DEPOSILIGHT

CLEAN TO CREATE

Eindhoven University of Technology, Bachelor College Major Industrial Design,
DPB100 Project 1 Design, *Light to Touch,* 2019/2020, Semester B

Team *Light to Touch* 2E

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INTRODUCTION

Trash is a problem in many public spaces. According to research, train stations are considered as one of the most polluted ones, which makes people less comfortable (Milieu Centraal, 2015). People do not feel connected to stations which makes them feel less responsible. Our goal is to make everyone take responsibility together by cleaning up their own trash.

To reach this goal Deposilight was created, an interactive trash can that uses light animation to stimulate people to clean up their trash. The design is created for the theme “Light to Touch”.

When trash is thrown away by someone, direct positive feedback is given by a triangle that goes up. This piece fits into a larger picture at the top of the trashcan. Every time something is thrown away, the picture becomes increasingly visible. This way, the small action of cleaning has a bigger purpose that can only be achieved if people work together.

In this report the design process that led to Deposilight will be explained. During the process three iteration phases were finished. Every iteration consists of three phases: Ideation, Realization and Validation. These will be shown by the yellow lines in each iteration. The process picture on the next page illustrates the complete design process. This will also be used as a supporting timeline throughout the report, in which the arrow visualizes the moment of action in the iteration.

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INTRODUCTION

As a starting point for the project 'Light to Touch', different spaces with special lightning conditions were analysed. The majority of spaces that came to mind were spaces where there isn't enough light. For example places like a dark forest, a stairwell or cyclists driving without light. After further discussing the space of traffic, it became clear that there were a lot of different spaces within this topic. By comparing a village with a crowded city, daytime with night-time and by comparing different vehicles, the space of public transport became the space to focus on.

For the pressure cooker, the space in the train itself was chosen because it was very relatable to our own lives. Also, the passengers of the train don't need to focus on anything of the outside world, because they are not driving themselves.

When thinking of trains, the experience of the group is that people are very individualistic. For example by listening to music, watching a movie or reading a book. Initially people don't get in contact with others, but if something happens people tend to make contact. For example if there is a drunk man, everyone will keep an eye on each other. They feel the shared responsibility to create a safe space for everyone.

Secondly, the experience of the group is that passengers prefer to sit in a clean environment. For example if there is trash left people tend to sit somewhere else. When people have found a spot, they will settle in. They might take their jacket off, pack out snacks, put their foot on another chair or put their OV-chipcard away. When they arrive at their station, people tend to forget their trash or to clean up the chair where they put their feet.

IDEATION & CONCEPTUALIZATION

For the ideation process, different questions were formulated to give insights and ideas about the problem at hand. The first question was: *What are reasons for people not to sit somewhere?* Based on personal experiences that determined the mood of the train environment, the following insights stood out:

- Chewing gum.
- Graffiti.
- Garbage / full and dirty trash cans.
- Dirty looking chairs.
- When having to touch the seats with bare skin (in summer).

The following step was to come up with solutions for these reasons by answering two questions: How do we know when the train is dirty? How can a train be cleaned? Ideas that came to mind were things like measuring the amount of bacteria and using a light to show if the chair is clean or dirty, a button to give travellers the opportunity to rate the cleanliness of their chair, a light that kills bacteria or an automatic chair cleaner.

It became clear however, that these solutions do not solve the problem at its core. The core problem is that people leave the train dirty. Therefore, the question that really needed to be answered was: How can you make sure that people do not make the train dirty? This resulted in three main design directions:

- Show people how clean the train is when they come in.
- Create a more personal atmosphere so people feel connected to the space and take it into account better.
- Show people that they are making the train dirty.

These directions were analysed by looking at the potential it would have to make a real difference in making sure people do not make the train dirty. The first two options were disregarded because showing people how clean the train is when they come in might have the opposite effect of people becoming careless if the train is not clean to begin with. Creating an atmosphere to make people feel at home could make people feel more responsible, but in practise it is really difficult to create a space where multiple people with different backgrounds, opinions and values feel at home. The last option, showing people that they are making the train dirty, was chosen because it focused the most on addressing unwanted behaviour directly and immediately. This way, only the people who do something 'wrong' are confronted and it gives them the opportunity to change their behaviour immediately and be more conscious about it the next time they enter the train.

Different ideas were listed to *show people that they are making the train dirty*:

- Light that changes colour when something gets dirty.
- Emphasize stains using light;
  A stain that keeps growing until you stop the dirtying behaviour.
- Highlight 'wrong' behaviour (feet on a chair, leaving garbage) with light;
  Spotlight, led strip at the front of each seat.

Again, the analysis was based on the potential it has to make a real difference in making sure people do not make the train dirty. The idea of the spotlight was chosen because expectations were that this concept would have the most potential. The spot would highlight actions like putting your feet up on a chair or leaving trash behind, which would enable the user to notice their specific behaviour that is unwanted. That way, people are immediately confronted with their behaviour which gives them the opportunity to solve it. The individualistic atmosphere in trains will put pressure on this because people do not actually want to be in the spotlight. This could also prevent it from happening again in the future, which would thus change the behaviour and tackle the problem at its core.

REALIZATION

A prototype was needed to explore different options of light and to validate our concept later on by doing an exploration test with possible users. While making the prototype, it was hard to find a light that was bright enough to show a spotlight in the daylight.
A flashlight was the best option, because it was bright and easily movable. The flashlight would be put on if a user put his feet on a chair, or if trash was left on the side table.
A setting was built to resemble a small compartment of the train, to more clearly show how the product would work in a real-life situation.

Figure 1: Prototype "feet on chair"

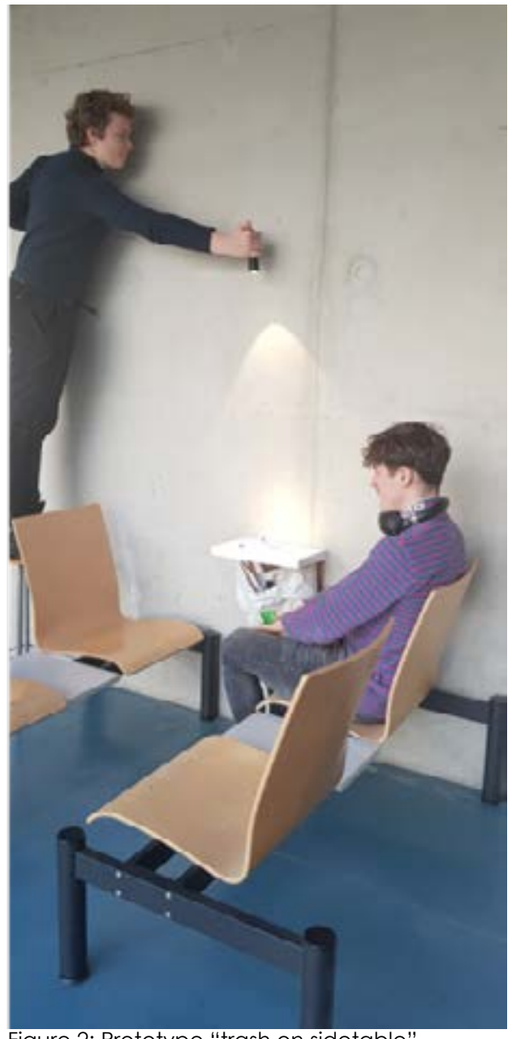


Figure 2: Prototype "trash on sidetable"

VALIDATION

EXPLORATION TEST

The prototype (see figures 1 and 2) was used to carry out an exploration test. The goal of the exploration test was to gain insights in how users would react to the signal of the spotlight. To achieve this, the exploration test was carried out separately for each of the participants according to the following steps:

1. The participant is told an introduction story. They have to get on a train in Eindhoven and depart the train when it arrives in Utrecht.
2. The participant receives a wrapped candy bar and is asked to get on the train. An outsider of the exploration test is already on the train.
3. The participant will eat the candy bar and is left with the trash of the wrapper. It is their own choice what to do with it. (Throw it away, take it with them, leave it on the side table).
4. The train arrives in Den Bosch and the outsider leaves his candy wrapper on the side table before departing the train. The flashlight will go on to highlight the trash. This is done to ensure that participants are confronted with the concept, even if they clean up their own trash.
5. The participant can react to the signal and their behaviour can be analysed.
6. The train will arrive in Utrecht and the participant can depart the train.

The full analysis of the exploration test can be found in appendix 1. Overall, the participants were positive about the idea and were curious about how this would work in a real situation of a train. However, it became clear that the concept was not tackling the problem at the cause, because it confronted the participant with the trash our team member left. This could be shameful for the people who did not do anything wrong. This could eventually even lead to those people not wanting to clean up their mess too.

PRESENTATION

A video was used alongside a pitch to clarify how the concept would work in everyday situations in the train. This is shown in figure 3 and 4. The full video can be found by clicking on the following link: https://youtu.be/Ic5yqaGwRWI

Feedback that was given after the presentation was that the design should implement more direct feedback to the people who don't clean their tables. Another tip was to take a look at positive feedback, because with the current idea, people are only getting feedback if they do something wrong. Instead, complementing the user when they keep a space clean could be an option.

Figure 3: Spotlight on shoestain (from video)

Figure 4: Spotlight on trash (from video)

RESULTS

1. The design should give people immediate and clear feedback on the behaviour that is "wrong" or not desired for the cleanness of public spaces.
   This was derived from the ideation process.

2. The feedback that is given should be more directly targeted at the people who do not clean their trash. The problem should not be passed on to others.
   This was derived from the exploration test and the presentation.

3. Positive feedback is also a good way of approaching people. However, the target group for the design are people who do NOT clean their trash. Those people will not be confronted with their behaviour if positive feedback is used. Therefore, positive feedback is should only be used if it can still target the people who do NOT clean their trash.
   This was derived from the feedback discussion after the pitch.

VISION

"Create a product that uses light as direct feedback to encourage individuals to keep public spaces clean."

The goal is to encourage individuals to clean up the mess they made. To do this, people need to be aware of the consequences of their actions. Light should give feedback directly after something happened and directly to the person who did it. This will result in an immediate change of behaviour. The choice was made to design for public spaces in general, because the product can reach more people if it can be implemented in many different spaces.

IDEATION

PAPER TWIST

To start the ideation process, all team members had to write three new ideas on a plain paper. Then, this paper was passed around so every team member had five minutes to add, change or further develop the ideas on the other papers. Once the papers were passed along to everyone and returned to their first owner, all the ideas were discussed.

Ideas like automatic cleaning robots and drones, as can be seen in figure 5, were immediately disregarded because they did not give direct feedback and therefore did not align with our vision. Also, they would not cause people to clean their own trash, because it would have been done for them.

Figure 5: Examples of automatic cleaning ideas

Ideas that needed an app to keep track of a scoring system or rewards for throwing garbage away were disregarded because it was expected that many people, especially people who do not throw their trash away to begin with, would think downloading and using an app is too much effort. For that same reason, ideas that included elaborate games (figure 6) were disregarded, as it was not expected that these would have long-lasting effect.

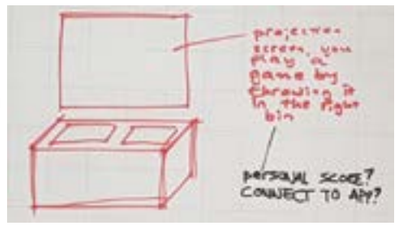


Figure 6: Example game bin

Of course, there were also ideas that had potential. For example, using a visual obstruction that would show up in front of people who did not clean their trash. This could be done with lasers (figure 7) or by using a hologram of the trash that was left, to remind the person of what they left behind.

Figure 7: Visual obstruction

Different forms of highlighting the location of the trashcan were mentioned (figure 8). Also, highlighting people's personal effect on the total cleanness of the space was considered in different ways (figure 9). With this, a community feeling can be acquired if people are aware of the fact that the positive effect their behaviour can have, helps others.

Figure 8: Highlighting trashcan

Figure 9: Highlighting the trash

IDEATION

FOUR CONCEPT POINTS

The paper twist brainstorm resulted in general requirements that the concept should meet. According to these requirements, four mind maps with the following themes were created: 'Direct feedback', People have to clean it themselves', 'Long lasting effect' and 'Community feeling'. The outcomes of the different mind maps can be found in figure 10, 11, 12 and 13 accordingly.

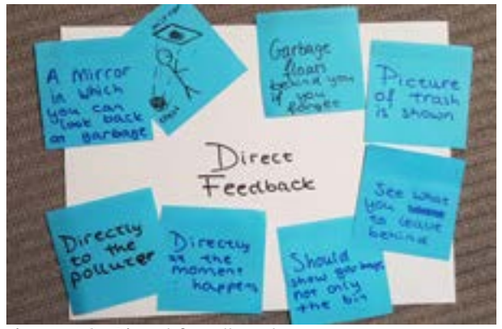


Figure 10: Direct feedback

Figure 11: People have to clean it themselves

Figure 12: 'Long lasting effect'

Figure 13: 'Community feeling'

When working on the different mind maps, it was quickly noticed that 'Direct feedback' and 'People have to clean it themselves' are closely related. Only if feedback is given directly to the polluter, directly at the moment they leave their trash behind, can they be encouraged to clean it themselves. An idea that came up, which elaborated on ways to show people what they left behind, was to use a mirror in which people could look back at the table (figure 14).

