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EINDHOVEN UNIVERSITY OF TECHNOLOGY, BACHELOR COLLEGE

DPB100 - PROJECT 1 DESIGN

TOPIC: DREAMS COME TO LIFE

2016/2017 SEMESTER B

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PROJECT COACHES: PROF. DR. MATTHIAS RAUTERBERG, DR. S.C. LENNEKE KUIJER

TUTOR: M.E. BOERSMA

STUDENTS: J.C. FRENS - s167766, P.M.C. FRANSSEN - s164240, N.C. VAN GLABBEK - s152437,

B. DE GROOT - s169756

| MAJOR INDUSTRIAL DESIGN

INTRODUCTION

Sleep, it is something we all need. Without sleep your physical and mental abilities will decrease. Young children often have problems with sleep. They are still hyper when they have to go to bed. They are not able to relax and they will keep themselves and their parents awake. Another problem is that they are afraid to go to sleep, they will focus on negative thoughts. A poll from the National sleep foundation (NSF 2004) shows that more than one-half of parents/caregivers of school-aged children and preschoolers report that it takes their child 15 minutes or more to fall asleep at night ("2004 Sleep in America Poll - Children and Sleep", 2015).

We have looked into ways to help children to relax before falling asleep and designed Nunki, an interactive cuddly toy. Nunki distracts children from scary thoughts and stimulates them to slow their heart rate down, so they will be relaxed. In this report our goals, process, iterations and final result will be showcased.

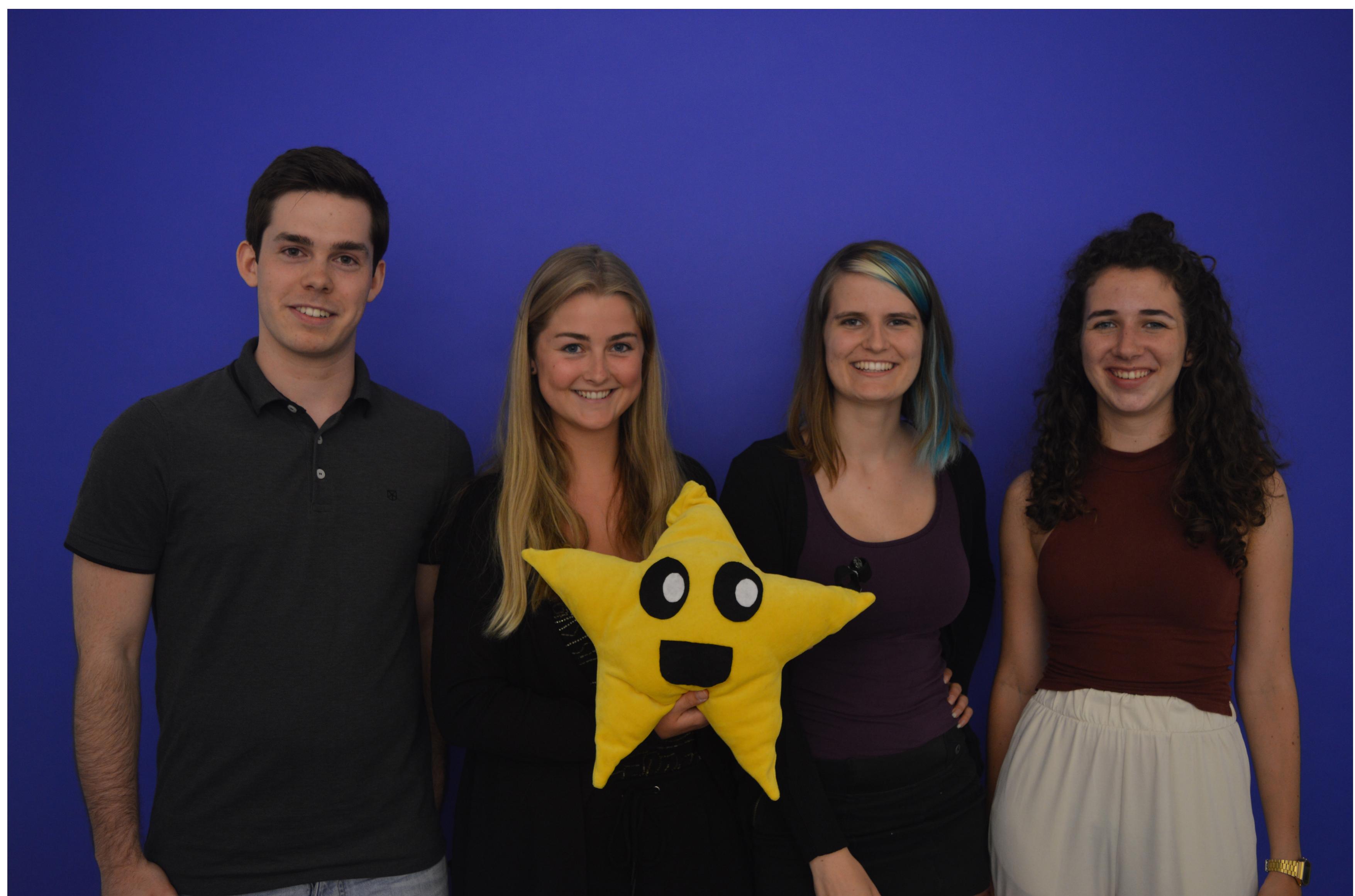
We have worked on Nunki for one full semester. In the process of developing our design we have been through four phases: ideation, conceptualization, realization and validation. We have met with a project coach and other groups every week to discuss our work and get feedback. After the first 8 weeks there was a midterm demo-day where we also got feedback from other students and teachers. All this feedback helped us improve Nunki. At the end of this semester, we had a final demo day. Here we showed our final design.

PROJECT GOAL

In our first weeks, we did some research on sleep and we found out that a lot of children have trouble with falling asleep. This causes a bad night's rest for the child, as well as their parents. This is a problem we want to solve.

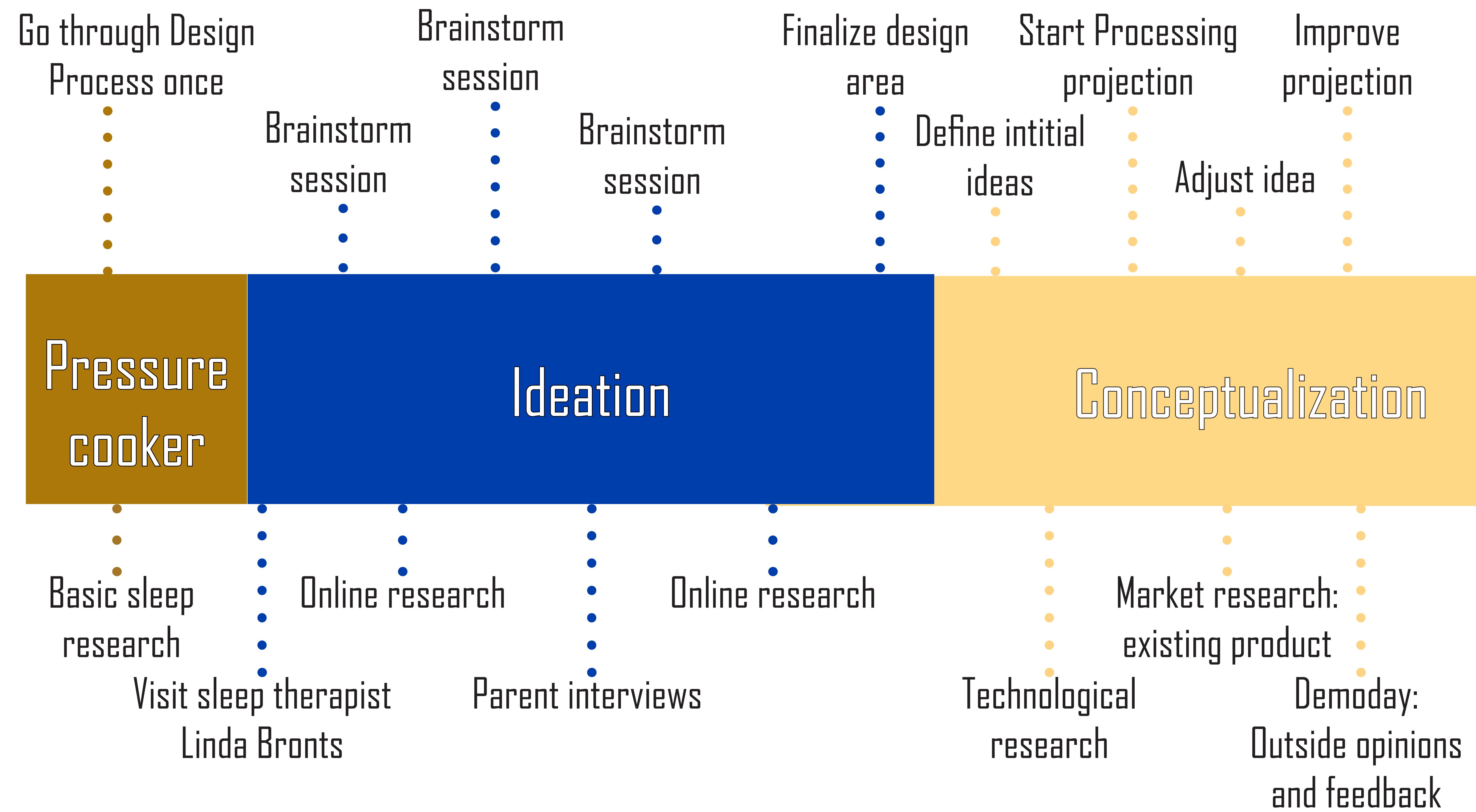
We wanted to present a product that helps children with calming down and getting ready to fall asleep when they are in bed. We wished to create a high quality product that is affordable for all families of the middle and upper class. We aspired to have a large target group, to help a lot of children and parents and make our product a success.

Whilst working on our product we wanted to take some things in account. We wanted to involve the users of our product into our process, by doing interviews and users tests with every big decision we had to make. We also wanted to focus on the business side. It is important to check whether the market is ready for our product.

