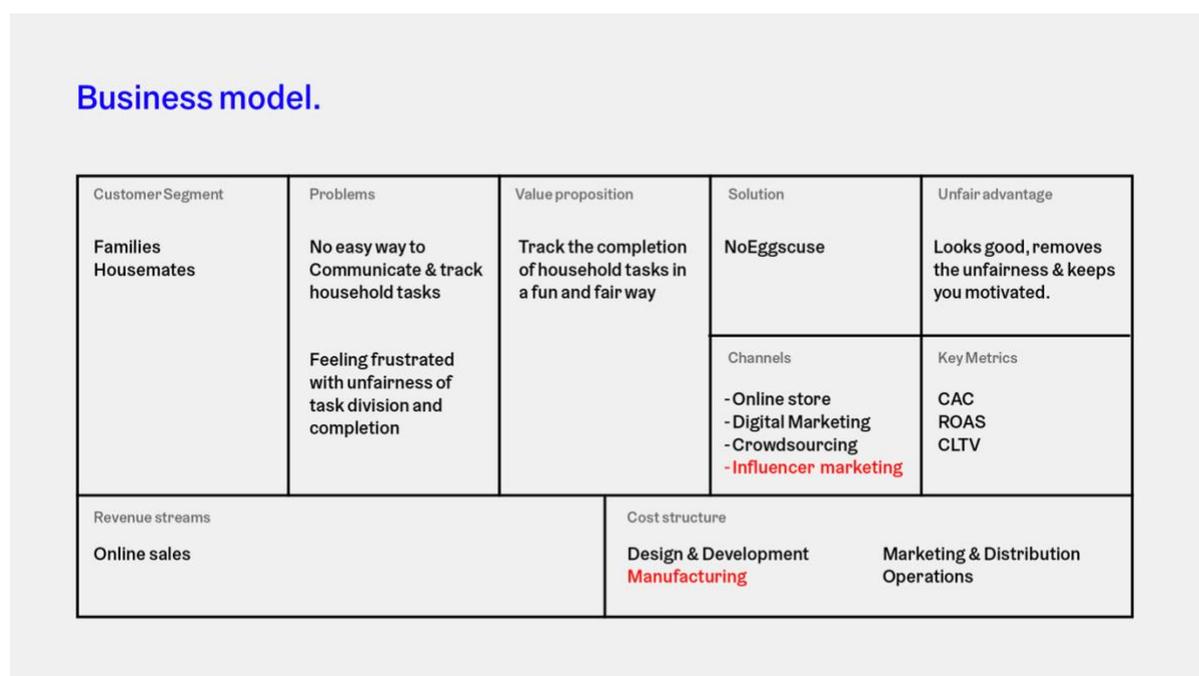


Figure 19. Focus areas of the NoEggscuse business model (adapted from Liikkanen, 2019)

Should a crowdsourcing campaign show tangible market demand for the product, the first phase of investments would fall into manufacturing equipment and/or partner deal and developing an online store, where future customers can buy NoEggscuse products. Thus, after the crowdfunding campaign, we would transition into a business model where design, marketing and distribution of our product lies in our hands. For manufacturing, a future decision on whether to partner up with a 3rd party or to invest into in-house machinery and capabilities would have to be made after the crowdsourcing campaign. Figure 19 summarizes the intended business model of NoEggscuse.

In the online store, we would have different products available to buy, based on the modular design concept. We can sell individual NoEggscuse modules as well as a standard pack of 3 for a family of 3 people at a discounted price. Customers can also buy add-ons, such as a new egg, or a new base module, in case they break or misplace one.

When buying, customers can choose from a variety of different surface details utilizing the online store, when buying the eggs, to differentiate, whose egg is whose. This would function as if choosing a color or size for a typical B2C eCommerce purchase, such as clothing. Alternatively, an engraving or other type of physical identification for the eggs during the purchase process would be recommended, so customers are able to tell their egg apart from other family members' eggs.

4.3. Products, pricing, costs & revenue projections

In addition, like mentioned, we would sell a premium wooden base version of the lighting system in the online store. This would be a premium product offered to families, who want an extra aesthetic appeal to the lighting system.