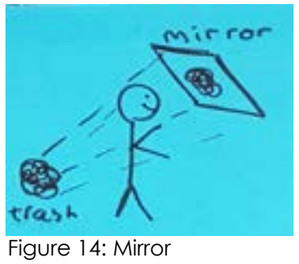


Figure 14: Mirror

The outcome of the mind map 'Long lasting effects' contained opposites because on the one hand, the product should be subtle so it does not disturb people who do nothing wrong, but on the other hand it should get attention and should not be easily ignored. Also, it should make people curious. The best potential for this to work on a long term was to give the product variety.

Lastly, even though it would be nice if a community feeling could be acquired through the product, it was realized that this should not be the most important requirement. People who leave their trash behind in the first place do not think about their environment and the community. Therefore, a community feeling will most likely not encourage them to throw away their trash.

IDEATION

BODYSTORMING

Bodystorming was implemented during the ideation process by having one team member to play someone who left their trash, while another team member played the product and did everything but speak to try to get the first person to clean the trash.

Figure 15: Bodystorming examples

The most important take-away from the bodystorming session was that, as you can see in right picture of figure 15, our ideas would not work if people do not look back at their initial seat. Therefore, the design should have a feature that makes people look back at their trash, which might cause them to walk back as well.

SKETCHING

Sketching was used as a brainstorm technique to envision how a potential product could work in different public spaces. Everyone took turns of a few seconds to add something new to the drawing. A train environment (figure 16) and a cafeteria environment (figure 17) were used as scenes. An idea that elaborated on nudging people to walk back, was to project a circle of light around the person who did not clean their trash, with only an opening towards the place they left their trash. This idea was developed from a big river that was drawn around with only a bridge in the direction of the trash to get out (figure 17). Also, the idea of using a visual obstruction was elaborated on, by using a light wall in between the train seats if someone left their trash (figure 16).

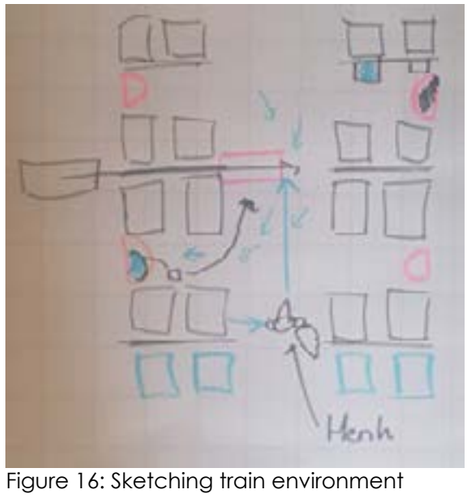


Figure 16: Sketching train environment

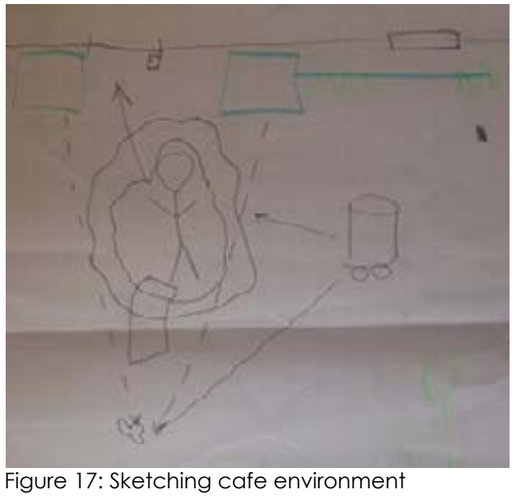


Figure 17: Sketching cafe environment

CONCEPTUALIZATION

When analyzing the ideas, it turned out that the pressure cooker concept could still be a good solution to the problem. However, this concept does not take into account that people do not always look back after leaving their seat. Therefore, the idea of a light circle with one visual exit was looked into. However, this design would not work in a busy space, because when many people stand together it would not be visible. Then, the idea to create a visual obstruction was looked into. This idea was also elaborated on several times which brought the concept of projecting the trash the person left in front of them. This could remind the user of what they left behind. Also, it gives variety because the picture always shows the trash that is currently on the table or chair.

The question remained, *how can the trash be projected in a way that clearly hints to the required action (cleaning up)*? This was solved by combining the idea with the concept of creating a game above the trash can with a screen. The idea of a game itself was disregarded because it would not fit the target group, but placing a screen above the trash can seemed like a good way to get the attention of the polluter. This screen could depict a live image of the trash that is left behind, which make it personal and direct. This will also cause it to be effective for a long period of time. The screen should be clearly visible when someone leaves. By placing it near the exit, the screen will always be seen when people walk out. In trains, this can be executed by using the screens that are already present (figure 18).

By combining the spotlight and the screen, 'Spot It!' was created. The spot will be located above the seats. If someone leaves their trash, the spot will give direct feedback by highlight this and it will clearly show where the trash is left. Because the person is still standing next, it is relatively easy to clean it. However, if the person does not notice the trash and the spots and walks away, they will be confronted with the screen that shows a picture of their trash. This should make them aware of their behaviour and the consequences and they will have a chance to go back and clean up their trash. If they decide it is too much effort to walk back, it might cause them to think twice about leaving their trash behind next time. This way, the problem will be solved at its core.

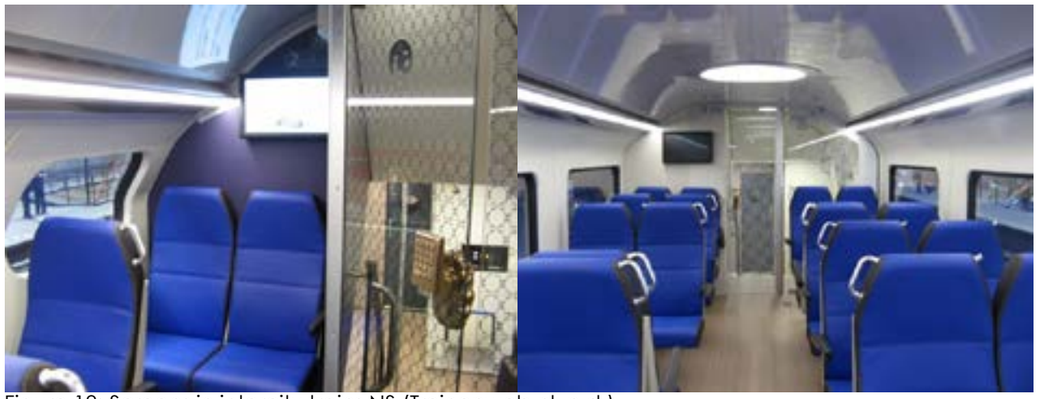


Figure 18: Screens in intercity trains NS (Treinenweb.nl, n.d.)

REALIZATION

A model prototype was made, to show how the system would work together in a public space. The model prototype represents a public eating space. The frame is made of wood and by including the electronics the idea is represented. In the prototype, two buttons are used to represent pressure sensors. One button is located on the table and the other one is located on the chair. The buttons can stimulate a certain reaction as explained in figure 19.

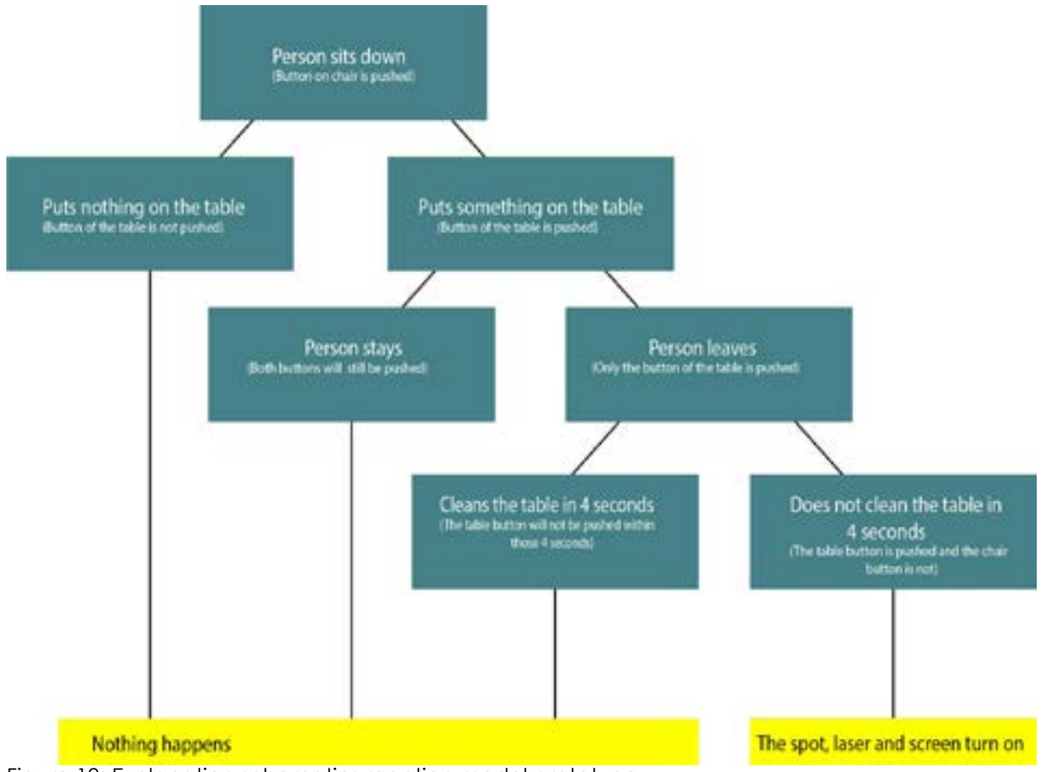


Figure 19: Explanation schematics reaction model prototype

A RGB led was used as the spot and the Waveshare 2.7 inch e-paper HAT was used as the screen that shows the trash that is left behind. The screen is placed next to the door, above the trash can. This way, the screen can be seen when people walk out of the public space (see figure 20, 21, 22). Both the buttons and the display were connected to and controlled by a microprocessor Teensy 3.2. The full code that was made to make this work can be found in appendix 2. A stopmotion video showing the functioning of the model prototype can be found in the following link: https://youtu.be/TmIXZLvKhjU.

Figure 20: Prototype

Figure 21: Prototype on

Figure 22: Screen

VALIDATION

USER TEST

A user test was set up to determine the way people would interact with 'Spot It!' and what their opinion was on this experience and the product. At first, the plan was to do this user test with a life size prototype in a setting that would match the setting in which the product would be implemented in reality. However, due to the Covid-19 situation the user test had to be altered to an online format.

The first part of the user test was focussed on enabling users to interact with the product in an online setting. To do this in a way that resembles reality, a simulation consisting of multiple short videos in a cafeteria was created. After each video, the participants were asked to choose between several follow up actions which determined how the system would react and what video the participant would get to see next. This is summarized in the diagram shown in figure 23. The analysis of the answers is shown by the numbers in the red circles, they depict how often a certain choice was made. The first step was disregarded for the analysis, as this was only used as an introduction for the participants. A total of 55 people participated in the user test.