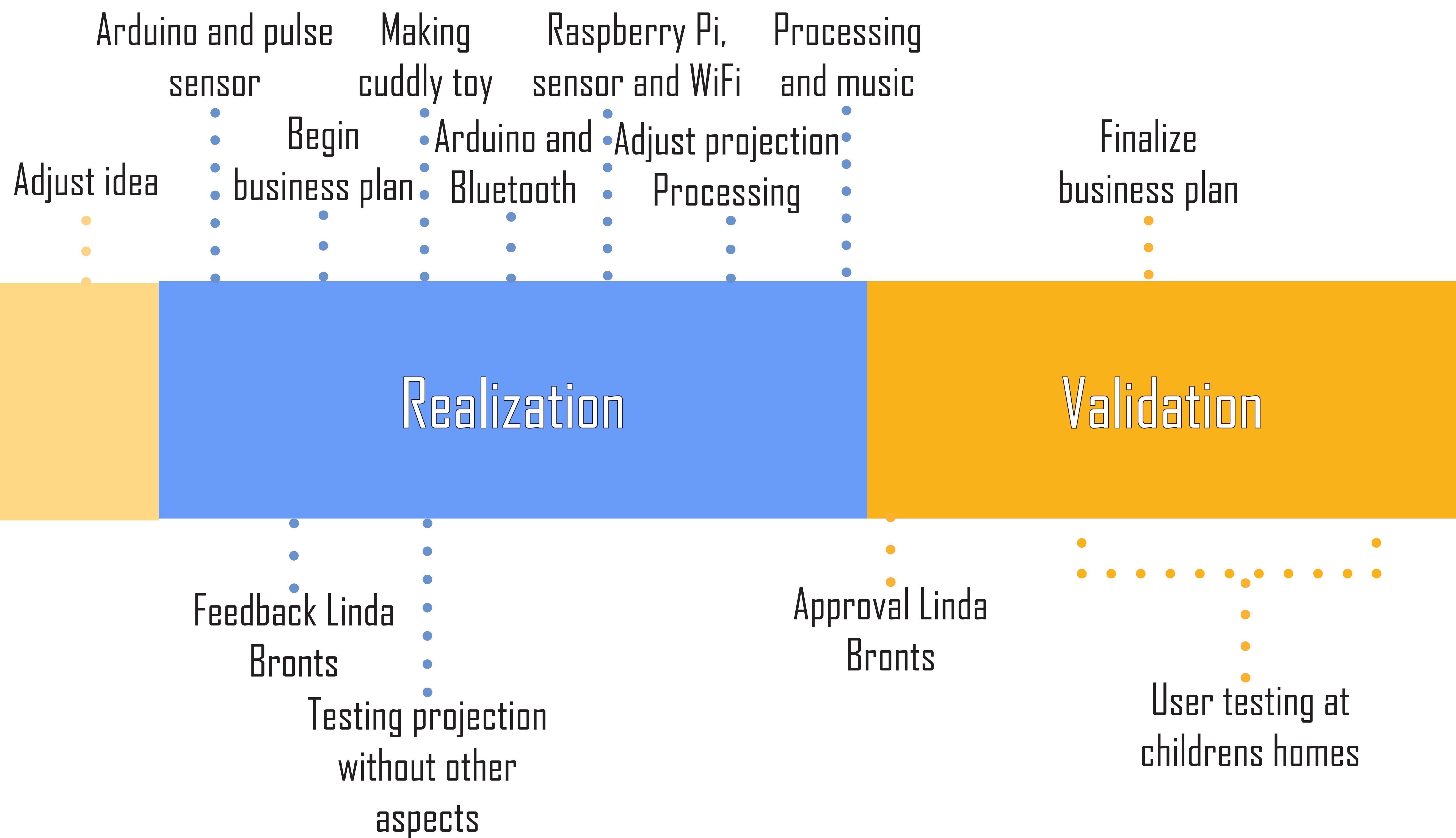


DESIGN PROCESS

For the design process we went through different stages. We find it important to make several design decisions based on research, in order to make our final product fit our target group. In the time-line you can find the design steps we took at above the line and the research we did on below the line. As you can see, we try to vary between design choices and research, so we could base our design choices on the research we have done.



In ideation, we went back and forward between design choices and research to define our initial idea. In conceptualization, we continued this going back and forward to make a feasible design that fits the market. In realization, we mostly did design choices, because we had to put everything together. We did, however, try to get some feedback, while making the design work. In the validation phase, we did a lot of research and barely made design choices, because we had a working prototype. We did make design choices for the future development in the business plan (see Appendix 1).



ITERATIONS

Pressure Cooker

In the first week, we started off with the pressure cooker. First, we did some research on the internet by ourselves and explained our own experiences to each other. After sharing this, we started a brainstorm, where we put problems concerning sleep on a big paper and tried to generate ideas for solving or minimizing those problems. We did this using a mind map and making small sketches. We picked the subject snoring, because this is what we had the most information and knowledge of at that point. In this week, we came up with an anti-snoring mattress (see picture 1a and 1b).

Ideation

During the first three weeks we had an ideation phase. The goal of this phase was to have an initial idea on what we could work on during the rest of the project.

We started this phase by going to Linda Bronts, a sleep-therapist in the St. Antonius ziekenhuis in Nieuwegein. She gave us information about sleep and she had feedback on our pressure cooker idea. We gathered knowledge in our talk and went to the drawing table, where we would start brainstorming (see picture 2). During this brainstorm session we picked the four topics we were most interested in: snoring (direction: noise cancelling), young parents with babies, young children and sleep, and nightmares and sleepwalking ("Sleepwalking" 2017). Before we



1a. Our idea for the pressure cooker: an anti-snoring mattress that lets you sleep on your side.

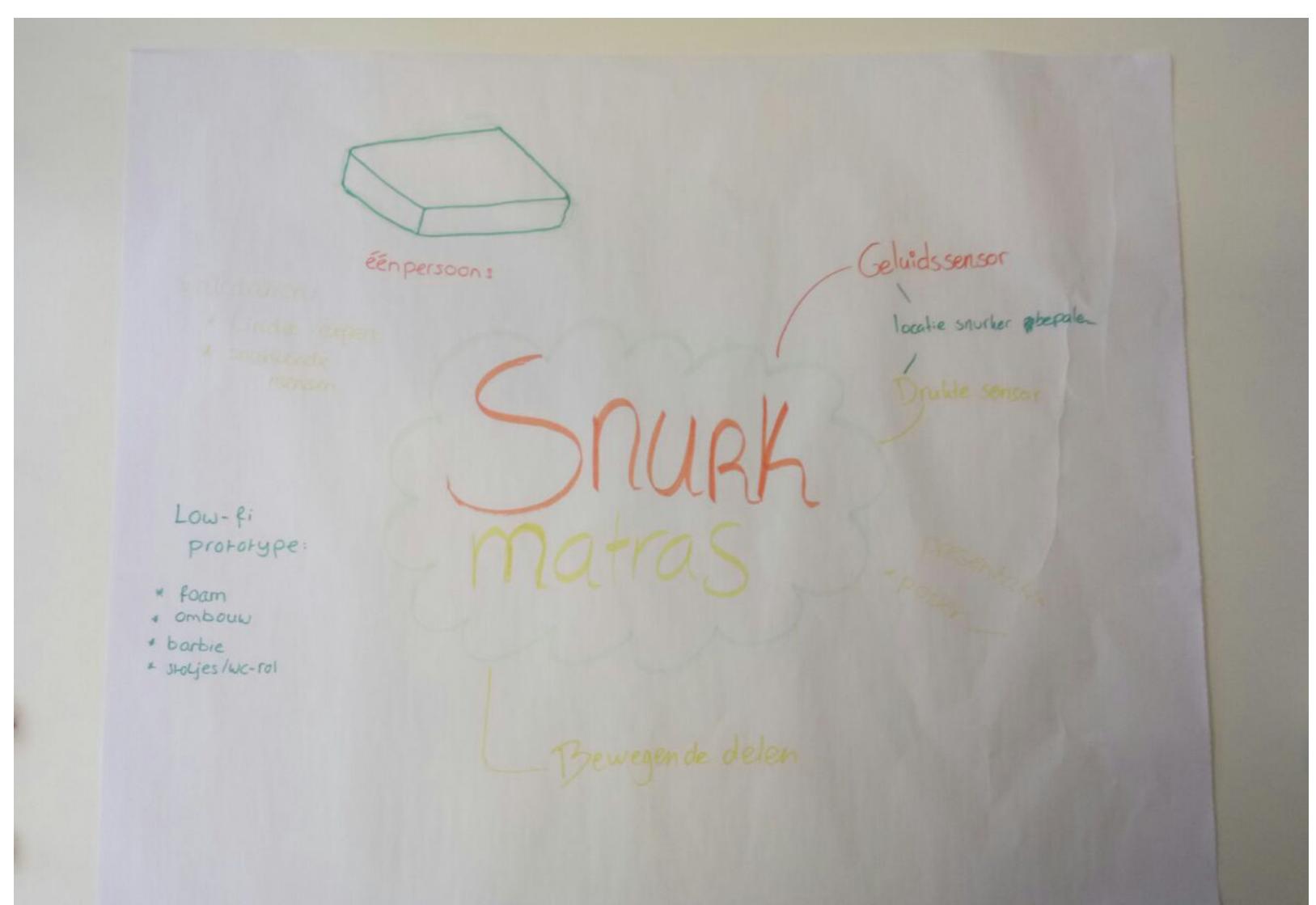
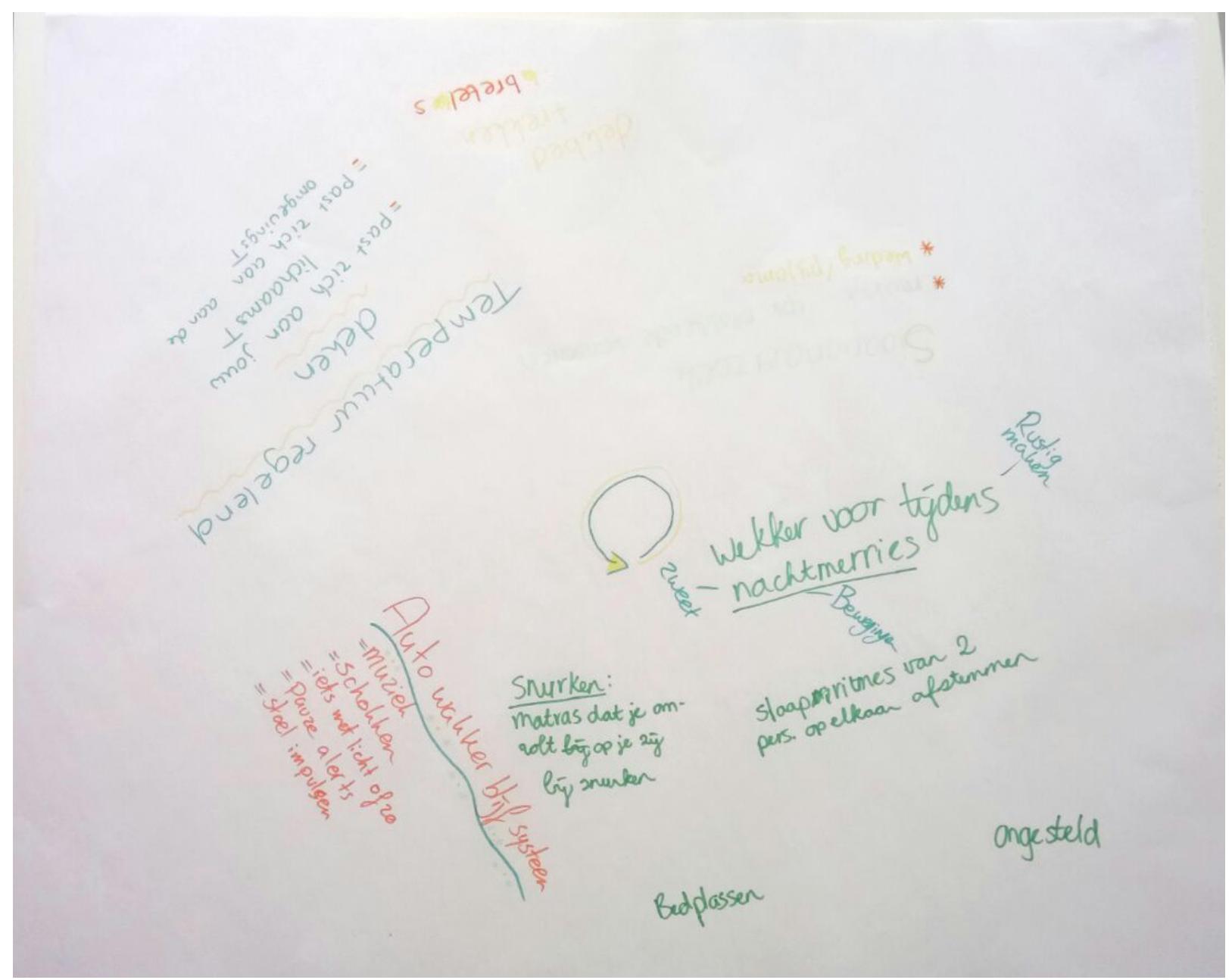


1b. Our prototype for the pressure cooker



2. One of our brainstorm sessions during the Ideation phase

- wanted to go further, we decided it would be better if we would do some research on these subjects, so we wanted to do some literature research. ("How to influence Your Dreams", 2017)
- After we had gathered the knowledge we were required to have, we would come back together to share what we had found.
- We found out that there were already a lot of products for snoring involving cancelling. Furthermore, we realized that nightmares and sleepwalking was a too difficult subject for us: the problems are really psychologic and it is hard to make a product that will minimize these problems. Thus, two topics were left: young parents with babies and young children and sleep.
- Again, we brainstormed on both of them. Eventually, we wanted to focus on Sudden Infant Death Syndrome (SIDS) or children that cannot or will not sleep, when they need to go to bed.
- After we started generating ideas (see picture 3a and 3b), we decided that we would like to continue working on the subject: children who cannot or do not want to go to sleep.
- To gather knowledge about children who cannot or do not want to sleep, we decided to talk to experts: parents with their children.
- We did some interviews to see if many parents face the problem of not getting their children to bed easily. The questions of these interviews, can be found in Appendix 6. The results gave us a good insight on what age group we had to focus on and what the difficulties were that the children and parents faced.



3a & 3b. Some brainstorming about different topics, for example snoring.

