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introduction

In our first project we did not only learnt to bug, but were also bugged ourselves.

The first project of our Industrial Design education at the Eindhoven University of Technology was Bugged 2.0. In this project we were triggered to think in ways that were counter-intuitive and develop skills we didn't think we would need.

Our objective was bugging an existing object. Initially a bug was explained as an unexpected inter-action that made the product harder to use unless you got to understand his character through use and get used to working around this bug.

Over the course of the project we started to dislike this negative bug and explored turning the negative bugs we had conceptualized into positive bugs. We tried to add a second layer to a product that would be unexpected, but added to the product instead of making it harder to use.

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our interpretation of bugged 2.0

Our first step in working in this open-ended project was determining the direction we wanted the project to go.

None of us had experience doing a project as open-ended as Bugged 2.0 so our first step was finding out what the goal of the project is and what our interpretation of that goal would be.

After deciding our direction we started brainstorming using several techniques. Through these brainstorms we created mind-maps, lists of keywords and a rough planning of how we wanted the project to go.

Using all the generated ideas and inspiration we formulated our goal. This goal was a combination of our interpretation of the project as a group and our personal motivations for doing this project and for choosing this study.

objectives

Our first step was understanding the goal, we listed the most important parts and went from there.

The first thing we did was looking at the project description, to us the most important sentence was:

"design a second layer that will excite people, let them smile, give them shivers or will affect them in another playful manner"

So we had to look at existing products, and especially at products people already have certain expectations of.

"in first instance there is nothing strange or abnormal with the space but then suddenly certain objects move while they are not supposed to"

We had to add movements or other clear calls for attention, preferably actions the product normally is not able to do.

"[…]. Be aware though this particular example does not incorporate technology and we expect you to do so!!!"

For most of us the focus on electronics was an important reason for choosing this project, so we already planned on doing this.

"give it behavior […] that teases the Homo Ludens (Playful human), make it smile."

Most of all, be sure to create a playful interaction. Don't create a purely utilitarian product, but create a product that takes getting-used-to and adds an extra dimension to using it.

research

Because this was our first project we didn't know where to start. We started with researching the design process.

After having decided on our initial direction we started generating more ideas. We started with looking into the skills all the team-members had when we started and which competences each of us wanted to develop. Then we looked into the several phases of the project and which competencies correlated with each phase, to create both a broad planning and a distribution of tasks.

Thereafter we used the *IDEO cards* to generate ideas. We looked into products we could bug, settings in which the bug could take place and personas our product could have. Then we combined these separate parts and used those to create several concepts. These concepts became the basis of a list of ideas we were continuously adding to.

We then started using the *Thinkertoys* book by Michael Michalko, we used his methods to further explore the ways we could bug objects. Looking from the user's point of view and seeing what kind of insights that could bring us.

Some of us also read *The Design of Everyday Things* by Don Norman and we used those new looks at interaction design to see where a bugged object would need to be different from those guidelines and found out that we could achieve a lot by messing with the signifiers, to create a red herring and an unexpected interaction.

formulating our goal

After defining our general direction we looked into specifying it further and making our first selection of ideas.

Our last step before starting to pick from our list of ideas and start developing some of those into real concepts was formulating a clear goal. The goal we came up with was:

Create a surprising interaction with a product in a public space.

To us, a surprising interaction is the core of the Bugged 2.0 project. We wanted to focus on doing it in a public space, because buying a bugged product for your own use would spoil the surprise and reduce the product to a one-trick-pony, gag product.

We used another *IDEO cards* method and split the keywords of our challenge into several words, the keywords we chose were: public space and interaction.

These were split into words like park, mall, trigger, suspense and then we used all of those words to create combinations and see what kind of ideas or products those new combinations would inspire.