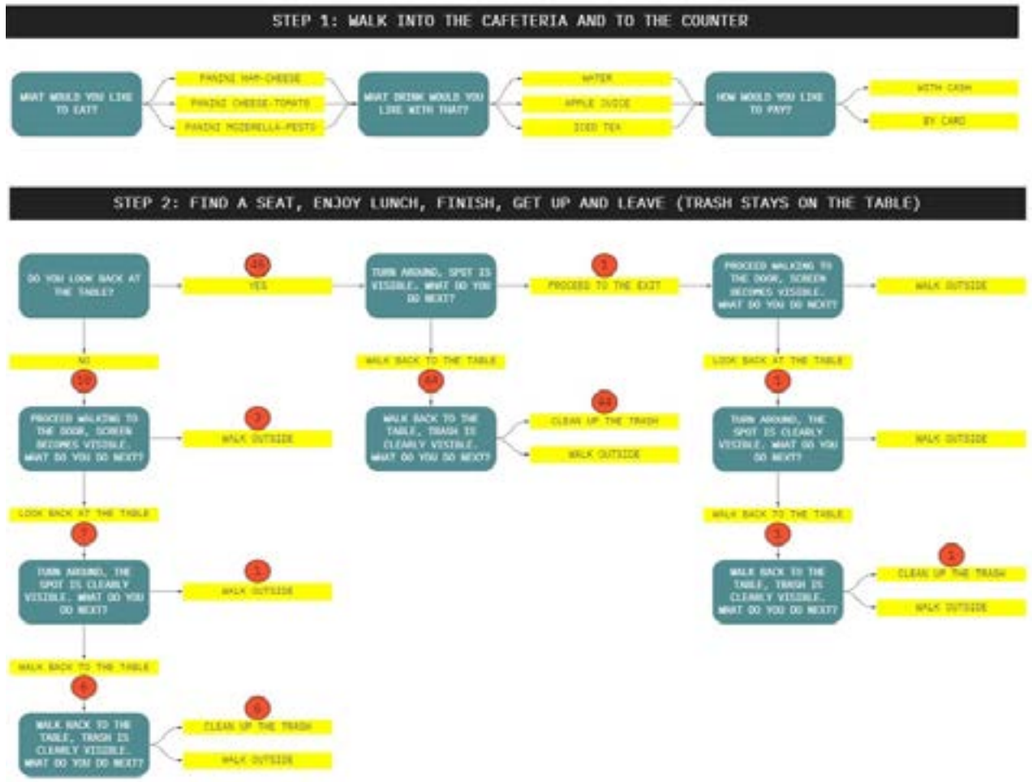


Figure 23: Summarizing schematics for part 1 of the user test

The second part of the user test consisted of an explanatory video and questions about the entire product, to gain overall insights in the experience and the opinion of users. Inductive analysis was used to categorize the answers and find different themes. In addition to this, interesting comments made by the participants were highlighted. In combination with part 1, this was concluded in an elaborate conclusion that can be found in appendix 3. The following list summarizes the analysis and gives a list of questions that can be regarded in the third iteration:

VALIDATION

- What is the best moment and time duration to give feedback to the user?
- What is the view of cleaners on 'Spot It!' or a developed version of the product?
- What is the effect of a cleaner space? Are people more likely to enter a clean space? Do they feel more comfortable? Are they inclined to stay longer?
- How would a concept like 'Spot It!' work in a busy environment?
- What kind of feedback is effective and stays effective for a long period of time?
- Why is trash left behind in public spaces?
- Is the product relevant in spaces like a restaurant? Other spaces might have more problems regarding trash.

BUSINESS PLAN

The business plan discusses three possible markets for 'Spot It!' (catering & canteens, fast food and public transport) and it covers the following aspects:

- 'Service offered', a description of the unique selling points is given, which include more customers due to a cleaner space. Besides this the cleaning cost will decline, due to the need of less cleaners.
- 'The market analysis', an overview of the statistics regarding the possible market 'Spot it' would join.
- 'The implementation strategy', explains how 'Spot it' could be implemented in the world, yet it isn't ready to be released into the world yet.
- 'The financial plan', an overview of all the (potential) incomes and expenses.

The full business plan can be revised in the pdf (https://drive.google.com/file/d/1jso9o-Qc_U-0rSXUlcHVl6jTyLhYreF8s/view?usp=sharing).

The business plan gave useful insights about the concept, for example, the fact that the corona crisis creates a lot of uncertainties for the food markets(FoodService Instituut, 2020). This means that most companies in this market will be more cautious about making investments. Another aspect that became clear, is that smaller companies would have relatively low advantages by the product, which makes an investment from smaller companies less likely. This is mainly the case because they don't have personal specific for cleaning, instead they train the staff members who sell the products to clean afterwards.(Stocco, 2011). This means the profit from reducing cleaning expenses will be minimal and the staff is still needed when everything is cleaner because of "Spot it'. Secondly, this is because "Spot it" needs to be implemented first. This will be different for different furniture, so for every individual company a little investigation is needed, costing both money and time.

Besides those topics noticed that an alternative instead of the pressures sensors might be a better option. This is because the pressure sensors need to be implemented in every chair and table separately. This is not only quite expensive, given that part of the furniture needs to be adjusted, it is also time costly, meaning that the company will be without revenue for a bigger amount of time. For the created design at this moment it is not only necessary to use a way of detecting trash and people, but also a camera for making a picture of the trash. It will become cheaper if the camera can be used for multiple goals, for example the detecting. Another technical aspect requiring looking into is the communication. While think about how everything would be installed, the conclusion was drawn that making everything wired will be a difficult and time taking job. This means a wireless solution needs to be found. By making it wireless, the implementation will become a much easier job.

VALIDATION

MIDTERM DEMO DAY

For the midterm demo day a presentation consisting of the following parts was prepared:
- A poster the describe the product and attract the public (appendix 4).
- An explanatory visual (figure 24).
- A video pitch (https://youtu.be/BknRS3dJbzk).

The feedback that was given on the presentation provided us with useful insights in what elements of the design needed clarifications, improvements or additional research:
- It should be clarified with what type of technology the trash would be detected.
- Research should be done to find out for what reasons people leave their trash. This could help to target the right people.
- Cleaners that have to work alongside the product should be considered.
- Would other sensory stimuli (e.g. sound) get extra attention?
- Is the system reusable in different public spaces?
- The product should (also) incorporate positive feedback.
- The product consists of two parts, because either one of them is not effective enough on its own, how can this be improved?

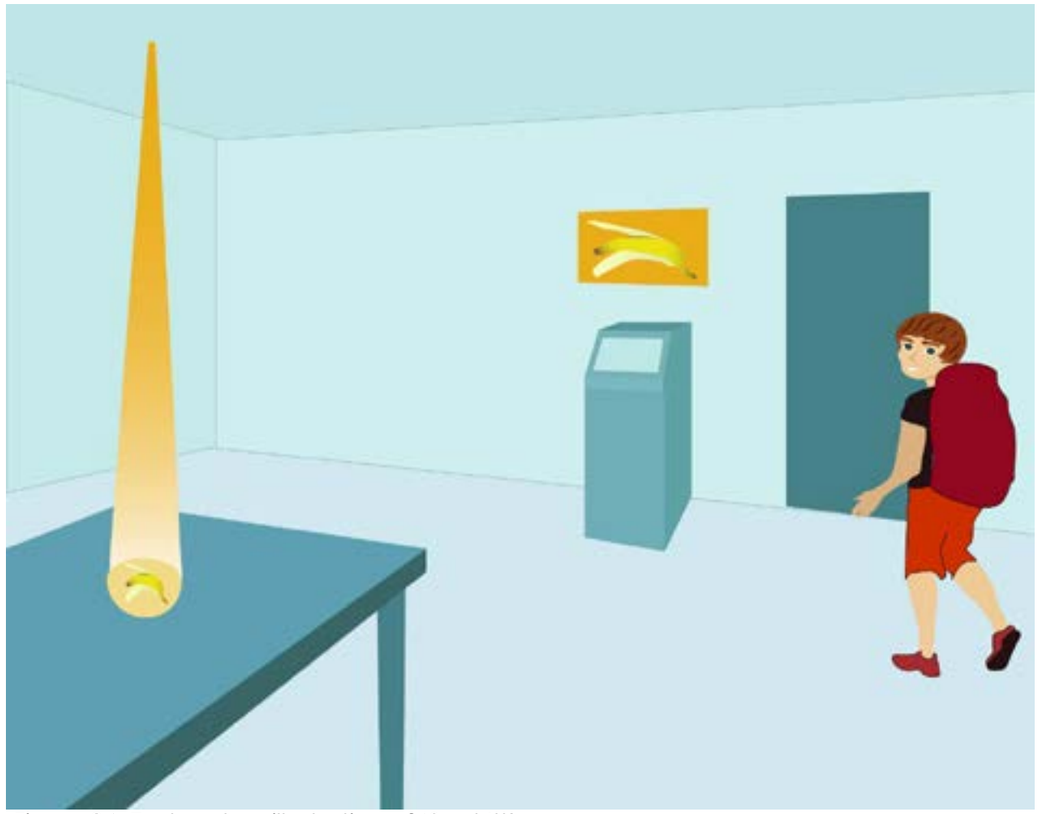


Figure 24: Explanatory illustration of 'Spot It!'

RESULTS

1. The design should give people positive direct feedback. After the first iteration, it was decided that giving positive feedback would not be the main focus because it did not fit our target group. During the second iteration however, it was realized that it is difficult to encourage and motivate people to clean up the mess they made, purely with direct feedback. This is because people can perceive this feedback as negative or pedantic.
   This was derived from the feedback discussions after the pitch of iteration 1 and the midterm demo day.

2. The design should be usable even if people do not look back at their seat.
   This was derived from the ideation process of iteration 2.

3. The design should be functional in busy and crowded environments. Also, the space that the design will be implemented in should be revised because the trash problem is less relevant in spaces like a cafeteria.
   This was derived from the user test that was done during iteration 2.

4. The design should be easily implementable in the environment without changing the environment too much.
   This was derived from the business plan made during iteration 2.

5. The concept should be one design. It should not consist of two seperate parts. This only shows the shortcoming of the effects of the individual parts. However, the results of the user test showed that choosing one of the parts and transforming it to a finished design, would not be good enough to prevent the whole problem.
   This was derived from the feedback discussion of the midterm demo day.

VISION

“Create a product that uses light as positive direct feedback to encourage individuals to keep trains and their surroundings clean.”

The goal is to motivate people to throw their trash away instead of leaving it behind. To achieve this, people have to become aware of their behavior. Positive direct feedback will be used to motivate and encourage individuals. Regarding the space, the decision was made to narrow down from “public spaces” to “trains and surroundings”. This is because the space is self-contained which makes it more important that people take responsibility by themselves to keep it clean.

IDEATION

To get new inspiration and new ideas, a different perspective was used as a brain booster. This was done by choosing an animal (figure 25), naming its characteristics (figure 26) and using those as a starting point for new input to solve the problem at hand (figure 27 until 31).

Figure 25: Animal brainstorm of 2 minutes

Figure 26: Characteristics penguin

Figure 27: Characteristic Herd Animals

Figure 28: Characteristic Funny

Figure 29: Characteristic Hot & Cold

Figure 30: Characteristic Black & White

Figure 31: Characteristic Caring

IDEATION

From this brainstorm, two main themes could be recognized: *cleaning for a bigger goal* and *connection with other travellers*. These themes were chosen because they came back in a lot of the ideas and were very relevant during the Covid-19 situation. The situation brings out the 'stronger together' feeling and people are more inclined to help others and to connect with each other. It was the goal to use this feeling and reinforce this in the concept focussed on encouraging people to throw away their own trash. Again, mind maps were created to summarize the ideas that came up. These can be found in figure 32 and 33 accordingly.

Figure 32: Cleaning for a bigger goal

Figure 33: Connection between travellers

Because the ideas of the animal brain booster were quite diverse, a new brainstorm method was done. This brainstorm was done to get a breakthrough in our ideation. Ideas that were generated in this brainstorm were a table that would light up when it's clean and the train arrives at the station (figure 34), linking a point system to cleaning to save for discounts (figure 35), or leaving a message for the next person on the back of a chair (figure 36). Another idea was showing the line of a heartbeat on a trash can (figure 37). To keep the heart alive, trash should be thrown away. This idea stimulated people to work together to get a good result, but it also gave a bad outcome if people didn't have any trash to throw away.

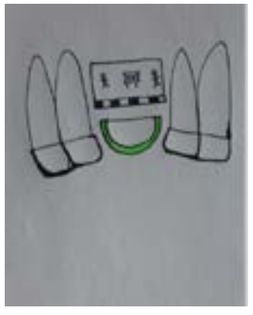


Figure 34: Table

Figure 35: Discounts

Figure 36: Message

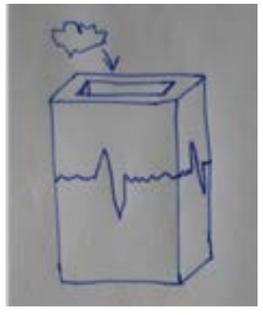


Figure 37: Heartbeat

IDEATION

BACKGROUND INFORMATION

Firstly, the current cleaning system in trains was researched. Hago Rail Services cleans the trains and does this in the following ways (Hago Rail Services, 2020):

- During intermediate stops approximately four times a day. The train stops for a short amount of time so only the toilets and visible trash is cleaned.
- Every night, the trains are cleaned performance oriented. This means that only the places which are considered dirty are cleaned.
- An intensive clean up is arranged every three months for each train. Everything which can not be cleaned during the night shifts will be cleaned now, such as attached dirt and the windows.

Of course, this system is focussed on cleaning afterwards instead of solving the problem at its core. To learn how much change a product would make that does target the core of the problem, Hago will be contacted. This will give insights in how much of the work they do regards to trash.

Also, products that are already on the market were considered. There are many products designed to stimulate people to throw away trash and by analysing what makes these products (in)effective, useful insights can be gathered. In addition to that, it is important to check if you are not designing an already existing idea.

Holle Bolle Gijs (figure 38) is a trash can that gives children a small positive reward in the form of sound for disposing trash, which makes it fun to do (Efteling, 2020).

Brightbin (figure 39) also gives positive rewards. It is a universal add-on for public waste bins that uses light and sound as a reward (BrightBin, n.d.). This makes throwing away trash more fun and it makes people aware of their behavior, something that aligns very well with the project vision.

While searching for interactive trash cans 'Ecosia' was used. This is an internet search engine which uses the profits of advertisements to plant trees. They create an atmosphere where people see that small actions can have a big impact, by using a counter (figure 40). This can be used in the project by linking throwing away trash to a bigger goal, which could motivate people more.