- After the ideation phase we had a clear design challenge for us to work on: helping children who cannot or do not want to sleep to relax and fall asleep easily and helping them to stay in bed in the morning. Within this challenge we had already generated a handful of ideas we could work on in the conceptualisation phase.

Conceptualization

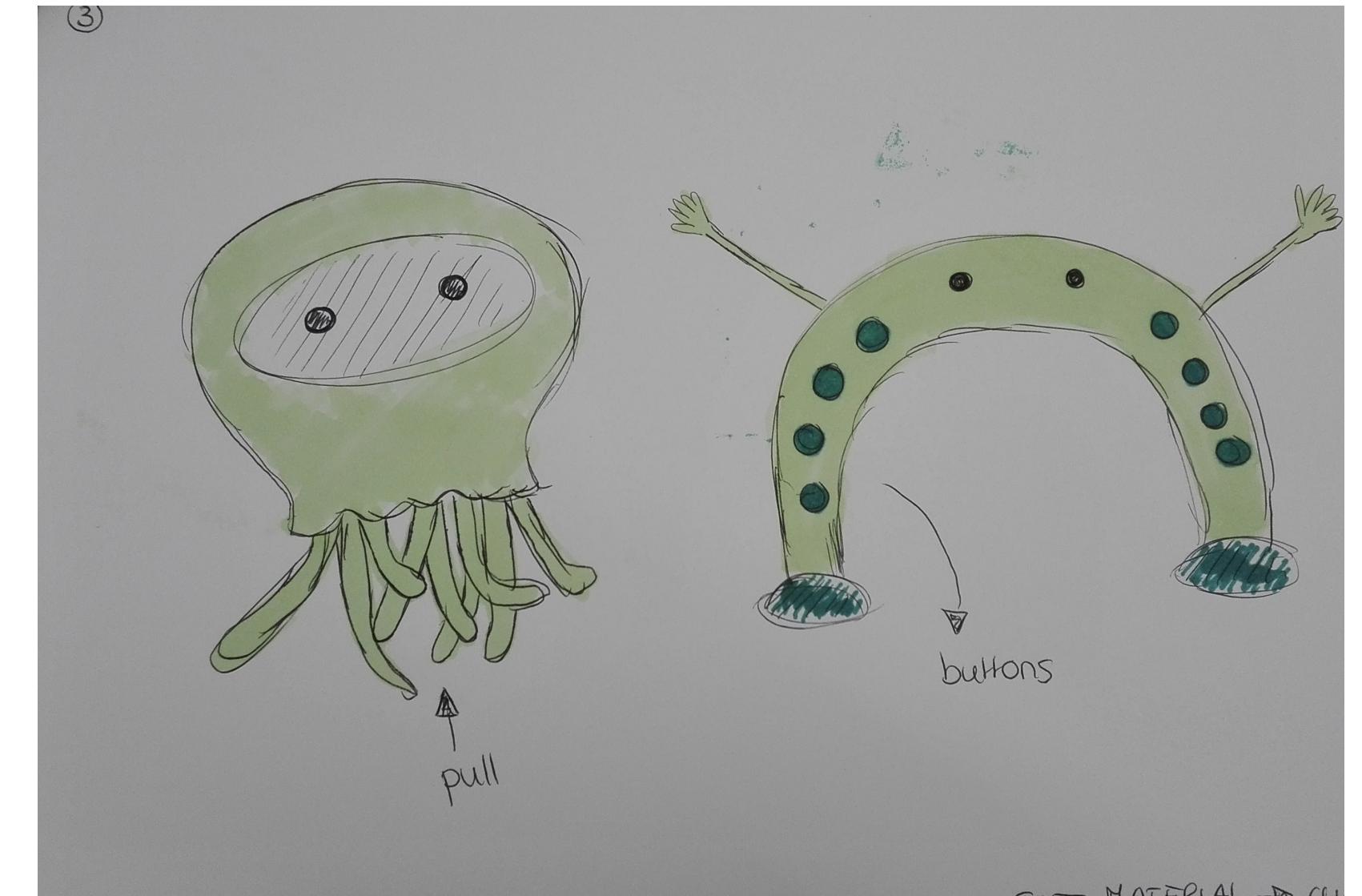
After the ideation phase, we started on the conceptualisation phase of three weeks. The goal of this phase was to have a clear concept of the product we will develop.

We started the conceptualization phase by doing some more research within our design challenge: influencing dreams, hyperactive children, fear to go to sleep and getting up too early. These subjects had appeared during the interviews with the parents and children.

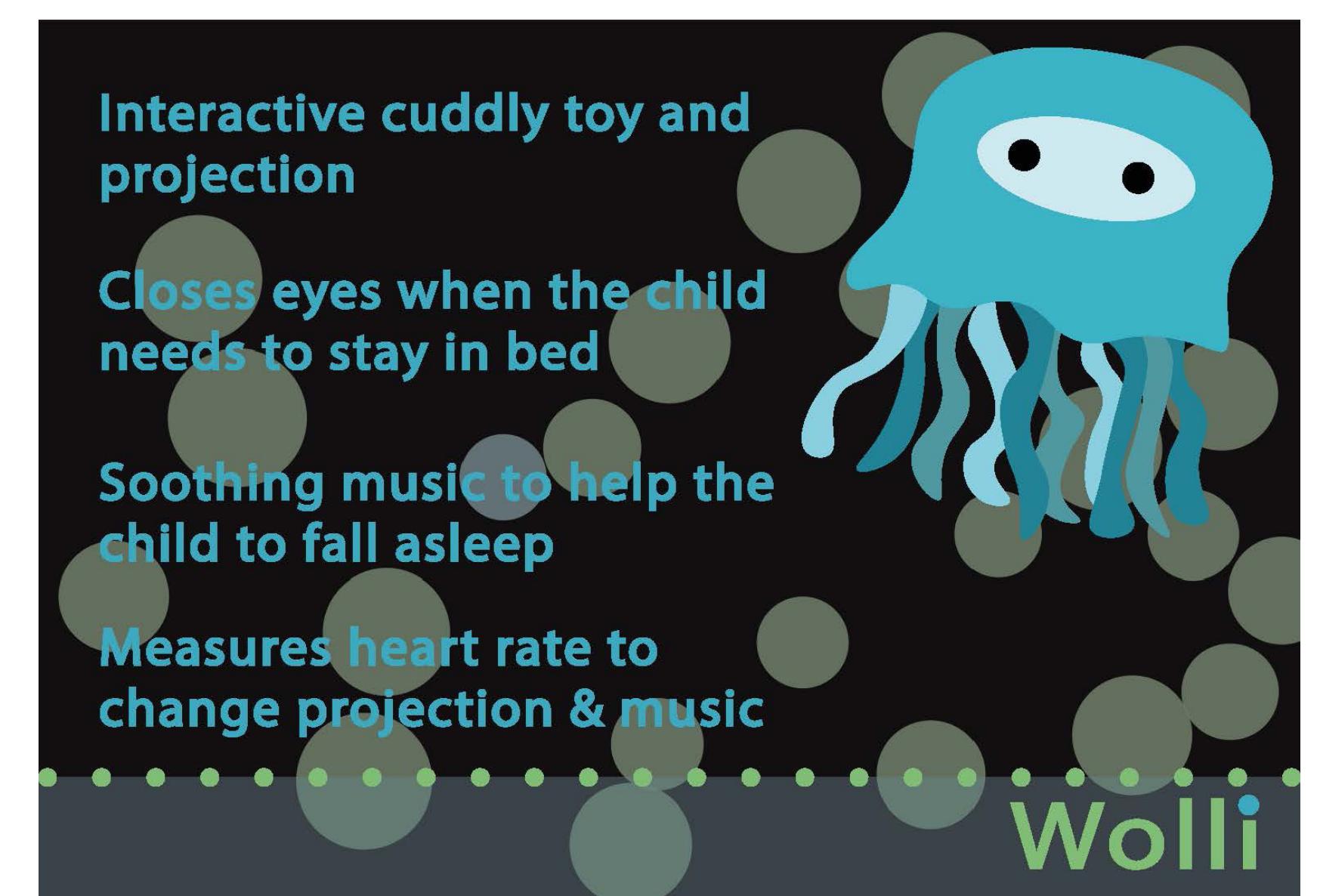
In week 6 we thought more about our concept. We decided that we are not going to include influencing dreams in our product, because it is going to be too difficult to also include this and it does not add much extra value to our main goal. We want to make children calm before falling asleep and keep them longer in bed. This can be more easily achieved with other means than influencing dreams.

After we all made some sketches (see picture 4), we decided that we want to make a cuddly toy with an attached wristband that measures the heart rate. In this way, we can create a projection on the ceiling that is influenced by the child's heart rate. This will motivate the child to get their heart rate down, and become more calm and thus sleepy. Since the projection is on the ceiling, it will motivate children to lay down and stay in bed. In the morning this system could become a game for the children to play before getting out of bed and waking their parents.

After some rethinking, we decided that this game might be too complex and counterintuitive to have in the same product as the projection to calm down.



4. Some sketches of the cuddly-toy with an attached wristband



5. Our concept we showed at the Midterm Demo Day



6. Our prototype for the Midterm Demo Day:
Walli.



7. Our stand, with the projection with beamer and LEDs,
two posters and the cuddly toy at the Midterm Demo Day

- We decided that it would work better if the cuddly toy could close its eyes when the child had to stay in bed and open them when they could get out.

- During this phase we had the midterm demo day (see picture 5,6 and 7), where we could demonstrate our concept and ask feedback what other people thought about it and help us make some key decisions. Our attention was drawn to three important things that we had to keep in mind: (1) our product had to be safe, so no long, thin things which could strangle the child, as our original sketch had, (2) our product should not have too much functionality, since this could cause time trouble and could be confusing and (3) whether or not we would use a beamer, which is more expensive and could become hot, or LED lights, which would limit our creativity and freedom and would have less effect with the projection.

Right after the demo day, we wanted come together to discuss the feedback and make decisions on the important feedback. We decided we had to go back to the drawing table to make a new design for the cuddly toy for safety. As for the functionality, we decided we would only focus on the evening, so the eyes could be static. Finally, we decided to use a beamer, since this would add more value to our product and differentiated us more from the already existing products.

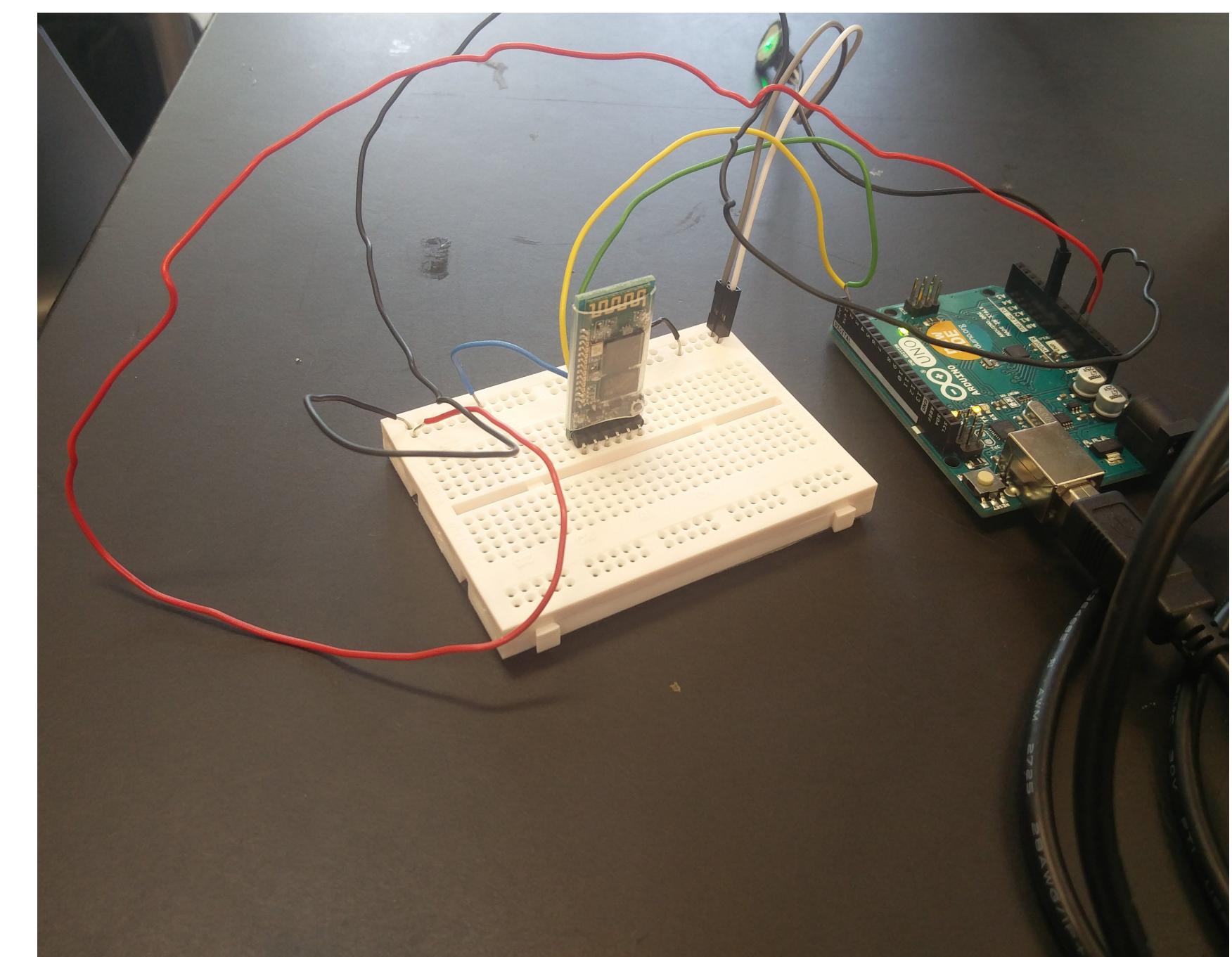
- After the conceptualization phase we had a clear concept on what we could work further in the next phases.