Using this goal we made an initial selection of our list of ideas and each of the group members picked an idea to develop into a concept. Every concept had to consist of a description of the product, both a character- and situation sketch, a quick interview with a prospective user and a quick sketch or prototype to show what it would look like.
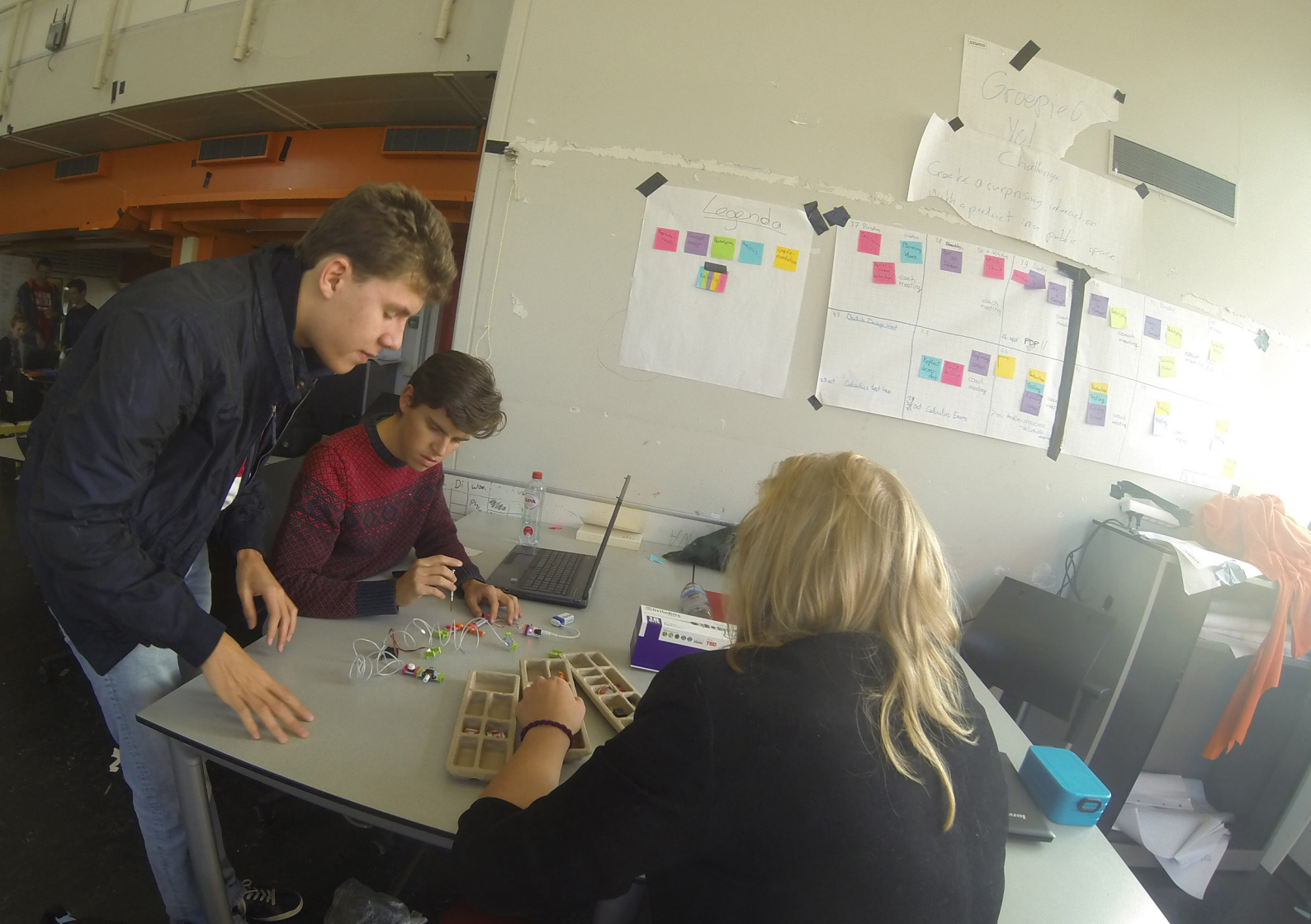
three concepts

To maintain the momentum in the process we picked three ideas and moved on.

We had been brainstorming for a while now and created a long list of ideas. We decided to stop widening our scope and start focussing. We all picked five ideas to make a smaller list, a couple of ideas were picked by everyone so we decided to focus on those. The three ideas that made this list were:

- The extinguishing lighter

- The waterfearing umbrella

- The shredding birdhouse

Each idea needed a character. The character development started by writing a story about each idea, this way we could find out which had the most potential to become a properly bugged product.

extinguishing lighter

A lighter that would blow out your cigarette right after lighting it. Improve society one less cigarette at a time?

The lighter would look like an ordinary lighter, it would light a cigarette just like a normal one would, but then immediately extinguish it again. The goal was to make people have to focus on lighting their cigarette, if they were too slow it would be undone. Through this we tried to make people aware of their smoking habit.

The product was quite makeable as well, a lighter is roughly the same size as a CO_2 cylinder and we could use a small CO_2 pump to regulate the flow. Plus it was a fun idea, surprising and possibly habit-changing. Because a lot of people are using lighters it could also have a big impact, changing people's perception of smoking and thereby contributing to society in a playful way.

The big problem with this idea is that it would be too annoying. We asked several smokers, to focus more on the actual user of the product, and most of them told us that they would simply throw the lighter away and use one that would work instead. They said that if they would really want to stop smoking they wouldn't use a lighter that constantly annoys you. Only the first time that you use the lighter it has the element of surprise, after that it loses its touch and you simply get a new one.