Figure 38: Holle Bolle Gijs (Efteling, 2020)

Figure 39: Brightbin (BrightBin, 2019)

Figure 40: Ecosia counter (Ecosia, n.d.)

Lastly, scientific research was done to products that influence behaviour. An interesting paper was found about using ambient displays to nudge people to take the stairs instead of the elevator. The paper concluded: "there are benefits of using ambient displays to encourage people to adhere to certain kinds of desired behaviors." (Rogers, Y., Hazlewood, W. R., Marshall, P., Dalton, N., & Hertrich, S., 2010). This makes it interesting to look at ideas that unconsciously influence the behaviour of people or only give a small reward.

CONCEPTUALIZATION

In the ideas generated, a selection was first made to extract the ideas that would give positive feedback. Ideas such as review systems or marked chairs based on how clean it is were filtered out because of the negative feedback. This was a quick way to make a smaller selection of the many ideas.

During the brainstorming sessions, the aim was also to connect other passengers. Ideas such as a “kletspot” or chairs with light that forces someone to sit next to someone else. Ultimately, the choice was made not to shift the focus here. But the goal was to tackle the trash problem.

The various ideas and techniques that remained after the rough selection have been thoroughly reviewed by the various positive and negative sides (see appendix 5 for all the results).

Everyone was enthusiastic about the idea that people save for a bigger whole. That is why the concept called ‘Charimate’ (Charity + Animate) was created. This concept was inspired by the website ecosia (https://www.ecosia.org) and it makes sure that people save together for a bigger goal, for example a charity. With this product, every time trash is thrown away, people support charities. The costs that normally go towards cleaning the train will now be used to support these charities. To achieve this the idea is to sow an animation on the wall and the ceiling. The location of the ceiling was chosen because this place is clearly visible from different seating areas. This ceiling visual will remind people to clean up the trash. The visual on the wall is intended to give people positive direct feedback to show that they support the charity. The visuals can be adapted to the relevant themes of the charities, in this way the visualization can always remain relevant.

Explanatory video: https://youtu.be/vqYzlEpqcRU

REALIZATION

Charimate consisted of two projections. The first is a projection on the wall above the trash can. It starts moving from the trashcan to the ceiling,when something is thrown away. The second projection is visible on the ceiling and when the wall image reaches the ceiling, the large projection changes. Animations were made to visualize this, they can be found using the following link: https://www.youtube.com/watch?v=Cpn72V-ivNc.

Initially we planned to use beamers for the projections. Those beamers would be placed such as shown in figure 41. Because the train is a busy environment, people might stand between the beamer and the place of projection. Because of this, other options such as placing the beamer in the trash can (figure 42), were considered.

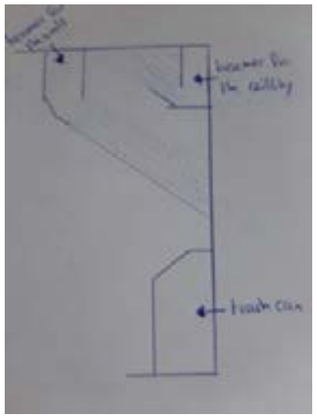


Figure 41: Beamer placement

Figure 42: Alternative

During prototyping it became clear that beamers are relatively expensive. An alternative was created for the projection on the ceiling by using a lens (DIY Perks, 2017). The workings of this are summarized in figure 43.

Figure 43: Step by step workings of the lens. (Arduino, 2020)(Processing n.d.)

To recognize the trash a proximity- and motion sensor will be used. The sensor will be connected as shown in figure 44 and the processing and arduino code can be found in appendix 6 and 7 accordingly.

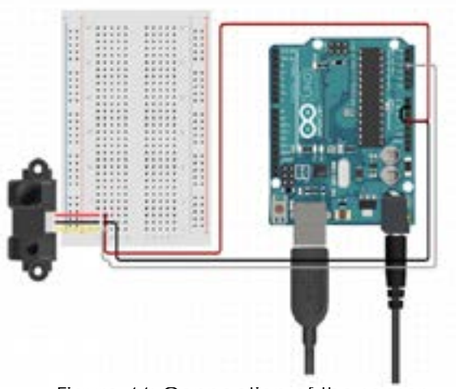


Figure 44: Connection of the sensor

REALIZATION

For the moving projection another alternative has been tested. This alternative consists of a bright light source which will be placed behind a cut-out shape. The light beams which pass the cut-out shape will create an image on the wall (figure 45).

Figure 45: Testing cut-out techniques

The image is only visible when the cutout shape is near the wall or when a lens is placed right behind or before the cut out shape. The lens will be used to display the image on the wall. To move the image, the cut-out frame will make a movement by means of a servo motor. This will work as shown in figure 46.

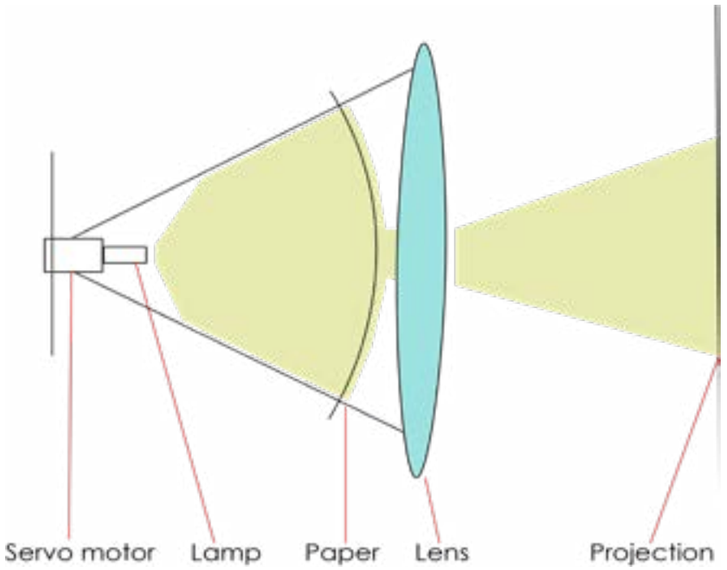


Figure 46: Functioning of the cut-out frame with a servo motor

VALIDATION

USER INTERVIEWS

Multiple user interviews have been conducted, to get more in-depth insights on how the product would be used. Illustrations (see figures 47 until 50) were made to explain to the user how the product would work in the situation of a train. There were three sections of the interview: demographics, questions about trash in trains and questions relating to our product. The full list of questions can be seen in appendix 8.

Figure 47: The red cross goes up because a person who just left the train threw something away

Figure 48: A big heart is projected on the ceiling

Figure 49: Trash is throw away, a red cross rises

Figure 50: The red cross merges with the heart. The heart beats once. A small donation is made.

VALIDATION

The participants of the user interviews remarked that the trash cans that are in the train are often full. However, NS uses small trash cans in the train on purpose to stimulate travelers to take their trash with them and throw it away in a trash can on the station (NS, 2018). While asking the participants about this option, most of them said they would take their trash with them if there was a more fun way to deposit their trash at the station. One participant said that in combination with smart sensors, it would also be easier to report information, like when the trash can needs to be emptied, to the cleaners.

Something else that was mentioned by participants multiple times, is that it is important to take recycling into account. This is also something NS and ProRail are already working on. All participants thought it was an advantage that they were not obligated to focus on the environment around them and that they could do their own activity while traveling by train. On the contrary, a disadvantage of traveling by train was that the train is often crowded, which could complicate the use of the product. Furthermore, the participants were motivated to clean up by seeing the animation. They liked the idea of being a part of a bigger goal.

"I like your design, because it makes me see the effect of my own action."

Nevertheless, it was not clear that money would be donated to charity by cleaning up. This could be an extra stimulation if the design explained this clearly, but participants also said seeing the animation was already very nice. Also variety was a must to keep the design interesting and motivating.

"I think that when the newness of the animation is gone, it will no longer be widely used. But if the animation changes overtime, you might want to try again."

From the user interviews, the following can be concluded:

- The train station might be a better option for the product. It is more valuable for NS, because people take their trash with them.
- The product should not counteract recycling.
- The product should not be too outstanding, in order to let people do their own activity on the train.
- A crowded space should not be an obstacle for using the product.
- Users liked the idea of being part of a bigger goal.
- Donating to charity is nice, but isn't necessary to stimulate cleaning up.
- The product should be clear on itself. A QR-code or a video in the train can make the concept more clear, but this won't be used a lot.
- There should be a variety in animations.

ITERATION 3

VALIDATION

EXPERT INTERVIEW

A conversation with a light expert was done to get a deeper understanding of how the projections would function in a train. The expert said that there were different lighting rules trains need to meet. Because there is a lot of light, there aren't many options to work with external light in trains, causing the projections to be unusable. Choosing another environment for our product might be useful, but the main advice was to try a lot of different things with light. From our experts opinion, light always turns out to behave differently than you expect, sometimes worse, sometimes better. An example to try out was to use a lightbox instead of projections. Shining light through a template, like what was done with the prototype, doesn't give a clear view on a wall, but it might give a clear view on a paper that is placed in front of the template.

Besides this, the product was based on saving money on cleaning costs and donating this to charity. However, there was no hard evidence this would level the costs. Especially in these times with Corona, hygiene is more and more important. The advice was to get to know the market better to justify the idea. To make the product financially more feasible, the animations can show companies NS already sponsors, instead of donating money to a charity.

Conclusions from the expert conversation:

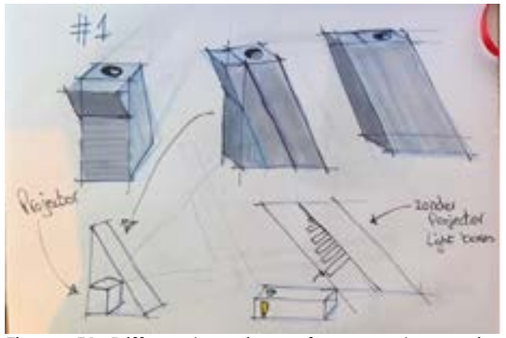
- Projections will not work in a train, because surrounding light is too bright.
- Switching to the station might be a good option, but the surrounding light should still be kept in mind.
- A lot of testing should be done using light. A light box should be tested in such a way that is closely resembles how it would function in reality.
- Thought should be put into what the bigger goal of the product can be if it's not donating money to a charity. It should be in line with the vision.

IDEATION 2.0

Based on the gained insights from the prototype, the user interviews and the expert interview, the decision was made to do another ideation session. During this session, focus was put mostly on train stations instead of the train itself. This was based mainly on the lighting regulations that have to be kept in mind in trains and because the product can reach more people while less installations are needed. Also, the plan to use savings for charities was let go because it would most likely not raise enough money to actually realise this. However, "Charimate" also had features which were worth keeping. Using an animation was a good way of drawing attention and many participants of the user test mentioned that they liked that their contribution of a small image added to a bigger picture. Even when they did not know the bigger meaning behind this. It draws attention for a bigger crowd, yet at the same time adds a personal feeling for the person throwing away the trash. By working together on a bigger picture, a community feeling gets created as well.

The brainstorm session was based on keeping these good aspects of "Charimate" and creating new ideas while keeping the necessary improvements in mind. First, general requirements were set. To keep people interested, the full animation should only be visible for people who participate and contribute, while it should also show enough to make people interested in the first place. Also, recycling should be implemented in the design. It was derived from the user interviews that people want to have the option to recycle and it also aligns with the vision of NS and ProRail (Rijksoverheid, ProRail B.V. , & NS Groep N.V., 2018).

Different ideas were proposed to show the animations. For example a peep box (figure 51). This would solve the problem of surrounding light disrupting the projections, because a closed environment is used. Another idea was to display the animation on the floor using a lightbox principle (figure 52) or a light grid (figure 53). The trash can could also have its own vertical wall and overhanging roof (figure 54).



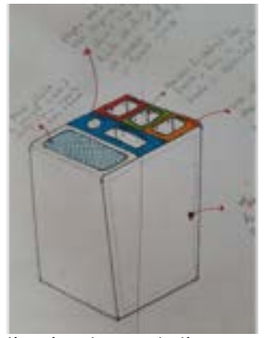
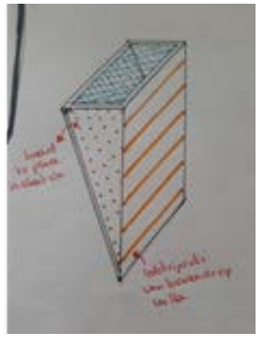



Figure 51: Different versions of a peep box animation implementation.