Realization

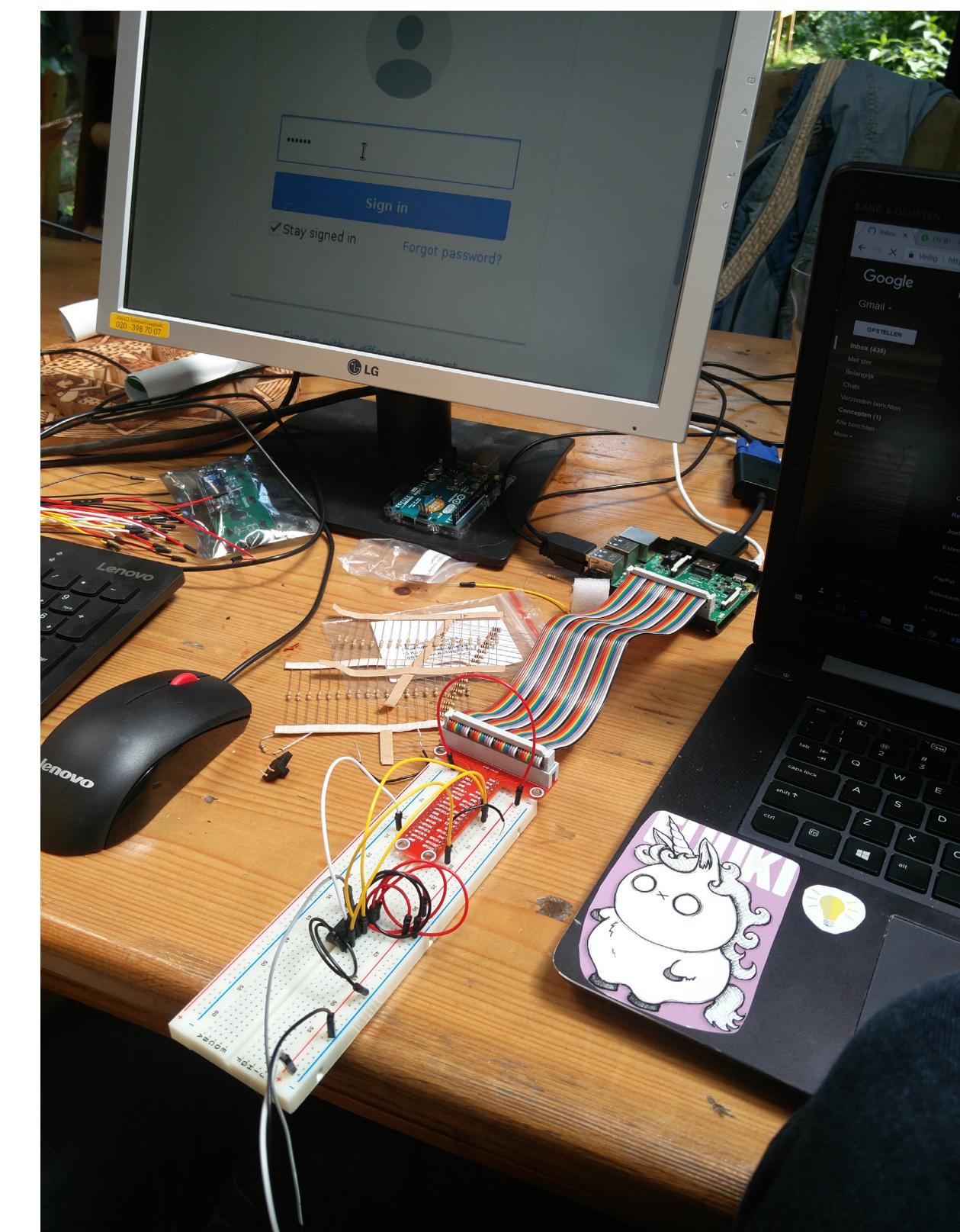
Next, we started the realization phase. In this phase we set two goals for ourselves. The first goal was to make all the technology work properly. The second goal was to have a base for a business plan. We decided we could already start on this, since we had a clear concept and had an idea what we would need and it was useful to already start thinking about the model.

We decided to split our team up in two groups. Bas and Noelle would make the business model (can be found in Appendix 1) and Kelly and Joline would work on the technology (schematics and codes can be found in Appendix 2 till 5). It was decided that they would use Arduino with Bluetooth to make the product work (see picture 8). To make sure that everyone did learn all the aspects we would still meet once a week and explain what we had done this week and how everything worked. Joline and Kelly would also check the business plan and change where needed so they would gain experience here as well. Noëlle would also sew a cuddly toy for the prototype (see picture 10)

After some of the technology was put together we decided would have to test whether the projection would work with people who did not work on the project itself and we let 10 people try our projection (see picture 11). We asked them questions after doing the test, to see how they felt after using it. These questions can be found in Appendix 7. Before we did this little user-test we called with Linda Bronts to check if it would be okay to test with students, to make sure whether children and adults fall asleep the same way. She told us the difference between testing students or testing children would be negligible in this case. The results of the tests can be found in Appendix 11. After these



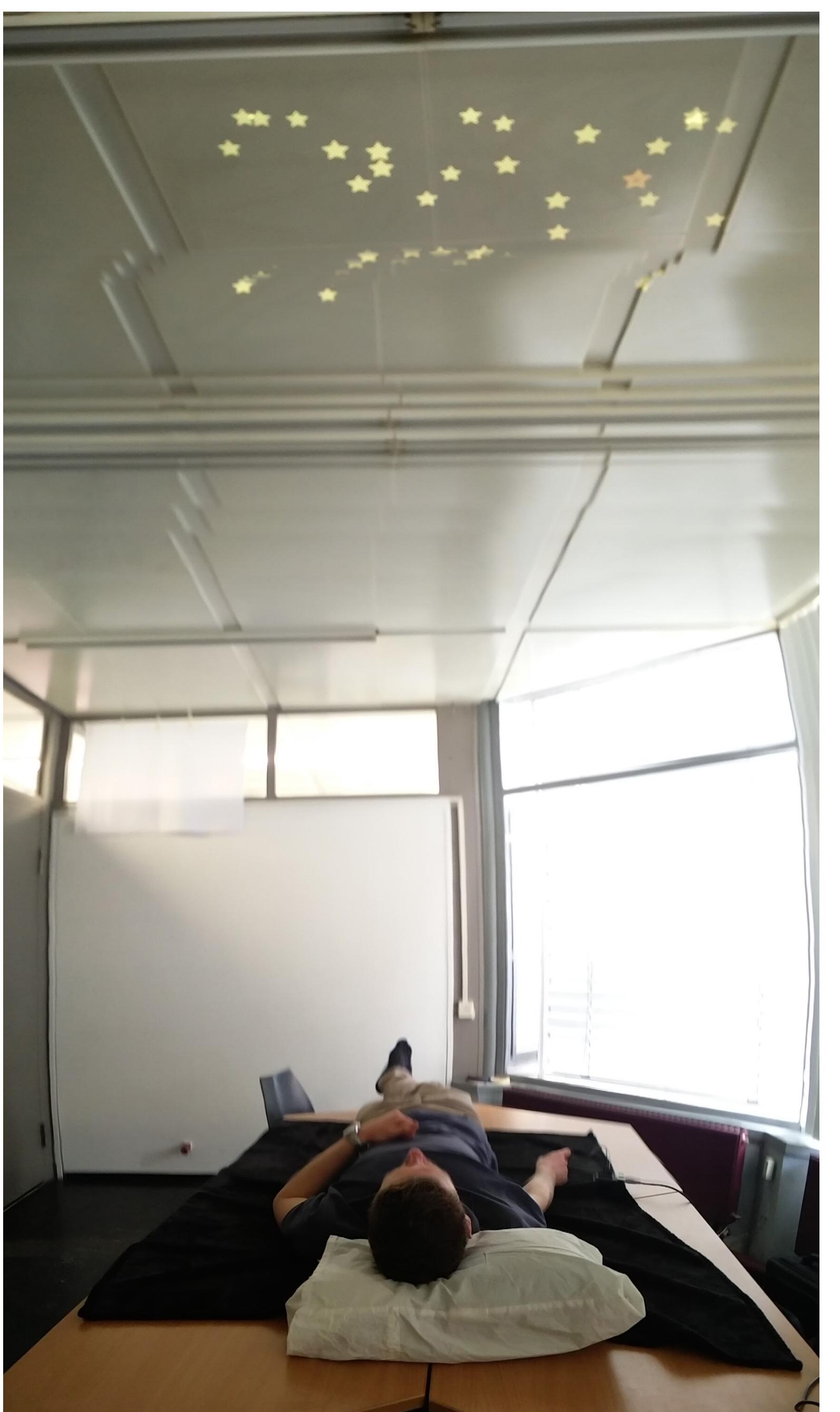
8. Trying to make the technology work with Bluetooth and Arduino