For this reason we didn't choose this product in the end. It wouldn't be able to sustain the bug and devolve into the gag product we were trying to avoid.
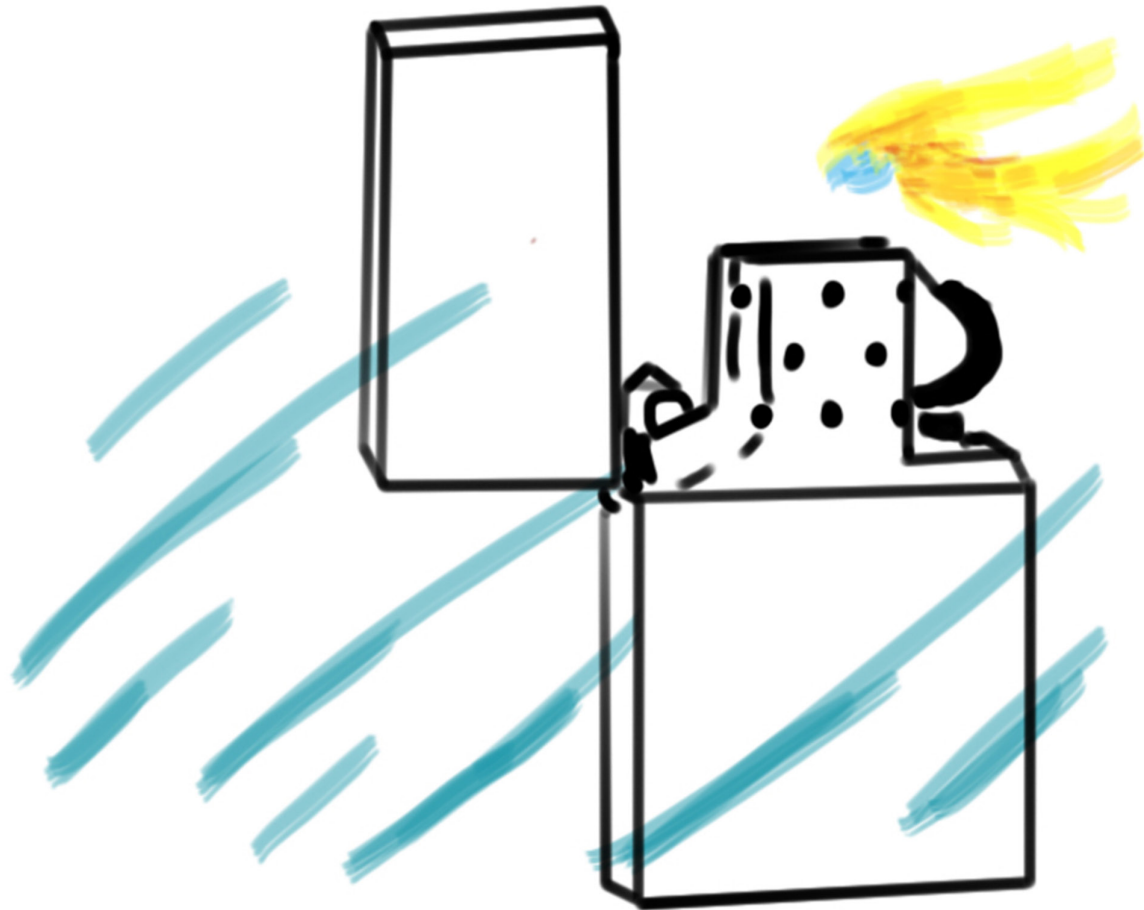
shredding birdhouse

A birdhouse that would seemingly shred birds. Spark a social debate about the over-consumption of meat?

The idea of the shredding birdhouse was mostly to shock. We wanted to hang it in a park or another public space, just like a regular birdhouse. When a bird flies into the birdhouse makes a shredding noise and feathers fly out. Instant shock.

The moment you see the bird being shred (not for real of course) the user is supposed to be shocked and appalled, which would be the bugged inter-action. Making the product wouldn't be a big challenge, neither would doing user tests.

There were two problems with this idea; a bird will never fly into a thing that frightens it, so it wouldn't take long before the birdhouse would be deserted.

And more importantly, the interaction would be between the birdhouse and the bird, our intended user would merely be a spectator instead of being involved in the interaction.

This meant it would not be a bugged object, but a confrontational artwork at most. Our initial goal was sparking social debate about the consumption of animals, after all machines which do the exact same thing at a huge scale are running 24/7, but it wouldn't work because the animals wouldn't cooperate and even if they would it still wouldn't be *bugged*.

water-fearing umbrella

An umbrella that is afraid of rain. Is removing the core functionality of a product the key to bugged?

This umbrella would be afraid of the rain and getting wet It would try to close itself when it started to rain to avoid it as much as possible. You'd have to give it attention and calm it down in order stop it from closing and make it do its job.

At first this seemed like a very one-dimensional, useless and annoying product, but as an assignment we were triggered to elevate its senses and see what that brought to its character. We changed simply being afraid of rain into sensing it was going to rain in the near future. This added a new dimension to the character and made us explore it further.