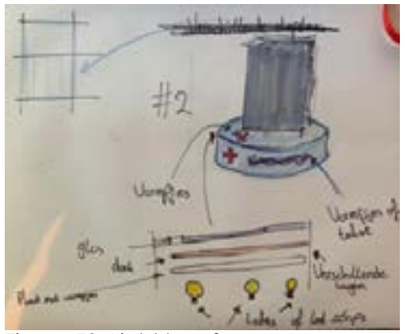


Figure 52: Light box floor


Figure 53: Light grid floor

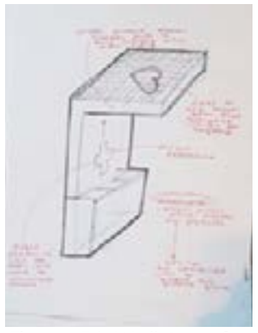


Figure 54: Wall & roof

IDEATION 2.0

Also, different ideas were proposed for the animations itself. It could be used to display animations made by local artists or to show local buildings and monuments. Or it could be used to market companies or events in a special way. It was still important that the animation would provide positive direct feedback each time something is thrown away, while also showing a bigger context. This could be achieved by using puzzle pieces that slowly create a full pictures. These pieces could be shaped like actual puzzle pieces or in a grid of shapes (figure 55).


Figure 55: A grid of shapes

CONCEPTUALIZATION 2.0

Projecting animations with a beamer wouldn't work on a bright location. To solve this, different ideas in the ideation were generated. One of them was the idea to make a peep box (figure 51). With this box it was easy to project something because the daylight won't influence the box so that the projectors are clearly visible. The idea came to make this box into the trashcan so that people only can see the direct feedback when they throw away something. The expectations were that this idea would not solve the problem, because only people who throw something away are able to see the special effect of the trashcan. Nevertheless the idea of keeping a little mystery seemed interesting, because it gives people who do throw away trash an extra impuls.

One of the positive points in 'Charimate' is that people see their own positive impact contributing to a bigger animation. The idea to create something together is further developed. An idea was to create a puzzle by light animations and that every individual contributed with their own part.

Another idea was to use the floor to show animations. The problem was that it will take a lot of space and it is not very good visible, especially when a lot of people are nearby (figure 52, 53). A better option seemed to use a wall or the roof for an animation. The animation on the wall can give this direct positive feedback and an animation on the roof can show the bigger animation. The choice to have a roof instead of placing the big animation on the wall is because of the mysterious effect. From far away people can partly see the visual, which can make them curious. In front of the trashcan the animation can be seen better, so people tend to get closer to the trash can.

The animation will be made by lightboxes, because it can be used in bright lighted stations. This technique is unique compared to normal screens. Normal screens are mostly used in public spaces for information and advertisement. Out of the user test came that people don't look very often on the screens. It is easier to create lightboxes with triangles or squares than with puzzle pieces. In the end triangles are chosen because they look less static than squares.

The animations of the lightbox can be made by different colored paper or RGB LEDs. The RGB LEDs will give the possibility to program different animations instead of changing the design itself. This will make it easier to variate between the animations, which will make the design more interesting for a longer period of time.

The goal of Deposilight (deposit +positive + light) is to stimulate people in a positive way to clean up their trash. This is achieved by using light animations as direct positive feedback. It will encourage individuals to keep train stations clean. If the user throws away trash a triangle will go up by turning lights on and off. This triangle will be combined with other triangles that are already at the top of the trashcan, because of the cleaning acts of others. All pieces together create a picture. For each station, pictures that are relevant for the location can be chosen. Examples are local events, artists and buildings. This makes it relatable which keeps people interested, makes them feel more linked to the station and more responsible.

Explanatory video: https://youtu.be/csF7_7vRC3c

REALIZATION 2.0

The visuals in the design are made by light boxes that are assembled according to figure 56. Panel one contains RGB lights, this enables the option to create shapes with different colors. Panel two consists of different triangles, so the triangles can be turned off and on separately. Panel three shows the final visual from the outside, makes sure the lights don't shine in the users eyes and that the lights itself are not visible.

While prototyping different materials are tested for panel three (figure 57) such as baking paper, sheets and tissues. In the end baking paper has been used because it is relatively strong, cheap and it has less crumbs.

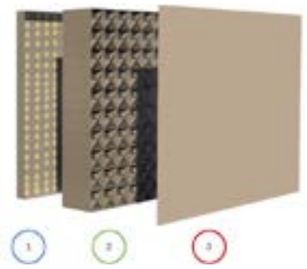


Figure 56: Technical assembly

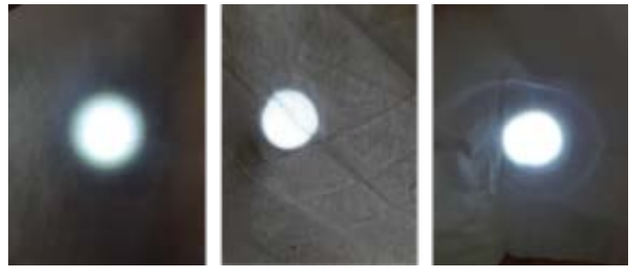


Figure 57: Testing panel three (baking paper, sheets, tissue)

Figure 58: Prototype 'Deposilight'

The lights behind the separation need to be bright enough to be visible on day life. Because of this, regular leds are not strong enough, but lightbulbs are.
The light bulbs are placed in triangle boxes (figure 59).

While prototyping and making illustrations, we noticed that the initial pattern from those triangles (figure 58) has a low limit of possible visuals. Because of this the pattern changed to the pattern that has been used for the illustrations shown in figure 60. This pattern makes it possible to make horizontal, vertical and diagonal lines, which results in more visual options.

Figure 59: Traingle box

REALIZATION 2.0

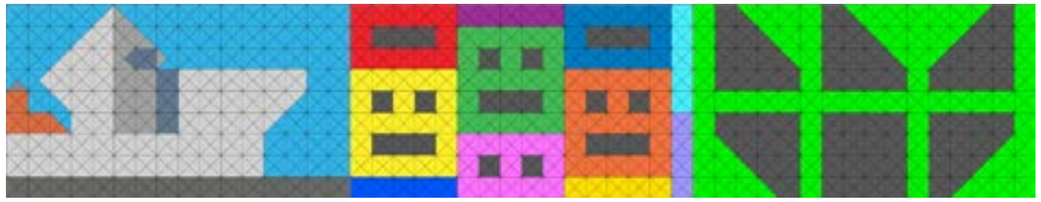


Figure 60: Eindhoven themed animations; Van Abbemuseum, Piet Hein Eek (Piet Hein Eek, n.d.), Dutch Design Week (Dutch Design Week, n.d.)

Also, a stop motion was created to show how the animation would grow. This can be found by clicking on the following link: https://youtu.be/YkAhp-PRefc.

To turn the light bulbs on and off, relays can be used. This relay will be activated depending on the values of the proximity sensor. The sensor needed to be replaced while prototyping, which caused the whole system not to work. This caused the realization that in the final design a sensor can not be replaced as quickly and easily. Therefore, it would be better to have two sensors so if one of them breaks done the system can still rely on the other one.

Figure 61: Scale model prototype

The power from the arduino is not strong enough to control 5 light bulbs (the minimum). To use the electricity directly from the socket could lead to dangerous situations. Because of this fittings are needed. Unfortunately, due to corona the fittings need to be ordered online which took too much time. Because of this the prototype in figure 58 is a wizard of oz (as can be seen in the video with the following link: https://www.youtube.com/watch?v=jKzCBHAN5Mw&feature=youtu.be. To still create a working prototype, a scale model was been built with normal leds (figure 61), the the circuit is shown in figure 62 and the arduino code can be found in appendix 9.

A video depicting the functions of the scale model can be found by clicking on the following link: https://youtu.be/Oad8QfOR5RI .

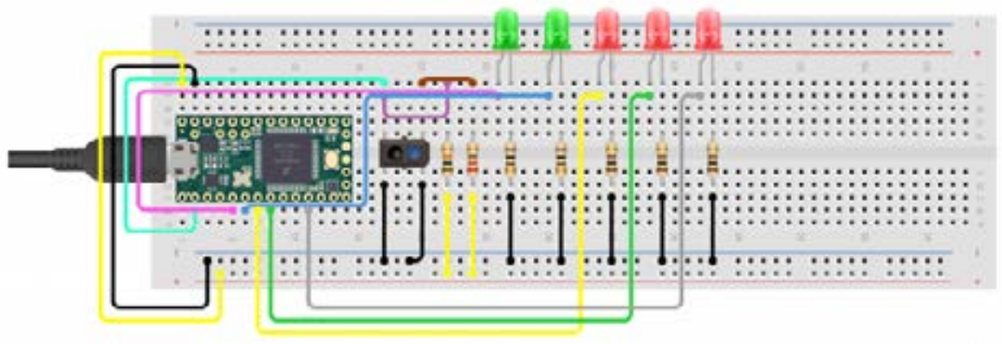


Figure 62: Electronics for the scale model protoype

VALIDATION 2.0

USER TEST - FOCUS GROUP

To stimulate the generation of ideas the users came up with during the user test interviews, a focus group has been chosen to evaluate our final product. This focus group consisted of four participants of different ages, who travelled by train weekly. Firstly, a short explanation about Deposilight was given while using illustrations (see figures 63 until 65). Afterwards, there was a discussion about the product.

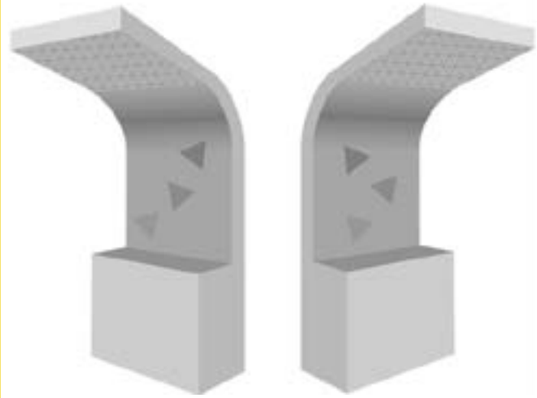


Figure 63: Full trash can illustration

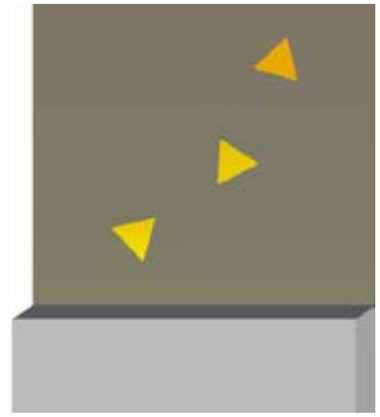


Figure 64: Triangle going up

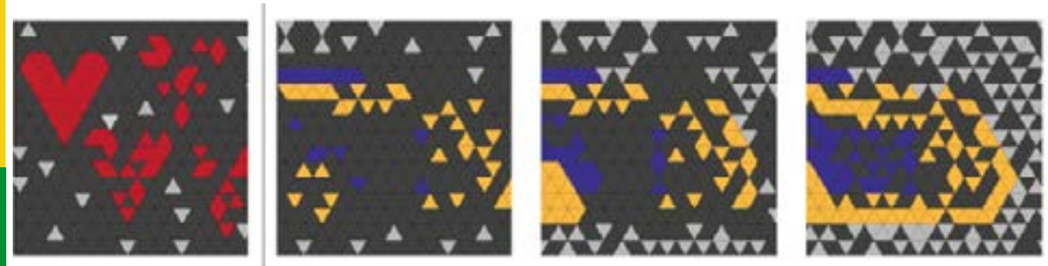


Figure 65: Every piece contributes

Interesting conclusions of the focus group were:

- The flow of people on the station should be taken into account.
- The ceiling is a good place for the animation. A high ceiling makes the trash can recognizable from far away.
- Adding a solar panel on the roof might save energy.
- Extra features like an app in which you can see the animations you contributed to, or a game in which you can guess the picture can be added. This can be done as marketing when the product is new.
- It is nice to link the animations to the city where the trash can stands.
- It is important that the trash can still looks like a trash can. In this way, people still understand the use of it. It can be easily done by adding stickers.
- To create more openness on the station, the wall of the trash can can be opened up. But it should also be hufterproof. Figure 66 was made one of the participants as an example during the focus group.

Figure 66: Openness (Smulders, 2006)

VALIDATION 2.0

EXPERT CONVERSATION HAGO

To get more insights about cleaning the trains and station, an interview was done with a team leader of Hago Rail Services. As already mentioned (iteration 3, background information), Hago is responsible for cleaning the trains. The focus for this interview was at the day shift. The day shift consists of 2 parts, one is cleaning the trains while driving and the other one is cleaning the trains at the station before departure. From this interview it became clear that trash is a real problem for the cleaners. When the train is at the station 80-90% of the work of the cleaners consists of cleaning trash. When the train is moving 30-40% of the work of cleaners exists on cleaning trash. This means that the cleaners can't focus on cleaning dirty spots on the windows or tables, because first they need to clean the trash so that the train looks clean. If people throw away their trash at the station, these cleaners can focus on cleaner tables or windows which make the train a lot cleaner.

BUSINESS MODEL CANVAS

The business model canvas was used to analyse 'Deposilight'. It can be found by clicking on the following link that shows figure 67: https://drive.google.com/drive/folders/1SsAfZ-RMIT8YwFFjvA3_qpuqMjwpXqPgf?usp=sharing

From the business model canvas, useful insights were gained. The aspects listed below required additional research:

- Base production costs.
- Strategies to sell Deposilight, for example by using a monthly subscription service including maintenance, designs and data analysis.
- Ways of creating/generating the images for displaying without the need for huge expenses, for example by using software.