9. Joline and her dad trying to make the technology work with the Raspberry Pi and Wi-Fi



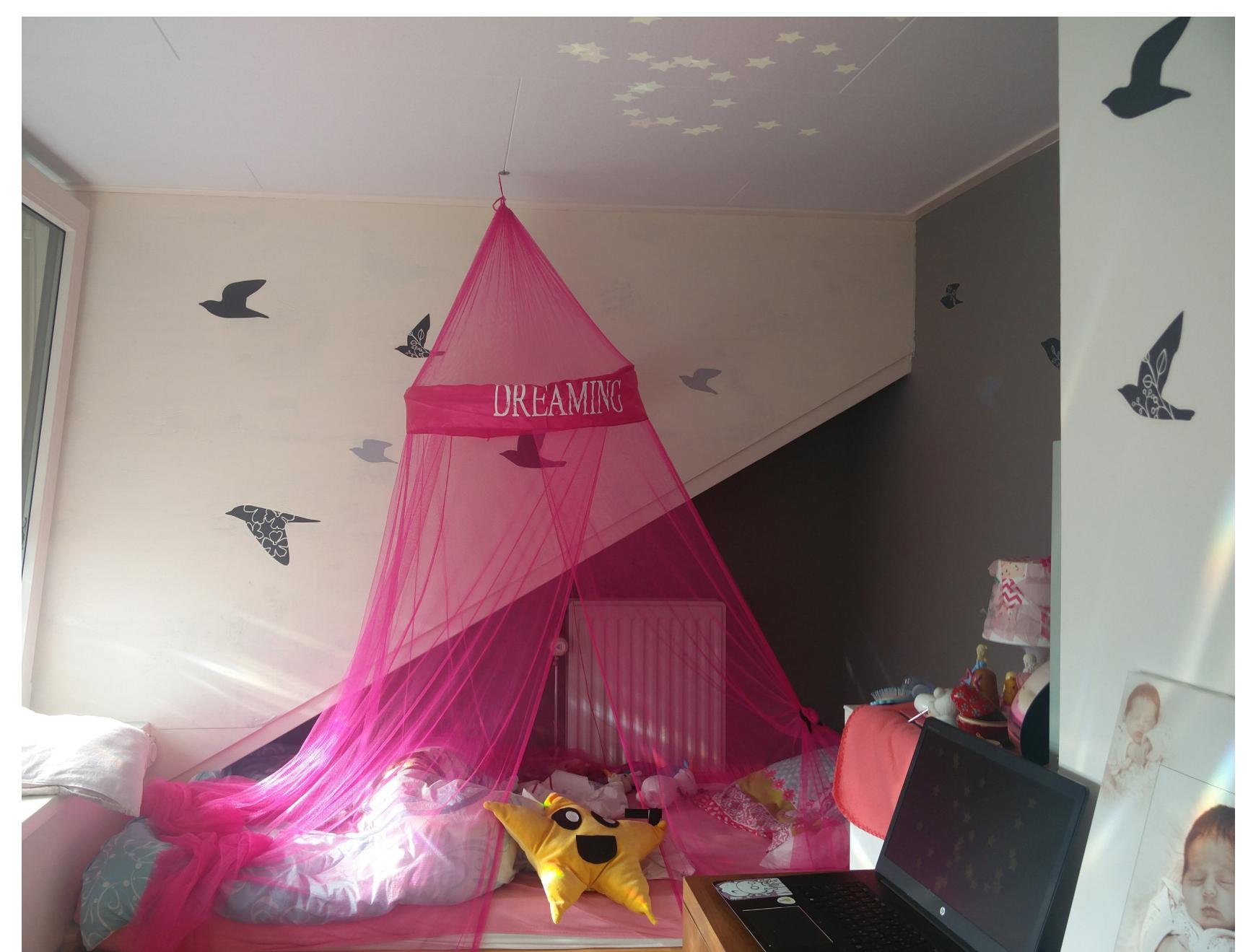
10. Making the cuddly toy



11. Doing some intermediate user-tests with students, to see if our projection works with slowing down the heart-rate



12. QR-code to see the projection or hear the music playing.



13. User-testing at children's home

tests, we made sure our product worked wireless. After a lot of struggling with Bluetooth, we decided it was not going to happen. We made the decision to go from Arduino with Bluetooth to Raspberry Pi with Wi-Fi. Joline and her father worked on this for an entire weekend for it to work (see picture 9). Furthermore, we made a new prototype where the Raspberry Pi fitted in the cuddly toy. Finally, Joline wrote the code for the projection and Bas for the music. Joline and her father made it work using the BPM on any given moment. You can find the codes in Appendix 2, 3 and 4 . To see the projection or hear the music playing, you can scan de QR-code given in picture 12.

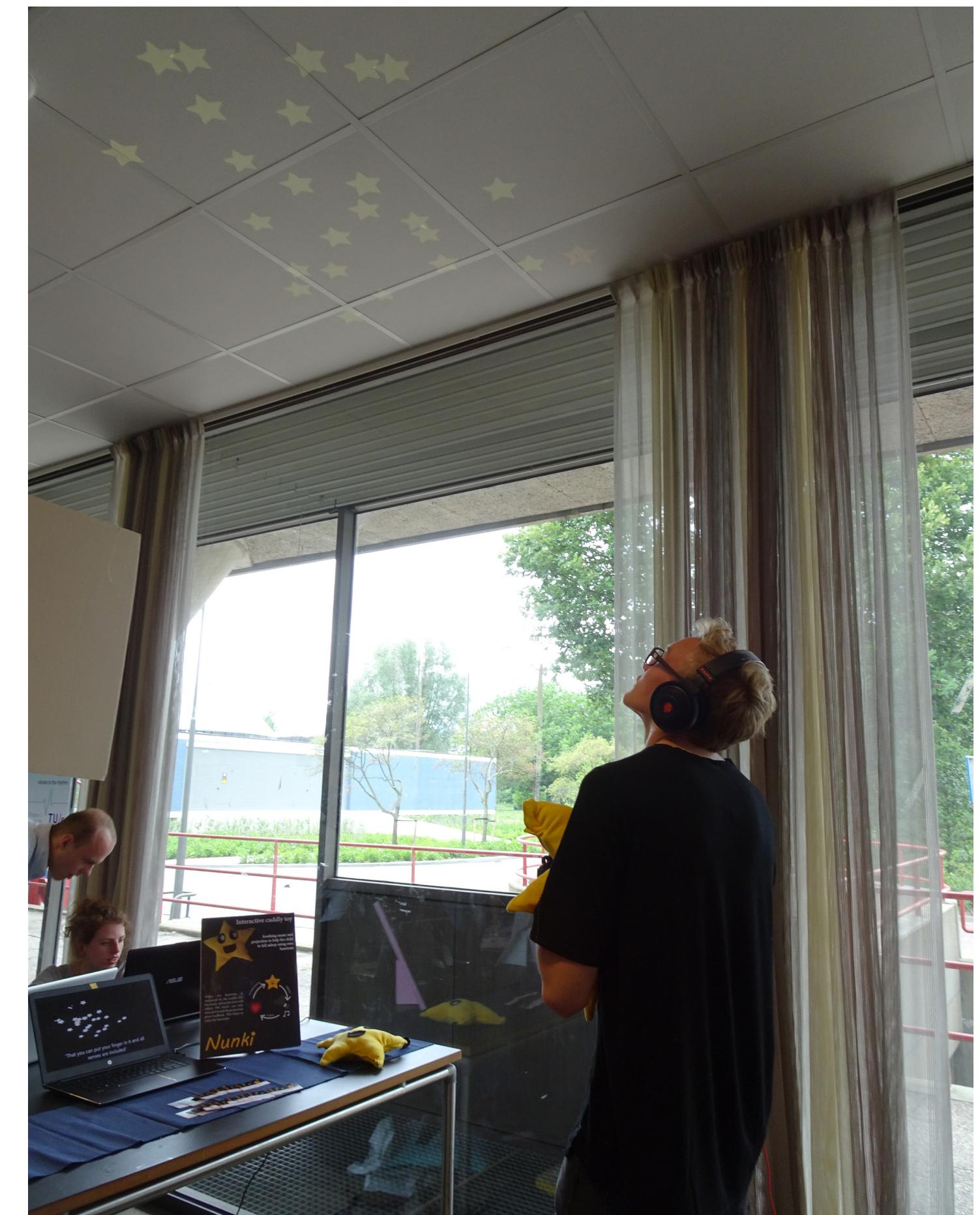
After this phase we had an alpha prototype. Essentially, it works and looks similar to the final product, but before it can be manufactured a lot needs to happen (e.g. the Raspberry Pi needs to be replaced with a smaller device that is specialized for our product). But for now, we can use this prototype to conduct user tests with children for the validation phase.

Validation

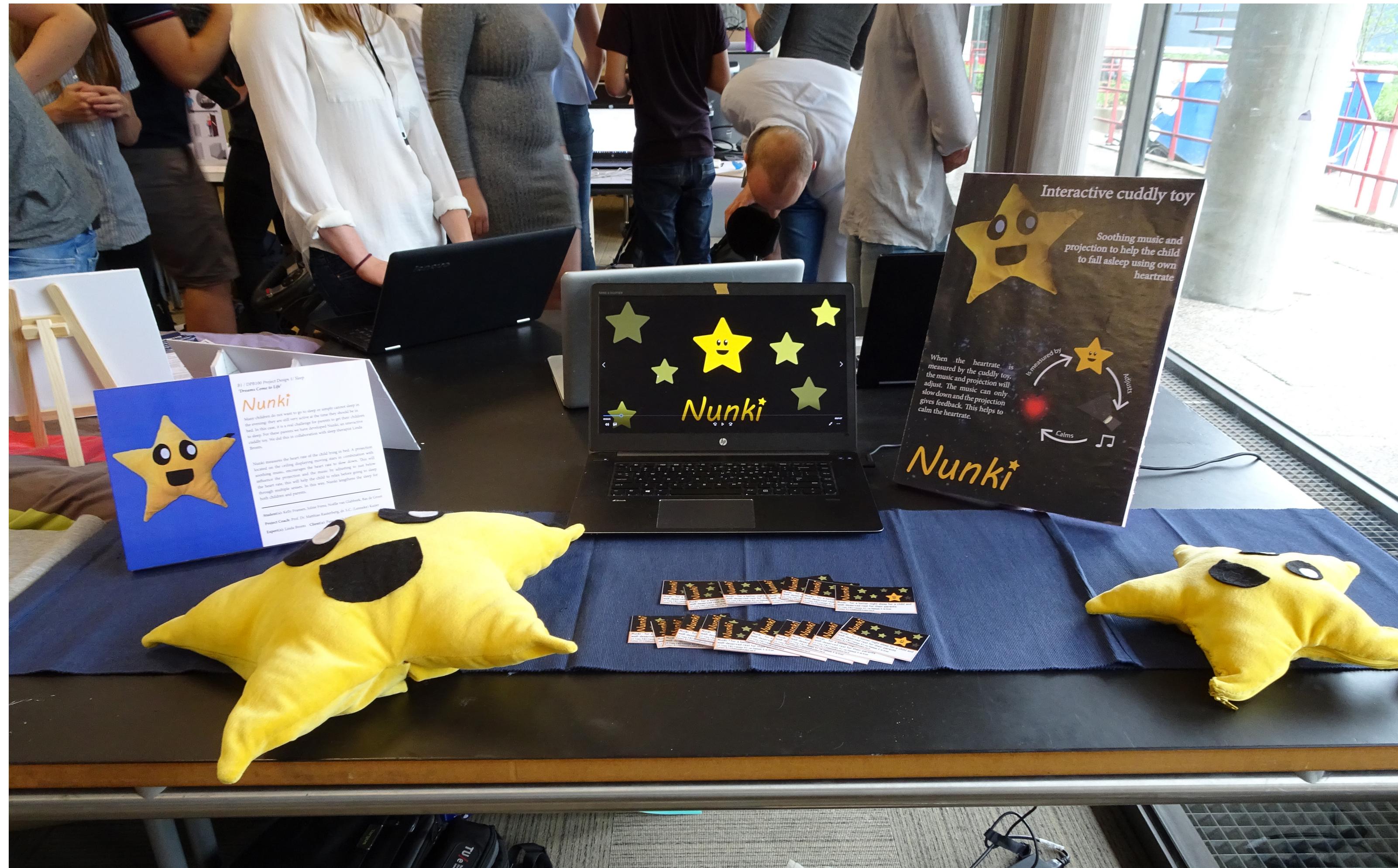
During this phase we needed to check whether our product will work on the market and whether children would like using the product. The goal was to get insight in whether children and parents enjoy using Nunki and would like to have it at home. Furthermore, these user-tests were also to get more feedback on what could be improved with our product. We tested three children, by setting up the projection and giving them the cuddly toy before going to sleep (see picture 13). Furthermore, we asked them some questions before and after using the product to see if they would like using Nunki and if it had an impact or not. These questionnaires, you can find in

Appendix 8. We evaluated all results and put them in a table to get an overview. This table can be seen in Appendix 12.

To get even more feedback on our product, we also asked expert Linda Bronts again, to see if she thinks our product would work. She told us that since we have a product based on different senses, it would be very appealing for children to use. We also showed our design on the Final Demo Day and got some feedback from people there (see pictures 14 and 15) From the results from the user-tests and the feedback from Linda Bronts and people walking by on the Final Demo Day, we were able to draw a conclusion about the outcome of our process and if this outcome fulfills our product goals.