This positive bug was what we had been looking for, we got ideas for characters that could give it ways to express its concern or excitement about the imminent rain. This made us decide to drop the other ideas and commit to this one.

Looking at the practical side of bugging an umbrella made us doubt this decision, because an umbrella is very fragile and has little space to add, let alone hide, components. But we were up for the challenge and started developing characters we could give the umbrella.
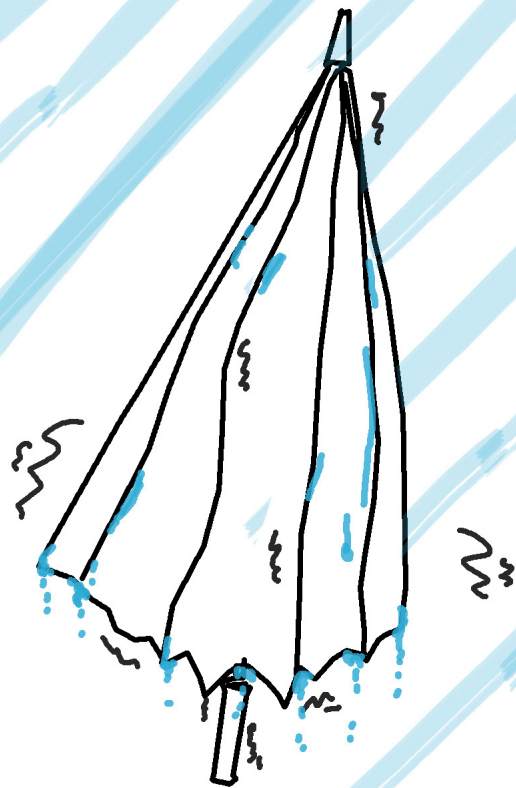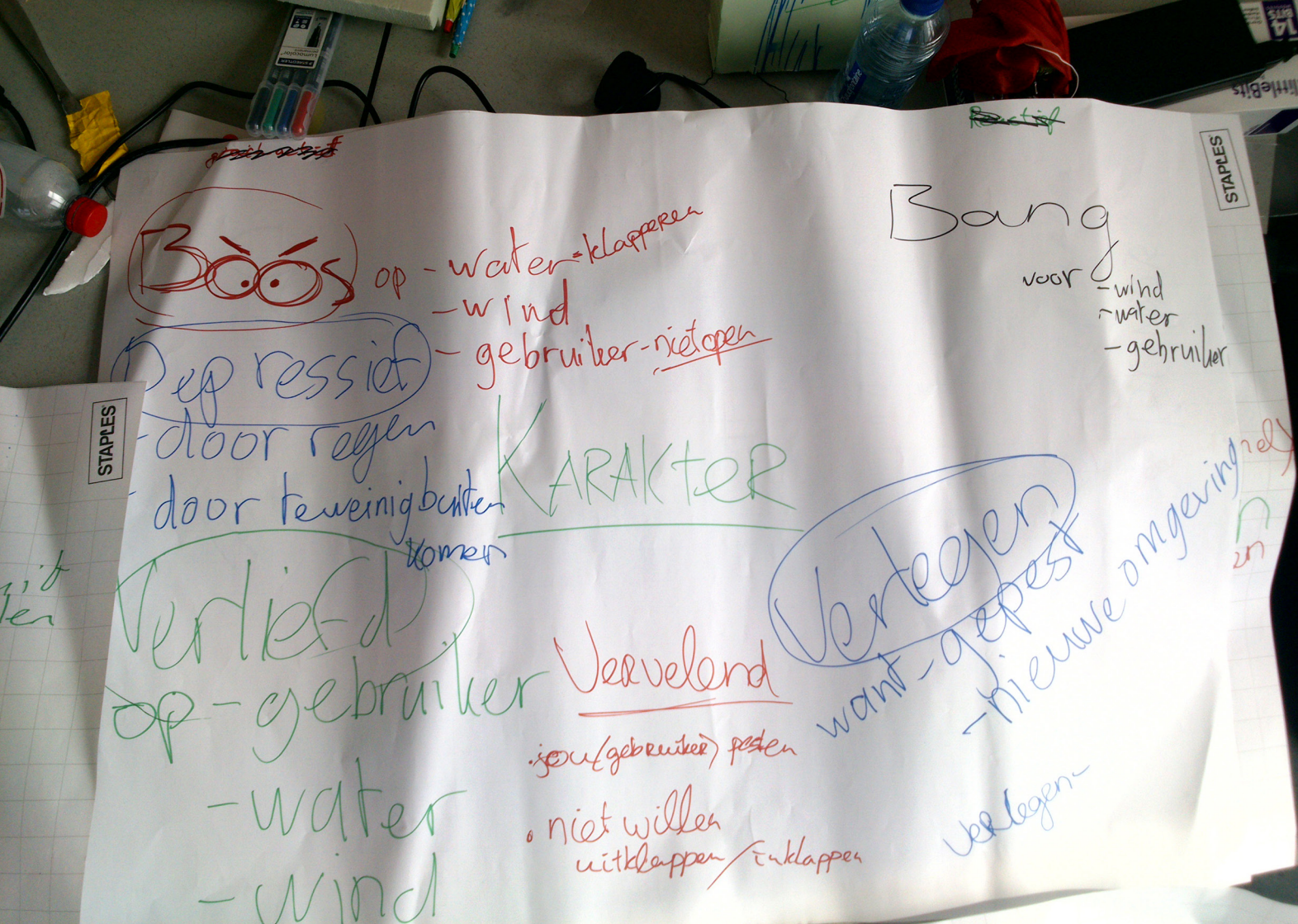
ideation