After thinking about these aspects, the following conclusions were drawn:

- The base production costs lay between 100-150 euro. Adding a solar panel, like was said in the focus group, would be worth considering adding, given that a 1m2 300W panel would only add 75 euro to the costs and would provide a decent amount of power. This could reduce the power supply costs, yet can only be done on bins without a roof above it. The base production costs can be found in appendix 10.
- A monthly revenue wouldn't be ideal for a company as Prorail. A better solution would be to make it a one-time sale and give them the opportunity to use their contacts and select animations themselves. Prorail can then easily send their request for an animation to "Deposlight", who will create the animation.
- There is existing software which can divide an image into pieces, yet not the one-colored required. This means either the software has to be developed, or the images have to be created by hand.

While brainstorming about other possible improvements, the idea was mentioned, that by starting a design contest, where people can use an app to create their own personal designed animation, "Deposilight" will get publicity and people will be able to see their own design being created. This reduces marketing costs and at the same time provides a big supply of animations.

ITERATION 3

VALIDATION 2.0

DEMO DAY

For the final demo day, a digital gallery was created to show "Deposilight" (https://demoday.id.tue.nl/projects/wz5j5DX36R). A lot of positive feedback has been received especially from the second assessor. She was surprised about the massive progress and the simplicity of the design. Besides this she was happy to see the way we handled her feedback from the expert conversation and how we managed to create a prototype which still showed the design without the missing electronica pieces.

The only thing she questioned was the roof. She understood the reasoning behind it, but if there was a fourth iteration she recommended testing the different angles to see what curvature works best. From other students feedback has been received about the form of the design as well. They recommended making the trashcan approachable from different angles and to do something with the back. Possibilities could be placing posters, a bench or holes in the back. For future steps the different options can be discussed and tested.

The students also questioned the place of the design. They expected that the design would work in city parks or streets as well. In that case solar panels on the roof of Deposilight can provide energy. For future steps not only ProRail for the train stations, but also local authorities can be contacted.

The coaches questioned the choice of lightboxes over a screen. The differences between a screen and lightboxes might be unrecognized by the user, because they will only view the front of the boxes. In future steps this is something which should be tested. If the differences are not as big as we expected further research will follow. This research will contain the differences in costs, energy supply, implementation and adaptability.

OVERALL RESULTS

In the end an interactive trashcan which uses light as direct positive feedback is created. To stimulate people to throw away their trash. If the users throw away trash a triangle will go up by turning lights on and off. This triangle will be combined with other triangles that are already at the top of the trashcan, because of the cleaning acts of others. All pieces together create a picture. For each station, pictures that are relevant for the location can be chosen. Examples are local events, artists and buildings. This makes it relatable which keeps people interested, makes them feel more linked to the station and more responsible.

The choice for a lightbox comes from a previous idea, namely projectors. These projections turned out not to be bright enough to be able to project in light conditions. The lightbox is not a standard way, so it must separate itself from the many screens on the station. In this way it attracts people's attention.

Furthermore, it was decided to place a wall and a sloping roof above the trash can. On the wall, a triangle will move towards the roof. To give clear feedback it was necessary to immediately attract people's attention after throwing away the waste. That is why a triangle in the wall goes up from the trash can. The sloping roof has been chosen to attract attention, because this is where the bigger picture will be seen. This picture is partially visible from a distance, which makes people curious and take a look. So when people are actually close to the trash, the big picture is really clearly visible.

The trash can is made to be put down at the station, so many travelers will throw away their trash. The choice has been made to link the big pictures to the city of the station. The station is usually your starting and ending point of visiting the city.

The final result can be seen in figure 68.

Figure 68: 'Deposilight' on the station

CONCLUSION

During the project, multiple designs were created. The biggest change in the project was caused by switching to giving positive feedback. In the beginning, the goal was to create a product that would make individuals who left their trash behind aware of their behaviour in front of others. By doing this, they would feel more inclined to clean up their trash. However, the feedback of the midterm demo day and the usertest made clear our idea 'Spot It!' would not motivate people who left their trash on purpose enough to clean up.

This is why the step to using positive feedback had been chosen. Positive direct feedback would encourage people more to clean up, because it is more rewarding than only making people aware of what they are doing. Therefore, the goal of the third iteration was to design a product that would motivate all people, and not only the polluters, to keep the space clean.

To achieve this goal, "Charimate" was developed to keep trains clean. From prototyping and the expert interview, it became clear that it was not possible to use projections inside the train, because the surrounding lights are too bright. Besides this, the idea of donating to a charity couldn't be realized because of the costs. Furthermore, the results of the user interviews pointed out that the station might be a better environment for the product. This is why a new ideation round has been done, which resulted in the new product "Deposilight". It still has the same core as Charimate, seeing your action contributing to a bigger goal, and gives positive direct feedback to the user, because they can see the effect of their own action.

The next step that should be taken to develop this product should be contacting ProRail, to get more insight about what their interests are. The business side of the product should be developed more. This is important to find the best way of selling the product and it is also important for the production of the animations that need to be up to date, to keep variety. Also, the product should be built and tested on a station, to optimize the product in operation. Hereby, others options for the wall of the can be explored. For example opening up the wall or placing a bench on the other side of the product.

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REFLECTION - INE HIKSPOORS

In a lot of public spaces people leave trash behind. For project 1 “Deposiglight” is created, an interactive trash can that uses light animation to stimulate people to clean up their trash. For my second part of the project I mainly wanted to focus on the expertise area Technology & Realization. I did this by creating my first SolidWorks drawing and contributing with the prototype.

For me as a designer it is important to understand the technical possibilities for a design. If I know more possibilities I can choose for the alternative which is easier to implement, cheaper or faster. Depending on the design goal a suitable alternative will be chosen to reach the target group. Because of this, I did the electronics of the first prototype in iteration 3. I learned to connect the proximity sensor to Arduino, how images can be shown in processing and to connect Arduino with processing. I learned those things by watching explanation video’s and reading forums on the internet. This taught me that I am able to work with more and completely new instruments by making use of the internet.

This new insight directly helped me get to know SolidWorks. I wanted to learn this program because it can help me calculate the forces on a design. With those forces it is possible to determine whether the design will break or if the form will change. Especially because I am interested in mechanical systems this information is very useful. During the project I was able to make a drawing of Deposilight in SolidWorks, but I was not able to calculate the forces yet. This is something I would like to do in my next project. Another big advantage of SolidWorks is that it can help you 3D print the design. This makes testing different components faster and more reliable.

By creating prototypes and online models I thought it was only possible to see if the technical aspects were possible. This is still partly true, but during project 1 I learned that insights of experts can be even more useful. Our expert explained why the technical aspects of the initial product “Charimate”, would not be possible in a lighted train. By seeing this outcome I became more curious about talking to experts or other tests myself. On Demoday other students gave us feedback. During this conversation it helped to ask questions, such as, “*Why would you use the design?*”. This made them think about the design in another way, which gave us extra feedback. Because of this, I would love to focus on asking relevant questions during the user test or expert conversation.

The prototype Jens, Thomas and I created in iteration three was wizard of oz, because of some missing components of the electronics. The wizard of oz prototype still showed the idea very well in the explanation video. This visual could have been used to ask feedback to the users. This taught me that it is not always needed to create a working prototype for feedback but that visuals itself could also work. This can also be concluded after the user test with the visuals created by Ilka and Jinte. This new insight can help executing user tests earlier on in the process.

REFLECTION - JENS VERVOORT

The most important thing I learned this project is how to communicate the idea to the user. For this project I made many different videos explaining the product. Because I was responsible for this, I learned how to view the product from the perspective of the user. For our project group, different choices were often clear and logical, but when you explain them to others, some choices do not seem logical. As a designer, I like to be closely involved in the final presentation. I think a video is one of the best ways to introduce your product to the users.

In addition to that, I have gained a lot of knowledge about the program which I worked with, adobe premiere pro. For this project I used my editing skills to make a wizard of oz prototype (https://www.youtube.com/watch?v=jKzCBHAN5Mw&feature=youtu.be). This way I found out that using editing for making prototypes can be an effective way to get a real idea of the product. In order to make even more professional videos I want to work on my film skills in the future. I plan to purchase the necessary materials for that. I said in the mid-term that I wanted to make certain design and technique choices on real tests, rather than thinking what is best. We as a group and myself have done a lot better in the second part. I made a lot of changes with the making of the last prototype, based on making and testing it myself. Although you sometimes do not have the materials, it can often be tested on a small scale, which ultimately saves much more time. A good example is the test with the template and the lamp for the idea of iteration 3.

Another goal of mine was to use my sketching techniques that I learned this quartile at the elective exploratory sketching. I made several sketches of ideas that I came up with at the time. I got to know a completely different side of sketching. Other than starting with an assignment, I now really started looking at how I converted my idea on paper. I think this is why I mainly developed my exploration skill. I will certainly use this more often in other cases. This is a fast and effective way to communicate the first ideas to others.

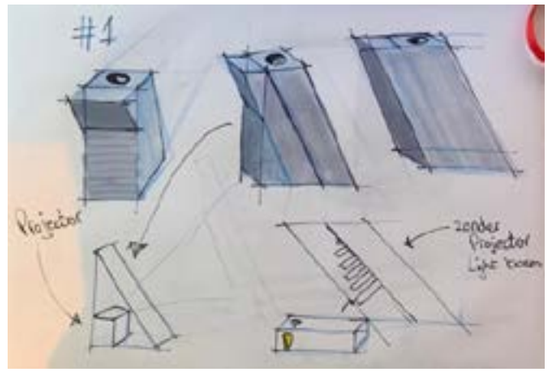


Figure 69: Sketch by Jens

One thing I could have done better on this project, is the use of different materials for the prototype. I had the goal to work with different new materials. In the end, with the limited time we had, it turned out to be better to make the prototype largely out of cardboard. Although, I used video editing to make this prototype look nice and functional. But for the future, my plan is to work this summer on 3D printing. In this way I can start with the basics of it so I can use it other projects next year.

REFLECTION - JINTE VRIENS

During the first part of the project, I focussed mainly on Technology & Realization. During the second part of the project, I shifted my focus towards User & Society and Business & Entrepreneurship. Besides this, I still wanted to develop pitching and learn how to work with Adobe programs.

One goal of mine for the second part of this project was to focus more on user testing. I knew this would become quite difficult because everything had to be done online, but I wanted to learn more about how to acquire useful information about the user to develop the product. The Corona situation made me think inventively about ways to make our concept clear to the user and how to get information. In this project, I worked on all user tests: the questionnaire, the user interviews and the focus group. From the questionnaire, I learned that it is a good way to get a lot of information, but it wasn't as extensive as I wanted it to be. Because we made short videos to guide the user through using our product during the questionnaire, it took a lot of time and in the end wasn't that efficient. This was something I wanted to improve during the next user tests. I learned that having a face to face conversation had more value to get answers on our product. Especially the last two user tests have shown me how important it is to choose the right user test to get the information I want. This is also really important for me as a designer, to make sure users get connected with my designs and with each other.

I also wanted to imply Business & Entrepreneurship into my project. In the beginning of this project I didn't know anything about what things are important aspects to think about while designing for a company. When we talked to our light expert, who is also a project coach, the first thing she asked us was how we wanted to make our product, Charimate, work business related. I felt a bit ashamed when I didn't have an answer to that, because money was eventually the core of this idea. From this I learned that it is very important for me as a designer to look into the business side, because it can make or break my design. With Deposilight we filled in the Business Model Canvas and I learned that also working on the business side can bring up new ideas for the product. For example the animations could be offered like a subscription, instead of a one time purchase, to keep variety in the animations. Despite the new ideas that came up, I also remarked that there still is a lot to do research on regarding the business side. The Business Model Canvas is a good start to begin with, but to "make" instead or "break" the design, more exploration should be done.

Furthermore, improving my pitching skills became only harder during this part of the project. In most courses I followed, live pitches were traded for short movies that explained the products I made. Nevertheless, I found a way to improve my pitching during the user interviews. Here I needed to explain the product shortly by using only a few illustrations. I learned that using illustrations can really help me with pitching, because it makes my story more clear. The illustrations of the user tests were made by Ilka and myself. From this I learned how to work with Adobe Illustrator and Indesign. These skills can help me with communicating to the users, which is essential if I want to design for communities and need to communicate with the users a lot.

REFLECTION - THOMAS WEZEL

During this project I decided to choose my working areas based on my personal goals as mostly described in my personal development plan. After the midterm I received the feedback to select one or two aspects of the design process and focus specifically on these to have more of my own personal adding to the project. I followed this advice and in the third iteration I mainly focused on the Techonology & Realization and Business & Entrepreneurship areas.

My first focus area this project was to work on my prototyping skills. I've done courses regarding technology and realization, yet haven't been involved much in the prototyping during the "From idea to design" project. I feel of it as having the knowledge from a course is nice, yet knowing how to apply it in a real situation is what really helps me grow as a designer.