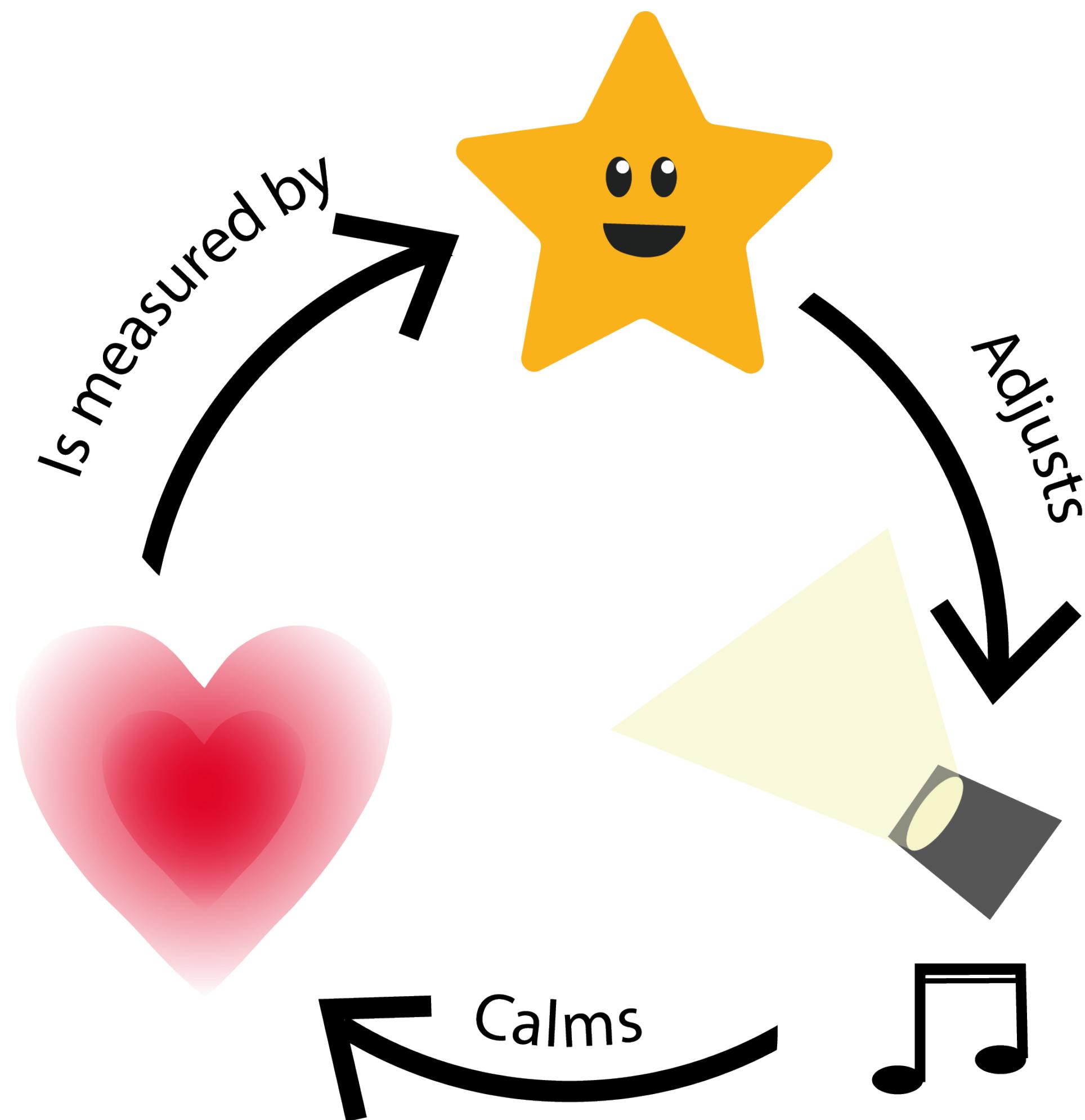
15. People trying out our product during the Final Demo Day



14. Our stand during the Final Demo Day

OVERALL RESULTS

The result of our first project is Nunki, an interactive cuddly toy. It will distract children that have problems with sleeping, before they are going to sleep. It will distract three of your senses: feeling, seeing and hearing. There is a cuddly toy that distracts your touch, a projection that will distract your sight and music that will distract your hearing. The projection and music are connected with the child's heart rate via a pulse sensor. The heart rate gets measured and will stimulate you to relax by using a lower BPM sound than the child's heart rate, which eventually fades away. The projection will also slow down and fade away with the decrease of the child's heart rate. In this way, Nunki provides a better night sleep for the child and a well-deserved rest for their parents or gardian.



CONCLUSION

Our goal was to help children with calming down and getting ready to fall asleep when they are in bed. When we showed our prototype to sleeping therapist Linda Bronts she was very positive about the outcome. She liked that we used different senses to distract the children. She believes that our product could have a positive effect on children trying to fall asleep. We tested our product with three children. Two children slept within half an hour and one found our product too scary. The mother of the child who found the product scary, said that she has troubles with coping with changes. To really test the outcome she should use the product more often, but we did not have enough time for that.

We also wanted to make our product affordable. From the estimation we made in the business plan we can conclude that it is affordable, but not cheap. Nevertheless we are not sure of the pricing, because it could vary a lot due to uncertain factors.

When we presented our idea at the demo day we got a lot of positive feedback: some parents recognized the problem and thought the product could work for their children. Even was mentioned that it could also work for babies: since babies are very distracted in bed. They can also try to focus on the projection and might fall asleep faster. We also got some feedback on our music. This sound could be more various, because it might get boring after some time. However, we think that this music fits our product, since it is about distracting and not about entertaining the child.

In conclusion, we can say that our final design satisfies our project goal. We are very proud of our process and outcome of the project and are looking forward to use our developed skills in future projects.



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REFLECTION - Joline Frens

During Project I I expected to go through the entire design process to discover different ways of approaching a problem, to really understand what the phases mean. I also expected to go through several iterations to experience an actual design process.

In Project I we went through the design process and were faced with all different aspects of it. I have mostly developed my Realization and my Computing skills during the project. This is because I have done a lot for the technical part of the product. Now that I am more competent in this area it will be easier in the future to deal with basic struggles I have faced in the last few weeks. For example, I will know what the possibilities are with Arduino and Raspberry Pi and will make a better informed decision to decide what I want to use.

Furthermore, I have grown in my professional skills. I have become more comfortable writing and presenting in English during the project. This will help me in my later life, since a potential client could be internationally oriented or international themselves. My teamwork skills have grown as well. Working in the same group for a long time helps to notice what is good in a group mate and what is not. This helps when I reflect on myself and try to mirror the good behavior and cancel out the bad.

Another thing in which I have developed in this project is research capabilities. During the project we have done different kinds of research: we have talked with an expert, conducted literary research, conducted user-interviews and done several user-test. Since we have done all this research, it became easier to split important information from less relevant information. It has also become more clear what kind of information one can get from the resources. This will be useful, since it helps to understand what is needed and what is possible. It is also useful to know who or what to address when facing design questions.



However, there were also things that did not go well. An example is that we did not try enough brainstorming techniques in the ideation phases. Due to this we did not generate a lot of ideas and might not have come up with the best idea. What I could do next time is pressure my group that I do want to try this and practise with different techniques myself when I have to make decisions in my free time.

Moreover, what I would have liked to do differently is that I would have wanted to work more on the business part of our project. Since the technology took longer than expected, I did not have time to implement the knowledge I have gained in my elective Designing with and for multiple stakeholders. Next time, I could make a better planning and make sure we have some spare time to do the things that take longer than expected. This way I can do everything I want to do. I have learnt a lot during Project 1. Doing this project helped me to learn basic problems one can face during the design process, which I can avoid or handle more quickly in the future. I have also become more professional. Altogether, this project has taught me important skills and information for later design projects.

REFLECTION - Kelly Fransen

Before starting this project I expected to create a product that is well-thought of and worked out completely, because this is something we didn't got the time for yet in other courses. I wanted to focus on all the competencies and make sure that I developed all of them during this semester. I wanted to use my strengths (Business and entrepreneurship, user and society) and get better at the competencies which I didn't develop as much yet.

My vision focusses a lot on the user, so this is something I also wanted to implement during our project. In the ideation phase we started with doing a lot of interviews with parents. So our product helps a common problem. When we finished our prototype we also tested it with possible future users, which was a nice way to validate our finished product.

Lastly, I learned how to present in a professional way. This was the first time for me to have a professional demo day. Even though I have a lot of experience with presenting from my work, I learned how to present for the specific expert audience that wants to know more about a product. This requires a professional approach, which I think I developed during the tutor meetings and the demo day.

Even though I followed some technical courses, I still felt that I needed to learn more to have enough knowledge to build a technical prototype. This is why I choose to help make that the prototype. Joline was more experienced than I am, so we worked together so I could learn from her. This helped me with getting a hand of coding and wiring.

Something I am very proud of is our planning as a group. We made sure that everything was due within the right phase and we held effective meetings with a planning. This worked very well for me and I will definitely continue this in all my group projects.



However, one thing that I would have done different in the ideation phase is the brainstorming.

We only used two techniques and didn't come up with a lot of ideas. Maybe if we tried more techniques we would have come up with a better idea. This is something I will focus more on in my future projects.

What I should have focused more on is aesthetics. I am still not as good as I want to be at sketching or developing a good-looking prototype. I believe that this is very important to convince people of your product. In my next project I want to focus more on working on the aesthetics.

Overall, I am proud of our result and myself. I focused on developing as much new skills as I could within our project which will help me in the future. There are some things that I should have done different, but which I can change in future group projects.

REFLECTION - Noëlle van Glabbeek

In this reflection I will evaluate on our design process, my own role in this project, the collaboration with the others and how various phases contributed to my goals within the different competences.

Our design process went very fluently in my eyes. For my PDP, I set a goal to not go through a linear process for this project, but to make several iterations and take steps back on time. I shared this goal with my group members and from the beginning on we started with using the RTDP-scheme within our process. We did some validation and some research already within the ideation and conceptualization phase to come up with a proper concept, for example. Since we've followed the deadlines according to the Project Guide, we took enough time for almost each phase. However, I think that if we had taken more time for the validation phase, we could have done more user-tests. This is something we also saw at the pressure cooker, but due to some trouble with the realization of our prototype, we didn't have time to begin earlier. I'm taking this with me and will pay attention to it in my next projects. '

My role in this project I can describe as an organizing role: I was the one focusing on the time-table and made sure everything was done properly and in time. I learned a lot from the workshop, where the focus was on having structured meetings by having a chairman and secretary. We implemented this in the meetings and it worked very good: everything was clear for everyone and there was a clear role distribution each time. I dared to speak more in the group and the communication between me and my group members was very good, which satisfies my goal to give my opinion more and communicate better within a group.

Our collaboration went surprisingly well. I already worked together with Joline before, so we were already quite used to each other's working attitude. Kelly was very strict and clear to us, which I find nice to work with. With Bas the communication was a bit variably in the beginning, but when I got more used to his working attitude this got a lot better. We also evaluated our group work after the Midterm Demo Day, which made it possible to look back at how it went



during the first weeks and what points we could focus on next weeks. This resulted in an even better communication and driven group than before.

My professional skills as presenting and reporting have developed as well during the project.

Since we had to present after each phase, I had to present at least three times. These presentations make me get used to speak in front of people: something I don't like, but have to learn. I'm planning to do it more often, so I will get more used to doing it. My reporting skills developed as well, since I took upon the most tasks for the report. I developed both my writing and InDesign skills.

My goals for the project were, next to better communication within a group and going through a process with the RTDP-scheme, to develop my prototyping skills with different materials and to make a business model or plan for our product. Since I took upon almost all the tasks regarding the prototype, the first goal developed a lot. I learned to use wood and various textiles. For the future, I want to develop these skills more using other materials as foam. Furthermore, I would like to do some more with fabrics, to develop my skills with that material as well.

I told my group as well that I wanted to do a little bit more within the business area of our product, to gain some knowledge about how to look if there's market for your product and what the retail price might be. We set that goal in the beginning of our project and Bas and I took into account the business side the whole project. We made a business model as well. I think this was a good way of developing my knowledge within this area, because we discussed a lot and learned from each other. However, I do think that I could have gain more knowledge by reading a book about business models and plans as well. This is something I want to do for my next projects, so I can imply that knowledge and make business models that are more broad and going into depth.

Overall, this project definitely contributed a lot to my development as an Industrial Designer. A lot of goals I set, were completed within the project. Also new goals have arisen, which I'm going to take with me in my future projects.

REFLECTION - Bas de Groot

This reflection is about the first year's bachelor project. I chose the theme 'Dreams come to life', because I want to reduce stress in the everyday life with my products and sleep could be a big stress factor if you do not have enough of it. I had set some goals before this project in my personal development plan, which I hoped to achieve.