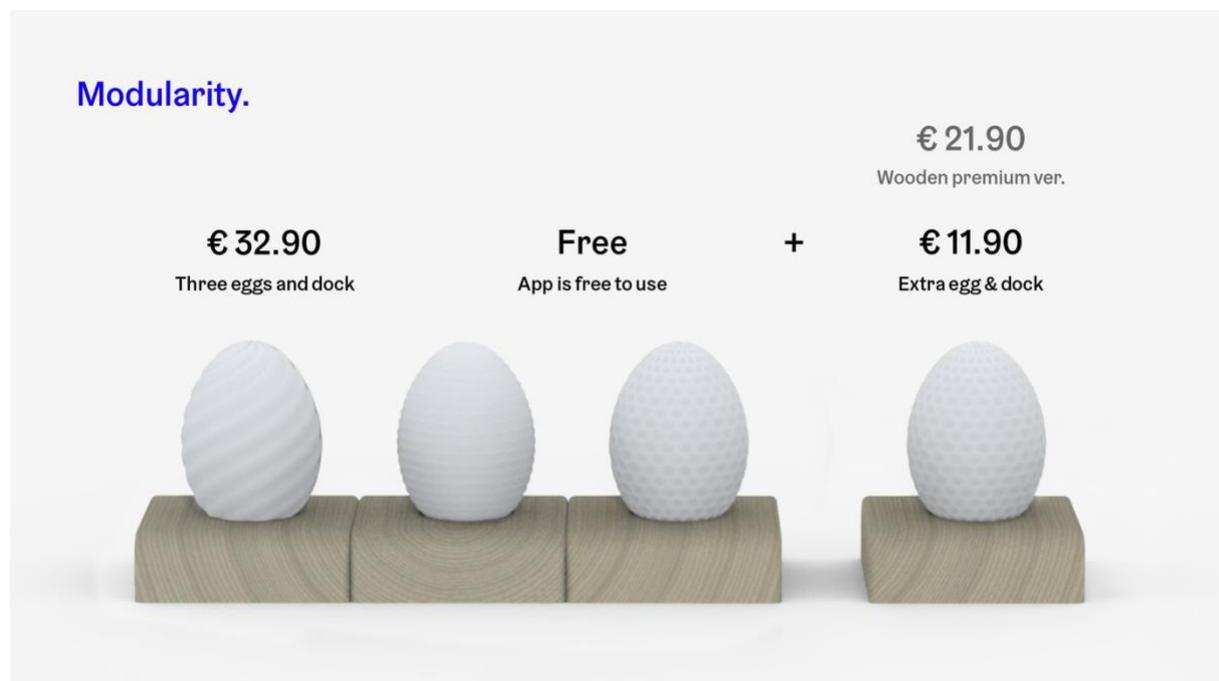


Figure 20. Products sold and pricing options

Estimating the viability with the pricing illustrated in FIGURE 20, we would roughly break-even with an annual amount of 28193 individual modules sold (FIGURE 20). Roughly, this would translate into

servicing ~ 2900 families of three. These projections have been made with the assumption of selling only plastic version with relatively low manufacturing costs. We estimated the variable costs by researching various sources and made approximations based on wholesale prices found online.

In addition to variable manufacturing costs, we estimate having fixed monthly costs for manufacturing overhead, marketing expense, salaries (design, marketing, distribution, operations), IT systems (software, internet, licenses, phones, laptops) as well as office space. The fixed cost estimates are based on a typical 4-person startup team of CEO, product designer, engineer and a marketer, each making roughly a 3000€/month salary, utilizing an office space, software needed, computers. In addition, the manufacturing process is set to have a fixed monthly overhead cost. Naturally, startups do not pull salary in the very first phases of their operations, as they build the business to be profitable first, but for the sake of evaluating the possibility to create sustained impact as simply as possible, we think it is fair to estimate profitability with fixed salary costs from the very beginning of operations.