In the second iteration, I set myself the goal to work on the life-size prototype by making the circuit, using sensors and getting experience working with electronics, which is a great match with my similar goal for the "Creative electronics" course this period. I learned how to use loadcells for example, and in general a lot about the functionalities and possibilities of Arduino. This allows me to chose the best methods to give the user the best experience and at the same time making it easier to implement in prototypes.

In the third iteration I first worked on the animations using Autodesk Maya, and for the second prototype, we didn't manage to implement the technology into the larger prototype worked on by Jens, Ine and me. So to have a working interactive prototype after all, I made a scale model and implemented the technology which I did had into it. The larger prototype was used to demonstrate how it would look using a wizard-of-oz technique. Despite it not being interactive, it showed how it would look in the real setting. This taught me that prototypes can also be useful as visual, even without any technology or interactivity.

At the beginning, I've set myself the goal to contribute to the prototyping and have the knowledge to do similar Arduino projects in the future, and I feel like I completed this goal. I successfully made the scale model work, and for the future I want to keep being involved with making prototypes, for example for project 2. For the final demo day I also made renders for the technical assembly using Solidworks in combination with Vray.
I found it really useful for me as a designer to get more experienced with 3d modelling software and the possibilities rendering offers. By using well-rendered models, it becomes possible to visualize and explain designs and design aspects in a unique realistic way.

The other area I was eager to get into, and decided to focus on during the third iteration, is the 'Business and Entrepreneurship' area. I haven't got any previous experience on this, yet given the fact that I want to start my own company after my study, I really look to get as much experience as I can get.

In the second iteration, this meant working on the business plan with Ine. I didn't really had a clear picture of what specific aspects of 'business and entrepreneurship' I would come across during this project, so didn't set any concrete goals next to just being involved with the business plan and gaining as much experience as possible. Working on a business plan for the first time was a real good learning activity for me. I learned the basic setup, the different areas of a business plan and the financial plan with all the calculations. There are for example already quite some conclusions we have drawn out of the business plan, like how our concept should be focusing on larger companies instead of smaller individual businesses. In the third iteration, I've worked on a different type of business model, by using the business model canvas. I felt like this was for projects like this more effective then creating a whole report like plan as in iteration 2 was done.

My goal was to lay a solid base by taking the “Introduction to Business Design” course and working on the business plan for the third iteration. I feel like I achieved this goal, as I learned a lot about different types of business models, how to make them and when to make which. I want to continue developing myself in this expertise area, and I feel like having done this when I at least worked on the business area during project 2.

Despite the corona crisis, I feel like the feeling in the group was mostly good, we had consistently at least 2 meetings a week, where possible followed the long-term planning, and everybody was always willing to help each other when needed. For me, this group has helped each other grow, not only as designers, but also as persons. I myself am quite introvert, and sometimes people ask specifically me about something so that I can have my word as well. The fact that asking for help is a good thing, was also something that some people in this group, including me, needed to learn.

REFLECTION - ILKA VAN ZEIJL

The project *Light to Touch* has allowed me to develop myself throughout the process, mainly in the fields of User & Society and Creativity & Aesthetics. These also align with the goals I had for this project. In addition to that, I was able to develop my vision alongside the development of the process and project vision. Our project vision continually evolved throughout the process and finally became: *Use direct positive feedback to encourage individuals to keep the train's environment clean.*

The fulfilment of this vision comes through ‘Deposilight’. This end product gives direct positive feedback using light in a meaningful and dynamic way, which perfectly fits with *Light to Touch*. Focussing on the behaviour of people comes back in my vision through the focus I put on combining design with psychology. Also, our design focusses on enlarging a small action to influence the bigger context. This is something I developed in my vision as wanting to help people individually which can impact a bigger scale. This is important to me because I think it will allow me to keep designs personal while also connecting people to others and their environment.

During the ideation phases of the project, I was able to use many different brainstorming techniques. I noticed that this was really useful because different techniques give different outcomes. Brainstorming online also challenged me to use different approaches. It was harder to be involved in the process as a group but tools like an online white board were really helpful. Also, it was a really useful learning experience that allowed me to practice to postponing judgement more. Everyone had their own chance to write down what they thought was important, and it was only discussed afterwards.

In addition to this, I learned that exploration is not just ideation. Where at first I thought the ideation phase was equal to the exploration phase, I now realize that the exploratory phase of the project is so much broader. Prior iterations are exploratory for future iterations and all feedback can be used to reflect on and develop the project. Therefore, in next projects I would like to broaden my horizon and use other approaches to explore the design, such as building the prototype and doing more scientific research. This will help me to get more insights in what other perspectives can bring me.

During the project, I achieved my goal to involve the user in the design process. I did this by preparing, carrying out and analysing an exploration test, a user test questionnaire, user interviews and a focus group. Doing the latter three of these online, definitely made it all the more important to ensure that the communication of the questions and the concept were clear. This challenged me to put a lot of thought in how the user test could be made effective and to make visuals using illustrator to communicate the concept. As a designer, this was a really useful learning experience because it will better allow me to create designs that are useful and will be used in the future.

As a group, we made the decision to make some drastic design changes at the last moment. Looking back at this, we could have realized that this changes were needed much earlier. However, I still think it was a good choice because it led us to a much more developed design that aligned with the project vision. It asked for a lot of flexibility because it meant we had to step of off our plan and work very hard to come to a final design. This was a useful experience because as a designer, you always have to be flexible for input and changes that are needed to improve the design. Also, I think the last week challenged the group to all complement each other's strong point and have a clear focus, which was really nice to achieve after the whole project.

PROJECT WORK DIVISION

Iteration 1	Ine	Jens	Jinte	Thomas	Ilka
Space & Mood					
Ideation					
Conceptualisation					
Pitch					
Movie					
Exploration test					
Presentation					

Iteration 2	Ine	Jens	Jinte	Thomas	Ilka
Vision & Direction					
Ideation: Paper Twist					
Four concept points					
Body storming					
Sketching					
Conceptualisation					
Prototype: Base					
Coding & Electronics					
User test: Preparation					
Filming					
Analysis					
Business plan					
Midterm demo day: Illustration					
Posters					
Stop-motion					
Video					
Draft report: Text					
Lay-out					

PROJECT WORK DIVISION

Iteration 3	Ine	Jens	Jinte	Thomas	Ilka
Vision & Direction					
Ideation					
Research					
Conceptualisation					
Prototype: Research beamers					
Animations					
Coding & Electronics					
Illustrations user interviews					
User interviews					
Expert interview light expert					
Ideation					
Conceptualisation					
Prototype: Base					
Coding & Electronics					
Illustrations focus group					
Focus group					
Expert interview Hago					
Business Model Canvas					
Demo day: Render solidworks					
Prototype video					
Technical assembly					
Illustrations					
Poster					
150 words text					
Pitch video					
Report: Text					
Lay-out					
Prepare meetings					
Making minutes					

APPENDICES

1. ANALYSIS EXPLORATION TEST

Participant 1:
Participant walks to the reconstruction of the train. Sits down with legs across each other. Opens the chocolate bar that was given. Our team member leaves trash on the table. Light turns on above it. Participant cleans up the trash of our team member and the light turns off. Participant leaves the train.

Participant 2:
Participant enters the train. Light goes on, when our team member leaves the trash of a chocolate bar on the table. Participant looks at the trash. Participant picks up the trash, causing the light to turn off, and puts the trash back on the table, causing the light to turn back on. When he needs to leave the train, he picks up the trash again and throws it in the bin located in the train.

Participant 3:
Participant sits down in the train. When our team member leaves his trash, the light turns on. Participant doesn’t clean up the trash that is left on the table, but he does throw his own trash in the bin in the train.

Participant 4:
Participant sits down. Our team member leaves his trash at the table, and the light turns on. Participant looks at the trash and the light, when she needs to leave the train, she picks up the trash and throws it in a bin outside of the train.

General feedback participants after exploration test:
- Good idea, curious to see how it works in a real life situation.
- Right now, you aren’t trying to solve the problem by the cause of it. The traveller, in this case, is confronted with the trash of a fellow traveller. Because of this, the traveller might be tended to not clean up his own trash.
- The first time it is also confronting for other people, because of the sudden spot-light they might feel like they did something wrong.
- The shaming idea could work, because you don’t want to let others see you’re doing something wrong.
- The concept is also shaming the people who didn’t do anything wrong. This might be a pitfall.
- Maybe try to focus your concept on the polluter itself.
- Make sure you can see the light at any time, by using a small high concentrated spotlight.

2. CODE SCALE MODEL PROTOTYPE ‘SPOT IT!’

Project1model_version_display | Banana.c | Banana2.c | banana3.c | epd2in7.cpp | epd2

```
#include <SPI.h>
#include "epd2in7.h"
#include "imagedata.h"
#include "epdpaint.h"

#define COLORED     0
#define UNCOLORED   1

// constants won't change. They're used here to
// set pin numbers:

const int TablePin = 2;     // the number of the pushbutton pin 2
const int ChairPin = 3;     // the number of the pushbutton pin 3
const int ledPinGreen =  16;      // the number of the LED pin green
const int ledPinBlue = 17;         // the number of the LED pin blue
const int ledPinRed =  18;      // the number of the LED pin red
  // Pin 13: Arduino has an LED connected on pin 13
  // Pin 11: Teensy 2.0 has the LED on pin 11
  // Pin  6: Teensy++ 2.0 has the LED on pin 6
  // Pin 13: Teensy 3.0 has the LED on pin 13

// variables will change:
int TableState = 0;         // variable for reading the pushbutton status
int ChairState = 0;         // variable for reading the pushbutton status
int ledState = 0;           // actual state of LED
int delayCounter = 0;

Epd epd;

void setup() {
  Serial.begin(9600);             // start serial communication
  Serial.print("e-Paper init\r\n");
  if (epd.Init() != 0) {
    Serial.print("e-Paper init failed\r\n");
    return;
```


Project1model_version_display | Banana.c | Banana2.c | banana3.c | epd2in7.cpp | epd2

```
    Serial.print("e-Paper init failed\r\n");
    return;
  }

  // initialize the LED pins as an output:
  pinMode(ledPinGreen, OUTPUT);
  pinMode(ledPinBlue, OUTPUT);
  pinMode(ledPinRed, OUTPUT);
  // initialize the pushbutton pin as an input:
  pinMode(TablePin, INPUT);
  // initialize the pushbutton pin as an input:
  pinMode(ChairPin, INPUT);
}

void loop(){
  // read the state of the pushbutton value:
  TableState = digitalRead(TablePin);
  ChairState = digitalRead(ChairPin);

  // check if the pushbutton is pressed.
  // if it is, the buttonState is HIGH:
  if (TableState != HIGH && ChairState == HIGH)  {
     if (ledState == 0){
       if (delayCounter > 400) {
       // turn LED on:
       ledState = 1;
       digitalWrite(ledPinGreen, HIGH);
       digitalWrite(ledPinBlue, HIGH);
       digitalWrite(ledPinRed, HIGH);
       Serial.write(1);       // sent value 1 to processing

       epd.Init_4Gray();
       epd.Display4Gray(gImage_Banana2);
       } else {
         delay(10);
```

```
Project1model_version_display | Banana.c | Banana2.c | banana3.c | epd2in7.cpp | epd2

    if (ledState == 0){
      if (delayCounter > 400) {
      // turn LED on:
      ledState = 1;
      digitalWrite(ledPinGreen, HIGH);
      digitalWrite(ledPinBlue, HIGH);
      digitalWrite(ledPinRed, HIGH);
      Serial.write(1);       // sent value 1 to processing

      epd.Init_4Gray();
      epd.Display4Gray(gImage_Banana2);
      } else {
        delay(10);
        delayCounter++;
      }

    }
  }
  else {
    // turn LED off:
    if (ledState == 1) {
      ledState = 0;
      delayCounter = 0;
      digitalWrite(ledPinGreen, LOW);
      digitalWrite(ledPinBlue, LOW);
      digitalWrite(ledPinRed, LOW);
      Serial.write(2);       // sent value 2 to processing

      epd.ClearFrame();
      epd.DisplayFrame();

    } else
      delayCounter = 0;
  }
}
```


3. USER TEST ‘SPOT IT!’

Thoroughly analysing the user test, part one and two separately as well as combined, made it possible to gain interesting insights and conclusions. With this, it is important to keep in mind that most of the participants thought that the product consisted only of a spotlight.

Firstly, it was interesting to notice that the answers for part 2 consisted of many questions about if the user would turn around to look at the spot. In part 1 however, 45 out of the 55 participants answered the question Do you look back at the table? with yes. Afterwards, it became clear that this question could be considered leading. Another formulation for this question would have been better. However, the doubt many participants have about if people are automatically inclined to look back at the table, gives reason to wonder if it is possible to encourage and remind people to take their trash, before they get up and possibly forget.