The process of narrowing down our list of ideas and creating a clear concept and persona.

In this chapter we take a more detailed look at how we gave life to our umbrella. Giving the product a character is a very important part of the bugged project as it is the first step in creating the final prototype.

The first step was picking one of the three concepts explained in the previous chapter. We did this by creating a list of criteria, subsequently prioritizing these criteria and then grading the three concepts using this list.

After that we explored the possibilities of our concept by creating different personas and seeing which in- and outputs could be used with that persona. Again we compared the outcome of this with the list of criteria and the feedback of the demo day. Using that we picked the persona that would best fit our goal for the project.

picking one concept

How we created a list of criteria and used this to choose the concept we wanted to develop.

After working out three concepts we had to choose which of them we wanted to develop into a functioning prototype. We did this by creating a list of criteria. We looked at our goal and all of the ideas we had been working on since starting the project. Then we wrote down what we liked and disliked about each idea and how these opinions related to our goal.

After compiling a big list of criteria we chose the criteria it had to fulfil and the characteristics we wanted to avoid. The most important criteria it had to have were a surprising interaction that would have an impact on day-to-day life, and a makeable product with a clear and playful character.

We wanted to avoid making a cheesy product, it had to be subtle but without having too much suspense, i.e. taking too long before noticing the product is bugged.

The shredding bird-house was the first idea we ruled out, it had little interaction and didn't add much, it could have been an interesting confrontational art piece, but not a bugged product.

After asking several smokers we found out none of them would use our product for quitting smoking and although they said they might have used to fool their friends it didn't fit our vision of the bugged project anymore.

The umbrella promised perspective. We already had ideas for several personas more constructive than the water-fearing umbrella. And because we could work with existing umbrellas and had some ideas on how to make it move it would be a very makeable concept as well.

Suggestions for a new character, input or output?

deciding on a persona

Developing the concept, by creating different personas and investigating which would best fit our goal for the project.

After choosing a concept, the next step was finding out what capabilities an umbrella could have and how we could combine these capabilities to create a persona.

At the midterm demo day we wanted to get feedback on which persona we had to focus on and maybe even get suggestions for other personas or characteristics. We made several personas, both to create a frame of reference for what kind of feedback we were looking for and to get feedback on these personas. We did this by working out the in- and outputs an umbrella could have and creating three personas; the Psychic, the Though One and the Puppy.

The Psychic was able to sense the bad weather coming and let that know to you by shivering because it is afraid of rain.

The Though One would not open if it wasn't really storming. He thought society was becoming too soft and wanted people to toughen up and not bother him for a light rain. But when it's about to storm he'd try to get their attention and show how strong he is.

The puppy mostly wanted to be taken outside to play in the rain. And then when it stopped raining shake itself dry, just like a puppy does when it gets wet.