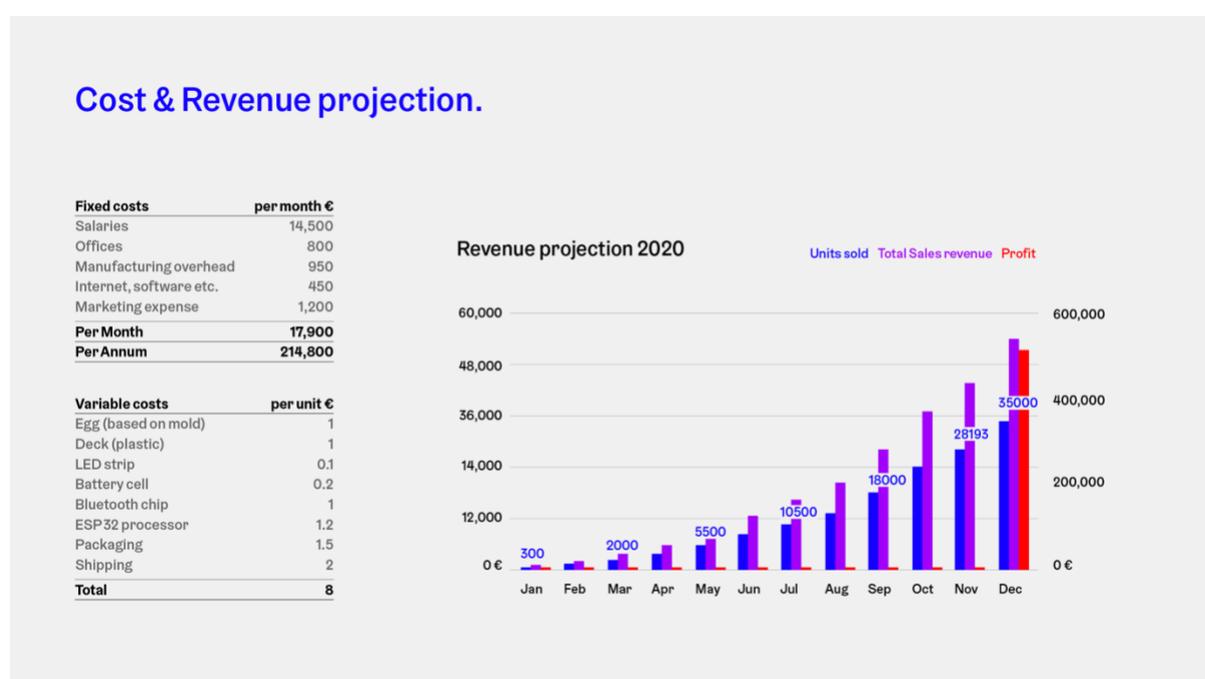


Figure 21. Fixed and variable cost approximations and revenue projections

In addition to the revenue projections for the plastic version, we conducted further revenue projections and analysis for selling a premium wooden version of the base of the product. With the assumption of having 5 times variable manufacturing cost and a higher list price of 21,9€ per module for the wooden base, we would break-even with a lower sales volume of 19826 modules sold, serving roughly 1900 families of 3.

As one might notice, the revenue projections are initial viability assessments for a potential B2C eCommerce business case. Thus, these initial assessments do not take into account the initial seed funding or other funding we would rally for initial investments (namely building the online store and other core operations such as investing in manufacturing equipment). Furthermore, the calculations have been created so that the pricing element can be further manipulated with e.g. mark-up pricing method (Chand, 2014), when more concrete actual cost estimates are gathered for each individual part of the IoT product. In other words, should the actual manufacturing costs of the product be higher for a plastic or wooden unit, we can add the required mark-up on top of the cost-per-unit, to generate the desired profit per-unit-sold.

4.4. Marketing and future possibilities

Finally, to deliver the product to market, we should identify channels that are aligned with our customer needs (Friedman, 2002). For an online store, digital advertising in e.g. Google Search Engine marketing would make sense, targeting advertisements for keywords such as “family chores app” or “family task manager”, which show steady monthly search volumes in Google (Figure 22), and thus, a demand for a solution such as NoEggscuse.

<input type="checkbox"/> Keyword (by relevance) ↓	Avg. monthly searches	Competition	Ad impression share	Top of page bid (low range)	Top of page bid (high range)
Keywords that you provided					
<input type="checkbox"/> family task manager	90	Medium	–	EUR1.41	EUR9.86
<input type="checkbox"/> family to do app	40	Low	–	EUR0.59	EUR3.11
<input type="checkbox"/> household task manager	10	Medium	–	EUR5.59	EUR11.01
<input type="checkbox"/> motivating kids to clean	–	–	–	–	–
<input type="checkbox"/> task manager for family	–	–	–	–	–
<input type="checkbox"/> family chore app	480	Low	–	EUR0.47	EUR1.46
Keyword ideas					
<input type="checkbox"/> family to do list app	170	Low	–	EUR1.01	EUR5.06
<input type="checkbox"/> best family chore app	110	Low	–	EUR0.66	EUR1.80
<input type="checkbox"/> todoist family	50	Low	–	–	–
<input type="checkbox"/> best chore app for family 2018	50	Low	–	–	–

Figure 22. A glimpse on potential Google search words volumes, competitiveness and CPC (cost-per-click) advertisement bid related to NoEggscuse product (Google Ads Keyword Planner, n.d.)