Since I would like to start my own company in the future I took the task on me to make the business plan. It was one of my goals and I had never done that before. I got to know with it and learned that in the early stage of a process it can be a lot of predicting how it could be, without knowing exactly how it will work.

Due to the fact that we had limited time we sometimes had to divide tasks. I for instance wanted to make the video for the demo day, because I want to improve in showing my design in an attractive manner. Unfortunately someone else also wanted to improve on this part. We agreed that working with two people on one video is counterproductive, so I decided to not take on this task.

We did a lot of research during our project, which I thought was very nice. This way we could check whether our assumptions were right and if not change our product.

I believe the collaboration in our group went very well. We were all present in every meeting with a single exception. We had a clear structure that every week there was a different chairman who made the agenda and a different minute's secretary. This actually worked really well and this way not one person constantly had to make minutes or make agendas. I also believe that looking at what is still to come helped us during our project. We did not wait until for instance the validation phase started with finding subjects for our user tests, but we started



a week earlier. When we divided work we evaluated each other's work when it was done or helped each other during the work, so that we would all learn something about it or assist when something is not really working out.

I learned a lot during this project. I now know how to do a full design process and where some bottlenecks could be. From the group work I also learned that I am not naturally the leader in a project. But I still have an active work attitude and want to learn a lot and improve myself. Maybe something I should do the next time is agree on beforehand who wants to improve on what part. We actually did that a bit but did not really stick to that all the time.

APPENDIX

1. Business model

Value-Architecture

Offer

We offer a product, that stimulates children to go to bed when they need to sleep, instead of being hyperactive and keeping the parents awake at bedtime. With this product, the parents do not have to deal with trying to get their kid to bed multiple times and they will get their night rest as well.

Target Group

We mostly focus on children from 4-8 years old. Throughout multiple interviews, we found out that this was the target group where our product would be most useful: children younger than four years old have a more stable sleeping pattern and most of them are not being hyperactive at bedtime or do not want to go to sleep for another reason. We also saw that children older than four years old not have that many problems with going to sleep and if they did, there were more psychological reasons behind it. Furthermore, we focus on the middle class, because we want our product to be affordable for most parents.

Tension plot

As a kid, it can be very boring to go to sleep at a time you are not tired at all. Keeping your parents awake is then something that's very likeable. The risk that this problem entails is that the child will not get enough sleep eventually, as well as the parents. They want to have a good rest and relaxing evening after a long day of work: not getting your child to bed is not the way they want to spend their time in the evening. With our product, the children's

attention is drawn to a projection on the ceiling. This projection shows an interesting 'dream' world, with slowly moving figures. The child also has their cuddly-toy with them which has a heartbeat measuring bracelet. The projection slows the heartbeat down with music and the speed of the moving figures, the heartbeat gets measured by the bracelet and when the heartbeat slows down, the music and speed of the figures slow down as well.

In this way, the heartbeat of the child will slow down in a way they get sleepy and tired. The child will fall asleep easily, when using this product the parents will get a good night rest as well.

Core Capabilities

The core capabilities that we strive for are making a good quality, safe, child friendly and affordable technology. The retail price must be affordable and the product should be trustworthy for the customers.

Partners

Shareholders

Hardware and electronic manufacturers

Distribution & Communication Channels

Our goal is to reach our customers by a targeted campaign focused on the parents of the children. They want to get rid of the problem of their children not sleeping and they'll buy the product. We will do this at stressful times of the day, mostly in the evening after dinner. The chance of the parents recognizing the problem and wanting to do something about that problem is at that time much higher than if we do it during the day. We want to communicate advertisements on television, radio and social media to reach our broad target group.

Value Finance

Most of the numbers or elements named in value finance are educated guesses or assumptions, since we cannot guarantee how it will actually work.

Key resources:

Physical resources such as a storage building and a factory.

Intellectual resources such as patents for beamer and heartbeat bracelet.

Human resources such as employees for customer service or software engineering.

Financial resources in cash to manufacture the product and build an inventory.

Cost structure

Fixed costs are the rent of the storage or outsourcing the fulfillment, the costs for the inventory, the salaries of the employees and the costs for patents.

Variable costs are the cost of manufacturing, those costs will increase when the amount of manufactured products will increase by increase of demand for our product.

Our product could be seen as value driven. We want to make the product as good as possible. We also want to reduce the price as much as possible so it is affordable for the middle class, and perhaps lower class. But lowering the price should not influence the added value.

Revenue streams

The revenue stream is a transaction revenue. The customer buys the product and has immediately the full license to use the whole product. In the future we could add expansions to our product such as different projections to not have one transaction, but more frequent transactions.

Pricing

Our retail price and production price are based on the price of existing products, therefore it is an educated guess. A mini beamer is around 50 euros on the market and a heart measuring bracelet is around 20 euros. With this knowledge we make the guess that the

retail price will be around 70 euros. And the production price that is a lot lower is based on the fact that mass production will make it cheaper to produce.

Retail price: 70 euro

Production price: 30 euro

Turnover and Total costs

There are around 720,000 children in the Netherlands between 4 and 8 years old. There is no research on how many of those children have sleeping problems, therefore we do not know the exact market for our product.

Variable costs:

The price for fulfillment is based on an existing company that does fulfillments.

Production costs: 20 euro

Fulfillment: 7 euro

Fixed costs per year:

Salary of employees: 200,000 euro when 10 employees are active

Cost for inventory when 500 products are stocked: 35,000

50,000 units

If we assume that we sell 50,000 units of our product our total turnover is $70 \times 50,000 = 3,500,000$. If we subtract the fixed costs of 235,000 euro and the variable costs of $27 \times 50,000 = 1,350,000$ we have a profit of 415,000 euro.

2. CODE - Raspberry Pi

```
1 import time
2 import RPi.GPIO as GPIO
3
4 GPIO.setmode(GPIO.BCM)
5 # read SPI data from MCP3208 chip, 8 possible adc's (0 thru 7)
6 def readadc(adcnum,clockpin,mosipin,misopin,cspin):
7     if((adcnum>7) or (adcnum<0)):
8         return -1
9     GPIO.output(cspin,True)
10    GPIO.output(clockpin,False) # start clock low
11    GPIO.output(cspin,False) # bring cs low
12    commandout = adcnum
13    commandout |= 0x18 #start bit + single ended bit
14    commandout <<= 3 #we only need to send 5 bits here
15    for i in range(5):
16        if(commandout & 0x80):
17            GPIO.output (mosipin,True)
18        else:
19            GPIO.output (mosipin,False)
20        commandout <<= 1
21        GPIO.output (clockpin,True)
22        GPIO.output (clockpin,False)
23    adcout = 0
24    #read in one empty bit, one null bit and 10 adc bits
25    for i in range(12):=
26        GPIO.output(cspin,True)
27        adcout >>= 1 #first bit is null so drop it
28        return adcout
29    #pins from the ADC to the Pi
30    SPICLK = 18
31    SPIMISO = 23
32    SPIMOSI = 24
33    SPICS = 25
34    GPIO.setwarnings(False)
35    #setup the spi interference pins
36    GPIO.setup(SPIMOSI,GPIO.OUT)
37    GPIO.setup(SPIMISO,GPIO.IN)
38    GPIO.setup(SPICLK,GPIO.OUT)
39    GPIO.setup(SPICS,GPIO.OUT)
40    #pulse sensor connected to ADC0
41    pulse_adc = 0
42    #Threshold for pulse sensing is half of values between 0 and 1023
43    THRESH = 900
44    #pulse detection
45    pulse = False
46    t=1
```

```
52     while True:
53         analog_value = readadc(pulse_adc,SPICLK,SPIOMOSI,SPIMISO,SPICS)
54         if (analog_value > THRESH):
55             if (pulse == False):
56                 pulse = True
57                 bpm = 6000/t
58                 if (bpm<200):
59                     print ("Beat ", round(bpm))
60                     file = open("/home/pi/Public/BPM.txt","w")
61                     file.write(str(bpm))
62                     file.close()
63                     file = open("/home/pi/Public/BPM2.txt","w")
64                     file.write(str(bpm))
65                     file.close()
66                     t = 0
67             else:
68                 pulse = False
69             #wait 0.1s
70             time.sleep(0.01)
71             t= t + 1
--
```

3. CODE - Projection in processing

```
1 int numStars = 25;
2 Star[] stars = new Star[numStars];
3 float speed = 1;
4 float visibility = 200;
5 PImage nunki;
6 PImage others;
7 float[] BPMar;
8 float BPM = 100;
9 void setup() {
10     fullScreen();
11     stars[numStars-1] = new Star(random(0, width-110), random(0, height-110), 100, random(0.5,1), random(0.5,1), round(random(1,2)), round(random(1,2))); //Start
12     for (int i = 0; i < numStars-1; i++) {
13         stars[i] = new Star(random(0, width-100), random(0, height-100), random(70, 90), random(0.5,1), random(0.5,1), round(random(1,2)), round(random(1,2)));
14     }
15     noStroke();
16     nunki = loadImage("Nunki.png");
17     others = loadImage("star.png");
18 }
19 void draw() {
20     File f = new File(dataPath("flag.txt"));
21     if (f.exists()){
22         String[] BPMstr = loadStrings("BPM.txt");
23         BPMar = float(BPMstr);
24         BPM = BPMar[0];
25     }
26     if (BPM< 100 && BPM>40){
27         speed = BPM/60 -4/6;
28         visibility = (255/70)*BPM - 765/7;
29     }
30     background(0);
31     for (int i = 0; i < numStars; i++) {
32         stars[i].x +=speed*stars[i].vx;                                //move stars
33         stars[i].y +=speed*stars[i].vy;
34         if (i == numStars-1){
35             tint(255, visibility);    //make one star a different color
36             image(nunki, stars[i].x,stars[i].y,stars[i].diameter,stars[i].diameter);
37         } else{
38             tint(255, visibility);
39             image(others, stars[i].x,stars[i].y,stars[i].diameter,stars[i].diameter);
40         }
41         if (stars[i].x < 0 ||stars[i].x + stars[i].diameter > width ){
42             stars[i].vx = -stars[i].vx;                                //keep stars in the thing
43         }
44         if (stars[i].y < 0 ||stars[i].y + stars[i].diameter > height ){
45             stars[i].vy = -stars[i].vy;
46         }
47     }
48 }
```