We got almost unanimous support for the puppy persona, people liked the playfulness and thought it would add most to the normal use of an umbrella whilst still being bugged. This feedback reinforced our preference for this persona, we already liked the positive twist it gave to bugged and the possibilities it offered. So the next step was making a prototype.
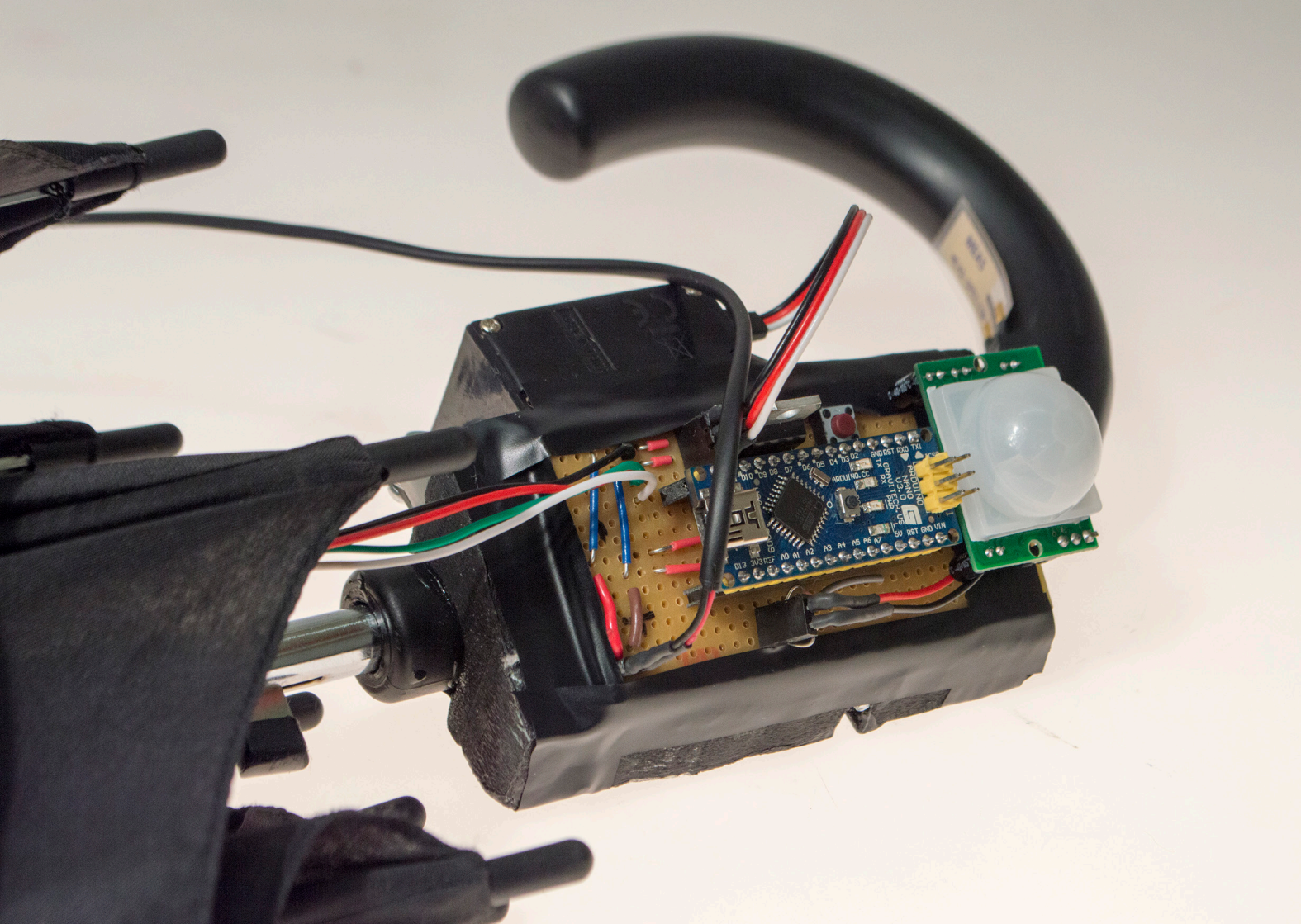
prototyping

Going from a theoretical concept to a working prototype and then presenting it.

After deciding on a persona the next step was creating a prototype. We expected the electrical components like sensors and actuators to be the biggest constraint so started with selecting and buying those.

The next step was turning the movements of our motors into movements of the umbrella, we designed and created a mechanism to realise this.

The last part of prototyping was determining when and why the components should do things they do, and then writing the code to make them do it.

After all the code is written we almost had a final prototype. The only thing left was putting everything together.

And finally we could present the prototype.

choosing the components

After deciding on the in- and outputs we started with choosing the components to make them possible.

We had to account for three in- and two outputs, detecting movement, touch and rain and making it jump and shake. The former were quite straight-forward; there is a wealth of information on all kinds of sensors on the internet. But every movement is different, and finding the right components for our two movements required several iterations and a lot of time.

Our main focus was making the umbrella jump up and down, so we started with looking into ways to do that. At first we wanted to use a stepper motor, but they are hard to control and a strong enough motor requires a big power supply. Looking at the other groups we saw servo motors are easy to control and require relatively little power for a strong motor, so we bought one. But we underestimated the difference between a continuous rotation servo and 180-degree servo, and soon found out we got the wrong one. When we finally wound up with a 180-degree servo it was perfect for what we wanted to do with it.

Our next step was finding a way to make it shake, we started with gluing a small eccentric weight to a DC motor, but this resulted in a buzz rather than a rumble. We then realized we wanted the rumble a gaming console controller produced and salvaged the vibration motor of an old Game Cube controller.