In addition, showcasing our solution to people who are seeking solutions on Google, we would team up with relevant industry influencers, such as mommy bloggers to create product reviews and other similar content to help us reach our core audience, generate demand and awareness for the product. Since the product is a physical lighting system, seasonal marketing campaigns can also be designed to encourage, for example, holiday Christmas gift giving spirit within families to boost sales.

In the future, the business model has various aspects on expansion we believe can foster a bright future potential (Figure 23 below). Firstly, we could expand the software offering side to bring more premium-like features into the to-do app and especially the egg-shape. One can imagine a Tamagotchi like virtual pet, your egg, that you can customize and take care of by managing household chores.

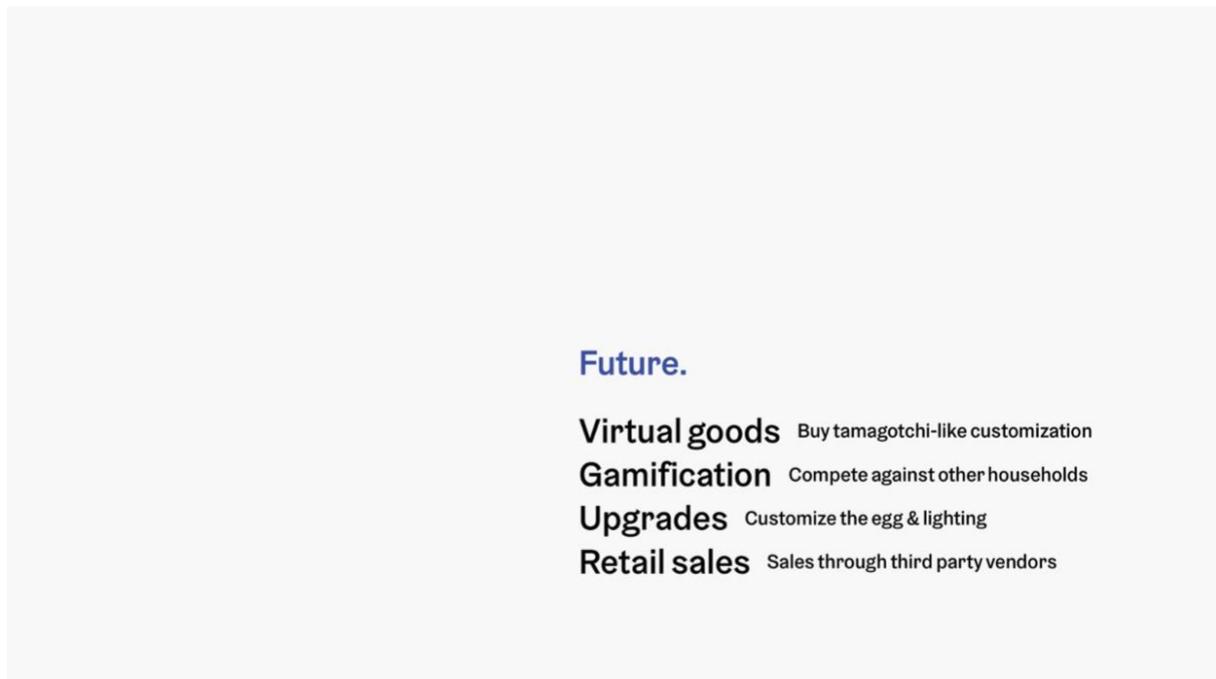


Figure 23. Future possibilities of exploration and expansion

Further digital gamification can also be a viable path forward. Secondly, we believe the gamification could be extended even beyond the single household, to host, for example, the national cup of household wars in Finland, in terms of cleanliness rate or tasks completed. In addition, as the surfaces of the egg are thought to be tailored, we could introduce further customization of the physical product, namely the surface and base materials. And lastly, we might partner up with 3rd party vendors, as we scale the business further, to reach families in the channels they are used to visiting, such as selling through Stockmann, SOK, Kesko and other national and international retailers.

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