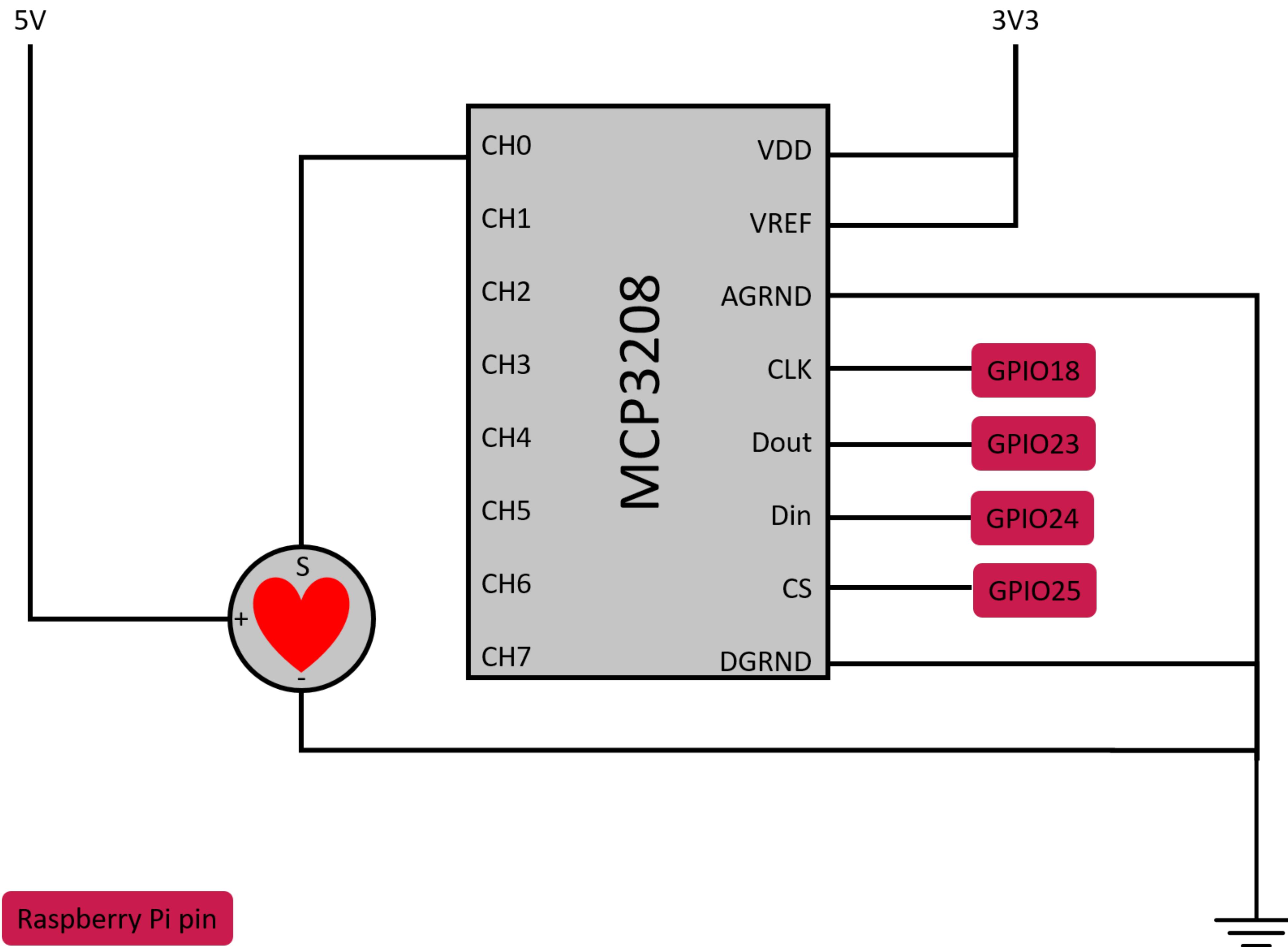
```
49
50 class Star {
51   float x, y;
52   float diameter;
53   float vx;
54   float vy;
55
56   Star(float xin, float yin, float din, float vxin, float vyin, int dx, int dy) {
57     x = xin;                                //start location x
58     y = yin;                                //start location y
59     diameter = din;                          //size
60     vx = vxin*pow(-1,dx);                  //start speed x + left or right
61     vy = vyin*pow(-1,dy);                  //start speed y + up or down
62   }
63 }
```

4. CODE - Music in processing

```
1 import processing.sound.*;
2
3 SoundFile soundfile;
4 float x;
5 float y;
6 float BPMlast =80;
7 float BPM;
8 float[] BPMar;
9 int t=0;
10
11 void setup() {
12
13     soundfile = new SoundFile(this, "vibraphon.aiff");
14     soundfile.loop();
15 }
16
17 void draw() {
18     File f = new File(dataPath("flag.txt"));
19     if (f.exists()){
20         String[] BPMstr = loadStrings("BPM2.txt");
21         BPMar = float(BPMstr);
22         BPM= BPMar[0];
23     }
24
25     if (BPM<BPMlast && BPM>50 && BPM<100){
26         BPMlast -= 1;
27     }
28
29     BPM = BPM-0.0005;
30     if (BPMlast<60||t==1800){
31         y=0;
32     } else{
33         x= BPMlast/100; // x delen door 60
34         y = BPMlast/130;
35     }
36     soundfile.rate(x); // sound afspelen met rate van x
37     soundfile.amp(y); // sound afspelen met een amplitude van x
38     delay(1000);
39     t++;
40 }
```

5. SCHEMATICS

- Raspberry Pi & Pulse sensor



6. QUESTIONNAIRES- Interview 1

(Ideation)

Target group = 4-10

Interview parents

How many children do you have in the category 4-10?

Age child(ren):

Gender child(ren):

Can you say something about the rituals you do before laying your child in bed?

Does this go easily/fluently?

What do you do when your child doesn't want to sleep?

Are there any other problems in the middle of the night, regarding your child's sleep?

Are there any other problems in the morning, regarding your child's sleep?

Interview children

How do you feel about the time you need to go to bed?

What do you do before you go to sleep?

While lying in bed, do you sleep easily/fast?

What do you do when you cannot sleep?

Do you wake up sometimes in the middle of the night? What do you do when this happens?

How does waking up go? Does it go easily or is it difficult sometimes?

7. QUESTIONNAIRES- Interview 2 (Realization)

The questions for students, after laying down and seeing the projection:

- 1: Did you have the idea that you were more relaxed (than before the test) after a while?
- 2: Did your eyes feel sleepy/heavy as time passed by?
- 3: Did you feel more sleepy after the test than you did before?
- 4: Did you have experienced any other inputs or outputs (or: senses) after the test than you did before?
- 5: Do you have any other remarks?

8. QUESTIONNAIRES- Interview 3

(Validation)

Questionnaires user-test

General information

Age child:

Gender child:

Before using the product:

1. Does your child have problems regarding sleep? If yes, what problems?
2. What do you do when your child is facing this problem/these problems?

After using the product:

3. Do you think Nunki helps?
4. Would you use Nunki? Why?
5. Would you recommend Nunki to other parents? Why?

For the child and their parent the next morning:

6. Did Nunki help to relax more and to fall asleep easily?
7. Is the shape of Nunki right?
8. How do you feel about the projection?
9. How do you feel about the music playing?
10. What can be improved?
11. Any other remarks?

9. CONSENT FORMS- User-test with students

Informed Consent Agreement

Please read this consent agreement carefully before you decide to participate in the study.

Purpose of the research study: The purpose of the study is to find whether the design product is understandable for the user (children between 4 and 8 years old). Another purpose is to find out what the user thinks about the product.

What you will do in the study: During this study you will be asked to do multiple actions. During this actions notes will be made and photos could be taken. This is for our future reference for making a report. After each action there will be a short questionnaire. You can stop the study when you want. There are no consequences if you decide to stop during the study.

Time required: This study will last approximately fifteen minutes. This includes the questionnaire.

Risks: There are no calculated risks.

Benefits: There are no direct benefits to you for participating in this research study. The study may help us understand how the design can be changed to fit the user group.

Confidentiality: Photos will not be used without further request. The questionnaires will remain anonymous.

Voluntary participation: Your participation in the study is completely voluntary.

Right to withdraw from the study: You have the right to withdraw from the study at any time without penalty. All received data will be destroyed.

How to withdraw from the study: If you would like to withdraw from the study you should contact the persons below.

Payment: You will receive no payment for participating in the study.

If you have questions about the study, contact:

Noëlle Glabeek, Joline Frens, Bas de Groot, Kelly Fransen

Industrial Design

Technische Universiteit Eindhoven, Eindhoven, 5623 AZ

Phone number: 06 - 40 08 08 23

Email: j.c.frens@student.tue.nl

Agreement:

I agree to participate in the research study described above.

Signature: _____ Date: _____

You will receive a copy of this form for your records.

10. CONSENT FORMS- User-test children and their parents

Informed Consent Agreement

Please read this consent agreement carefully before you decide to participate in the study.

Purpose of the research study: The purpose of the study is to find whether the design product is understandable for the user (children between 4 and 8 years old). Another purpose is to find out what the user thinks about the product.

What your child will do in the study: During this study your child will be asked to do multiple actions. During these actions notes will be made and photos could be taken. This is for our future reference for making a report. After each action there will be a short questionnaire. You can stop the study when you want. There are no consequences if you or your child decides to stop during the study.

Time required: This study will last approximately fifteen minutes. This includes the questionnaire.

Risks: There are no calculated risks.

Benefits: There are no direct benefits to you for participating in this research study. The study may help us understand how the design can be changed to fit the user group.

Confidentiality: Photos will not be used without further request. The questionnaires will remain anonymous.

Voluntary participation: Your child's participation in the study is completely voluntary.

Right to withdraw from the study: You and your child have the right to withdraw from the study at any time without penalty. All received data will be destroyed.

How to withdraw from the study: If you or your child would like to withdraw from the study you should contact the persons below.

Payment: You will receive no payment for participating in the study.

If you have questions about the study, contact:

Noëlle Glabeek, Joline Frens, Bas de Groot, Kelly Fransen

Industrial Design

Technische Universiteit Eindhoven, Eindhoven, 5623 AZ

Phone number: 06 - 40 08 08 23

Email: j.c.frens@student.tue.nl

Agreement:

I agree to let my child participate in the research study described above.

Signature: _____ Date: _____

You will receive a copy of this form for your records.

11. RESULTS -User-test with students

Questions from Appendix 7 (Realization)

Testperson	1	2	3	4	5	(decrease of) BPM	Date
A	A little bit	No	No	Focus on orange, but it is difficult because of fast moving	Orange star is more outstanding	73-64	5/11/2017
B	Yes	No (can be a consequence of the time of the day)	Yes, some	No	No	74-59	5/11/2017
C	A little bit, feels a bit muggy	Yes	Yes, not extreme, but a little bit	Not really, screen is somewhat high	No	61-60	5/11/2017
D	Yes	Not really	A little bit	Not really	The orange one with the face is funny	90-72	5/11/2017
E	Yes, nice to lay down with the projection	No	Not really, more relaxed now	Not really	Fun	70-56	5/11/2017
F	Yes, laying down helps and looking at moving stars as well	A little bit	Yes	A little bit	No	85-76	5/11/2017
G	Yes, it was nice to look at, better than clips on YouTube	Yes	No	No	No	74-54	5/11/2017
H	Yes, I'm way more relaxed	Yes, at the end they did	Yes, I could fall asleep, my head is empty now	The heart sensor was too tight on my finger, felt not good	bracelet around wrist would be better, it was a bit choppy now, maybe something with breathing and candle light	72-65	5/11/2017
I	Yes, more relaxed and you get feedback on your heartbeat which is nice	Yes, sometimes they already closed	It was too short now, but it could work	You feel your own heart beat	No, it is fun, music would help, good animation	2 BPM down	5/11/2017
J	Yes, got the intention to close my eyes	Not heavy	Not sleepy, but relaxed	No	The projection did not change much	5 BPM down in 5 minutes	5/11/2017

12. RESULTS -User-test children and their parents (Validation)

Questions Appendix 8

Gender	Age	1&2	3	4	5	Time when they were in bed:	Time they were sleeping:
Girl	5	Not really. Sometimes parents reads a book to let the child fall asleep.	Yes	Dad: No, maybe if the child had a real problem. Wouldn't invest in something if there isn't a real problem. Mother: Yes, I like technical stuff and it seems to work.	Yes, if a child has problems with sleeping.	19.27 19.42: calls her mam, because the projection stopped working, Joline fixed it.	20:04 : check if she was sleeping and she was.
Girl	7	Yes, the child has difficulties with falling asleep fast. Readin a book or the parent staying with her doesn't usually help.	Now it didn't, but maybe if she is used more to the product it would work.	Yes, I would.	Yes, this product could really work, after getting to use to it, the product could be very soothing.	19.25 19.56: thinks it's too exciting, cries.	20.30: doesn't sleep, too restless.
Boy	8	Most of the time the child does not have problems, sometimes not tired yet and then he keeps coming out of bed. The parents try to read them a story when this happens.	Don't really know, since this was a evening he would probably sleep well anyway.	No, sleeping goes well anyway most of the time.	Yes, if the child has real sleeping problems it could work.		

Questions the morning after using Nunki (for parent and child)

6	7	8	9	10	11
Nunki helped to calm down and to cuddle well.	She thought the shape of Nunki was fine.	She thought the stars were pretty and interesting to look at.	It felt nice to sleep with the music on.	Maybe more variation in colours with the projection.	No, we do not have any remarks.
No, Sophie thought it was too exciting.	Yes.	Good. She liked the stars very much.	Nice music, pretty.	The sensor should not be on the finger. The projection should be on the wall, so she could lay on their side.	No, we do not have any remarks.
Yes, it felt nice to hold Nunki.	Yes, the shape was not to big, you could cuddly it well.	It felt very nice. The stars were not moving too fast. He followed the 'Nunki-star' with his eyes and this maked him sleepy.	This was okay. Not too loud. It maked you calm and relaxed.	Maybe just his own cuddly-toy were you could put the technology in it. He prefers his own cuddly-toy more.	Willem sleeps well most of the time, but he thought the projection with music was very relaxing and in his eyes it made him more sleepy.