The rain and motion sensor were ready-made shields which only needed to be plugged into the Arduino and for detecting touch we used a Piezo-element with a 1 mega Ohm resistor, this big resistor reduces its sensitivity and disables its ability to detect sound.
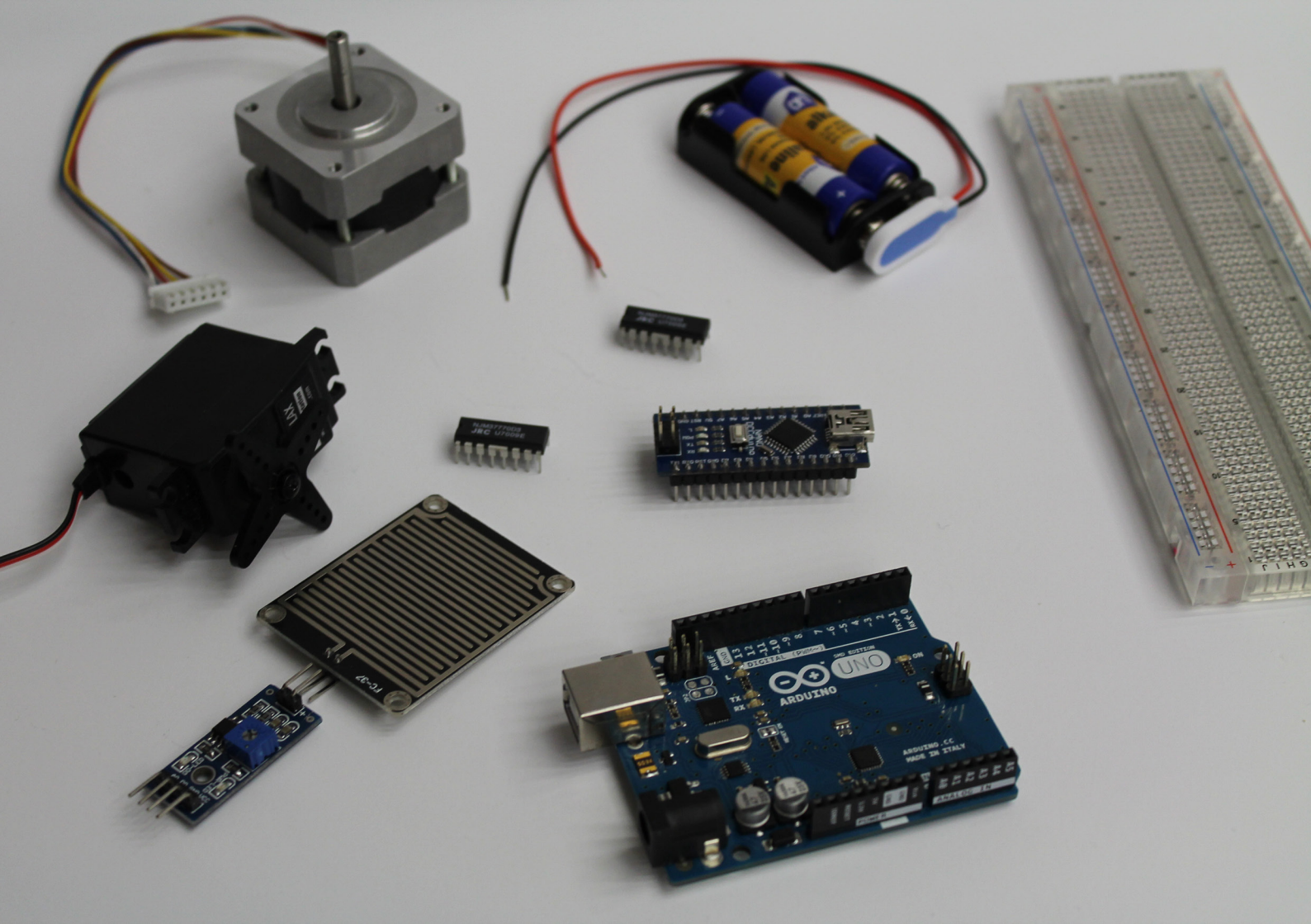
mechanics

Designing a mechanism to translate the circular motion of the servo motor into a linear motion of the umbrella.

After picking a 180 degree servo motor we had to figure out a way to use the rotary motion it creates to make the umbrella jump up and down. We looked into using a crank to create a reciprocating motion, using a leadscrew on a stepper motor as a linear actuator, a belt or chain drive so we could use gear ratios to reduce the power-output requirement of the motor, and using a rack and pinion for direct translation of motion.

We decided to use the latter, it was relatively easy to fabricate through 3D-printing and easy to control because it simply used the servo motor without any complications. The downside of this solution was the lack of speed in a servo, making it jump would have required a spring-loaded mechanism.

But we didn't have the skills nor the knowledge to fabricate such a mechanism, especially not in the small amount of space the umbrella offered.