In addition to that, several participants mentioned that it was too late to give feedback with the screen when people are already at the exit. Users would be less inclined to walk all the way back to the table because it would be too much work, or because they would feel ashamed. Therefore, during the next iteration it should be taken into account what the best moment and time duration to give feedback is.

Secondly, insight was gained in what the participants thought were positive aspects of the product. One of the advantages that was mentioned often, is that it could help the staff of the restaurants by lessening the time that has to be spent on cleaning. With this, it is important to realize that a possible consequence might be that less cleaners are needed, or that they could focus on other things than cleaning garbage during their work. Therefore, it could have a lot of added value to discuss “Spot It!” with cleaners to find out what they think about the product and to find out how they would envision working with the help of such a product.

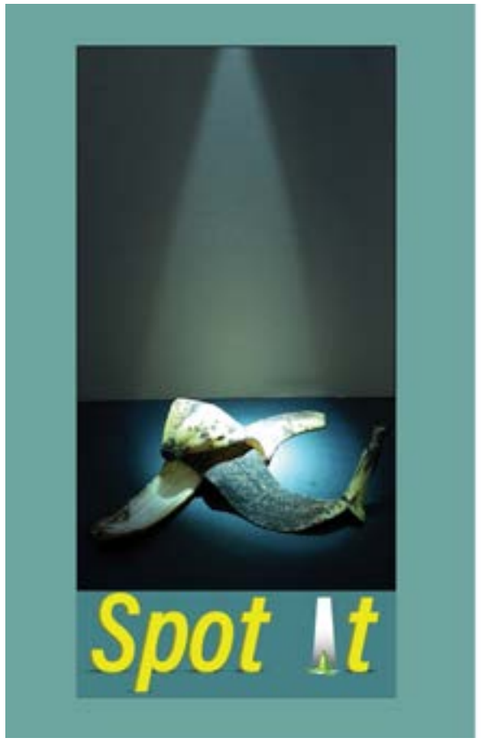
Also, many of the participants thought a positive effect of the product would be cleaner public spaces. From this, it can be derived that there exists an interest in products that could aid the process of creating cleaner spaces. It is also interesting to see what effect a cleaner public space has on a user. For example, are people more inclined to enter a clean space, do they feel more comfortable, are they more inclined to stay longer? If it is possible to give definite answers to these questions, it would give insights in what additional positive effects a cleaner space can have. This can provide extra reason to invest for companies who are interested in the product.

Thirdly, insight was gained in what participants thought were points of improvement of the product. The most important element that was mentioned was how the product would work if it was placed in a really busy environment. This is important to research because public spaces are often very busy and up until now, the design was mostly focused on one user at the time. In addition to this, some participants questioned if there were enough incentives to gain the attention of the user while others mentioned that they thought the product should give feedback in a way that is as subtle as possible. Therefore, the (longlasting) effectiveness of different kinds of feedback should be looked at in the next iteration.

The combination of the answers participants gave to what the advantages and disadvantages of the product are, it can be concluded that users will experience the implementation of social pressure the product can cause differently. Some of the participants thought this was an advantage, while others mentioned that they would experience this as a negative aspect. It is important that as many users as possible have a comfortable experience when using the product, to make sure as many people as possible will keep using the product. This way, the product will be the most effective.

Lastly, feedback on the possible effects of the product on society and on the participants themselves has been obtained. Generally, the participants expected a positive effect on the awareness of the user. However, there were also questions about if the effect of the product would last long enough and about if the product would also affect people who leave their trash behind deliberately. Therefore, it would be helpful to look into the reasons why people leave their trash behind. By doing this, a better product can be made with these reasons taken into account.

4. 'SPOT IT!' MIDTERM POSTER



B1 / DPB100 Project 1 Design
Light to Touch

SPOT IT

A design that uses light as a solution for the everlasting problem of people who leave their trash in public spaces. They do this while the option to throw it in a trashcan is close by. Spot it uses a combination of a LED screen and a spot to give direct feedback to encourage people to keep public spaces clean.

The screen is located above the trashcan in the public space and depicts a live image of the trash the user left behind. The spotlight helps the user to recognize the exact place that the trash was left at. Together, they should give the user a hint of what action is encouraged, to clean up the trash they left.

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5. IDEA LIST IDEATION ITERATION 3

Negative feedback

· Black and white seats.
· Phone case/ OV emits light when you're leaving trash.
· All doors close for people who leave trash.
· Review system for cleaning, for example the last person sitting here did not clean very well.

Only stimulates connection

· Chattering can (kletspot).
· Showing questions on the screen to start a conservation.
· Using light to highlight the seats that are free next to someone else.
· Seat picking based on personal interests.

Ideas with good and bad qualities

Lighted tables showing where the trash is located when the train enters a station.
+ Subtle.
+ Easy to implement.
+ Not a direct connection with the trash.
- Might not be clear enough to the user.

Participatory sensing (Tracker shows where your trash is located after throwing it away or leaving it).
+ People see their impact.
- Not focused on the target group.
- If the cleaners clean it up the trash might enter the same route.
- Privacy following someone.

Point system based on the time it takes to digest the trash.
- Point system is nice.
- Making sure everything is thrown away.
+ Nice that they learn about the time it takes to digest trash, it may make them more conscious of throwing things away next time.

A growing trash can if there is more trash in the can. This can also be done by placing a cartoon of a man/woman who gets older.
- Takes up a lot of space? As an animation.
+ Showing people how much the trash can grows might make them aware of the big amount of trash they produce.
- Why is it nice if someone gets older?
+ If a tree grows it shows the bigger goal.
+ Easier to implement, because in general
- Might not have a big impact because it's not personal.

Point system for discounts.
+ Good motivation.
- Who covers the discounts?
- You need to connect the trash with a person (voluntary?).

Make aware of who is sitting in your place after you.
- How?
+ Better connection.

Competition How clean is your trainsection > win points if they clean together.
- Not focussed on the individuals.
- People will probably not care enough.
+ Bonding.

Emoij based on cleanness.
+ Gives positive feedback.
- Not enough to make a change.

Ying yang picture is balanced when clean, and more black when dirty.
- Not enough focus on individual.
- Which is good, which is bad?
+ Can be seen by everyone.

Blacklight.
- Hard to realize in a day train.
- Might not be nice for travelers.

Game in trash can.
+ Makes throwing away trash more fun.
- Not explained enough.
- Already exists.

Use the train screen to tell people what happens with their trash.
+ Good extra feature.
- Not direct enough.

Feedback through vibrations.
- Not suitable for everyone.

Connection to phone / ov chipcard (voluntary?).
- Too much effort.
- Has to be done voluntary, target group will not participate.

Phone case/ OV emits light when you're leaving trash.
- Phone case voluntary.
- OV chipcard connecting with the trash.
- Another app to download.

When you clean things up, you help others with a surprise. You don't donate yourself. (bigger goal).
+ Gives a good feeling to do something for other people.
- Individuals might not care about other people they don't know.

"Only together can we handle it "(Corona) Only together can we change behavior.
+ Bonding.
- Not enough as an individual idea.

6. CODE PROCESSING ‘CHARIMATE’

test_part

```
import processing.serial.*;                    // Import value of arduino
PImage photo1, photo2, photo3, photo4;         // Import images

Serial myPort;                                 // Create object from Serial class
String val;                                    // Data received from the serial port
int intval;

void setup()
{
  size(225,225);
  String portName = Serial.list()[8];          //change the 0 to a 1 or 2 etc. to match your port
  myPort = new Serial(this, portName, 9600);
  photo1 = loadImage("Smallest.png");          // Animation 1
  photo2 = loadImage("Small.ppg");             // Animation 1 changed a little bit
  photo3 = loadImage("Normal.png");            // Animation 1
  photo4 = loadImage("Big.ppg");               // Animation 1 changed more
}

void draw()

  if ( myPort.available() > 0)  {              // If data is available,
  val = myPort.readStringUntil('\n');          // read it and store it in val
  intval = Integer.parseInt(val.trim());       // Set intval to the value of val
  }
println(val); //print it out in the console    // print val

if (intval == 1) {                             // if intval is equal to 1 photo 1 will apear
background(photo1);}
if (intval == 2) {                             // if intval is equal to 2 photo 2 will apear
background(photo2);}
if (intval == 3) {                             // if intval is equal to 3 photo 3 will apear
background(photo3);}
if (intval == 4) {                             // if intval is equal to 4 photo 4 will apear
background(photo4);}
}
```


7. CODE ARDUINO ‘CHARIMATE’

Count__proxi §

```
const int sensor = A5;                 // Proximitysensor connected to pin 5

int sensorValue;
int State;
int lastState = 0;
int Val = 0;

void setup() {
  pinMode(sensor, INPUT);              // Proximiti sensor as input
  Serial.begin(9600);
}

void loop() {
sensorValue = analogRead(sensor);      // Reading the sensor value

if (sensorValue > 500){                // If the sensor value is bigger than 500 state = 2
   State = 2;}
else {                                 // Otherwise state = 1
   State = 1;}

if (State != lastState) {              // If the state changes
    if (State == 1) {                  // And is equal to 1
      if (Val < 4){                    // And val is smaller than 4
      Val++;}                          // Val gets one higher
      else{                            // If val is not smaller than 4
      Val = 0;}                        // Val is set to 0
    }}

Serial.println(Val);                   // Value of val is printed

  lastState = State;                   // LastState is equal to State

  delay (1000);
}
```

8. ‘CHARIMATE’ USER INTERVIEW

General questions

- How old are you?
- How many times a week do you travel by train (pre-corona)?
- How long does your average train journey take?
- Are you travelling by train individually or together?
- What do you like about travelling by train? What do you think are positive aspects about sitting in the train?
- What don’t you like about travelling by train? What do you think are negative aspects about sitting in the train?

Trash specific questions

- What are you doing if you have trash while sitting in the train?
- Does it ever happen that you don’t clean up your trash? If yes, why?
- What do you think when trash is left behind?
- Does this affect your own feelings and behaviors? Does it have an influence on your seat?
- Do you clean up the trash others leave behind? Why/Why not?
- Do you think the trash situation in trains should be improved? Why?

Product specific questions

* Global explanation about how product works *

- What is your first impression of the product? What do you think the purpose of the product is?

* Explanation about charity linked *

- Do you have any questions?
- What is your impression now?
- What are positive aspects about the product?
- What can be improved on the product?
- Would you use this product? Why?
- What effect do you think the product has on you? And on the people on the train? And what if it was placed on the station?
- Do you think extra information is necessary to make sure people will under stand and are going to use this product?
    - What is your opinion on this if it came in the form of a QR-code?
    - Do you know what an RFID-tag is? *If not, explanation*
    - Do you think you would use an RFID tag? Would you be more tended to use the RFID-tag than a QR-code?
    - What do you think about a video, which will be shown on the displays in the train, that explains the product?

9. CODE ARDUINO SCALE MODEL ‘DEPOSILIGHT’

Scale_model

```
/*
by-Thomas Wezel
*/
int a;
int led1 = 8;
int led2 = 10;
int led3 = 9;
int led4 = 11;
int proximityA0 = A0;
void setup()
{
Serial.begin(9600);
  pinMode(proximityA0, INPUT);
  pinMode(led2, OUTPUT);
  pinMode(led3, OUTPUT);
  pinMode(led1, OUTPUT);
  pinMode(led4, OUTPUT);
}

void loop() {
a = analogRead(proximityA0);
delayMicroseconds(500);
if(a<600){
  delay(1000);
  digitalWrite(led1, HIGH);
  delay(1000);
  digitalWrite(led1, LOW);
  delay(500);
  digitalWrite(led2, HIGH);
  delay(1000);
  digitalWrite(led2, LOW);
  delay(500);
  digitalWrite(led3, HIGH);
  delay(1000);
  digitalWrite(led3, LOW);
  delay(500);
  digitalWrite(led4, HIGH);
  delay(2000);
  digitalWrite(led4, LOW);
}
delay(5000);
}
```

10. BASE PRODUCTION COSTS 'DEPOSILIGHT'

Requirements for 1 bin:

- RGB LED – 500x = 60 euro (+/- 12 eurocent per led) - (dhgate, n.d.)
- Proximity sensor – 1x = 1 euro (Tinytronics, n.d.)
- Movement sensor – 1x = 1,50 euro (Tinytronics, n.d.)
- 1mx1m fabric screen – 1x + 15cmx15cm fabric screen – 3x = 7.50 euro (Hunt the moon, n.d.)
- Processing chip – 1x = 10 euro (Tinytronics, n.d.)
- Frame/cover - 1x = 20 euro
- Assemblers salary = 50 euro

This roughly summarizes to about 150 production costs for the whole bin. The Led's are extra bright, to ensure the visibility of the animation. This results in higher power consummate however. A possible solution for this is to add a solar panel on the top of the bins which are placed in areas without a roof. The typical 300 watt(300 watt/hour) solar panels are 75 euro per square meter(Stralendgroen, n.d.). With about 350 watt/h(((2 Volt * 350miliamp hour)/100) * 500) power required for one bin, the solar panels could provide a part of the power required for the bins.