The rack and pinion were drawn in Solidworks and 3D-printed in ABS plastic, we had to reprint the rack because the 3D-printing tolerances were bigger than we expected. We then milled a slot in the umbrella handle and used that slot as a constraint for the pinion. Mounting the servo was straight-forward using existing servo mounts which we could buy in exactly the right size.
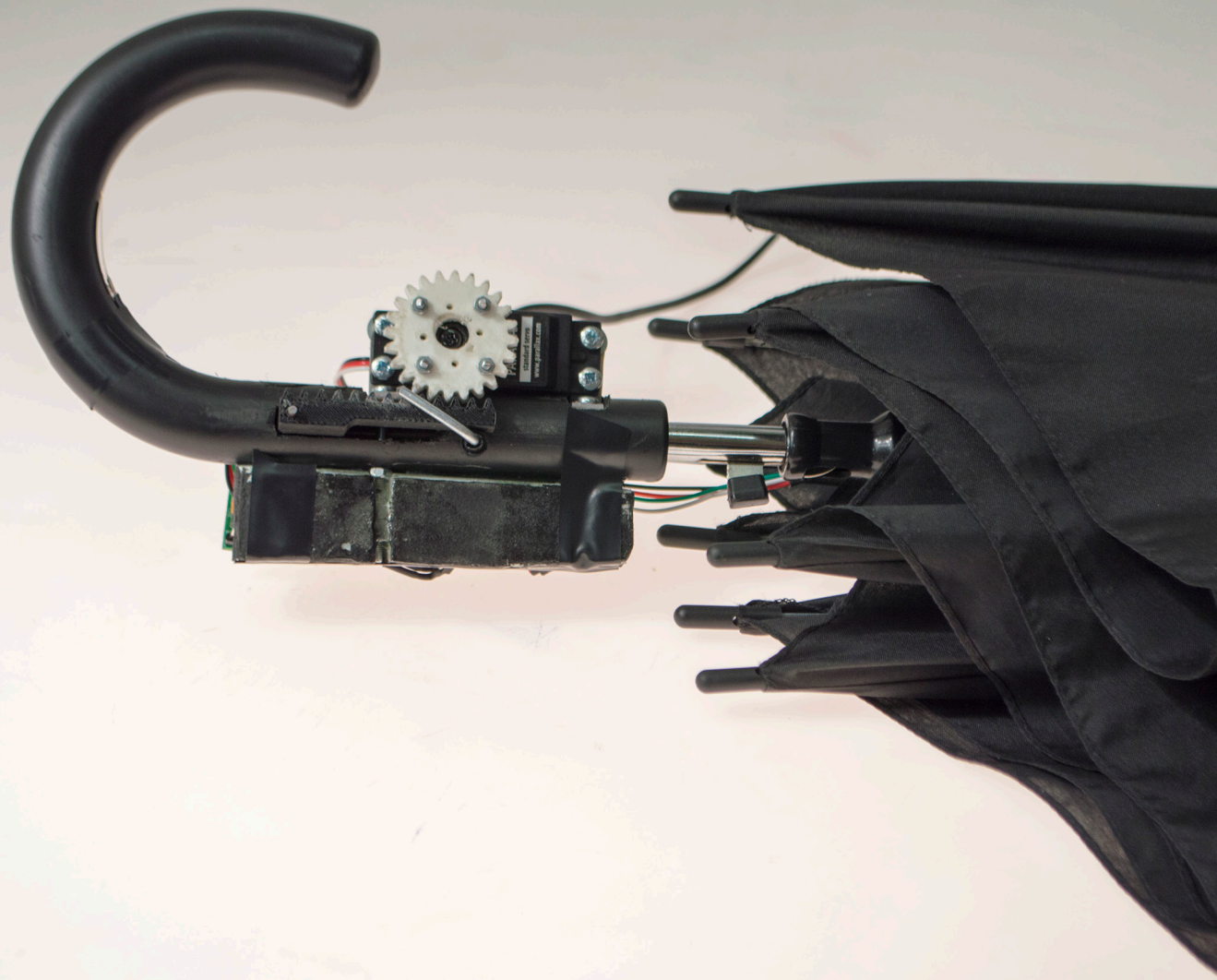
programming the arduino

Writing turned out to be as hard as we expected, but not for the reasons we expected.

During the acquiring of the components we had collected short snippets of code for each of them. These snippets allowed us to test whether they worked or not and gave us an idea of how the component would interact with the code. Most of these snippets could be found on the internet and required minor modifications, if any. Hardly having to write any code during the testing of the components made us unsure of how hard writing all these components into one big program would be.

So when we arrived at that point the task of actually writing software was a bit daunting. We decided to start off with making a flowchart of the several steps the umbrella would go through. The code could be split into four parts; detecting the user,

reacting to their presence, detecting the rain and then reacting to the rain. This gave us a much needed overview of the steps the software would have to take and reduced writing the code to a couple of hours of trial and error.

What we initially considered an afterthought turned out to be the hardest part; determining the delays between the several in- and outputs. The crux of a movement lies in its timing, and finding the correct speed and intervals for the servo and vibration motor required a lot of tweaking. We were limited by our choice in hardware, stronger motors would have allowed for quicker —more puppy-like— movements. But considering these limitations the movements were adequate.
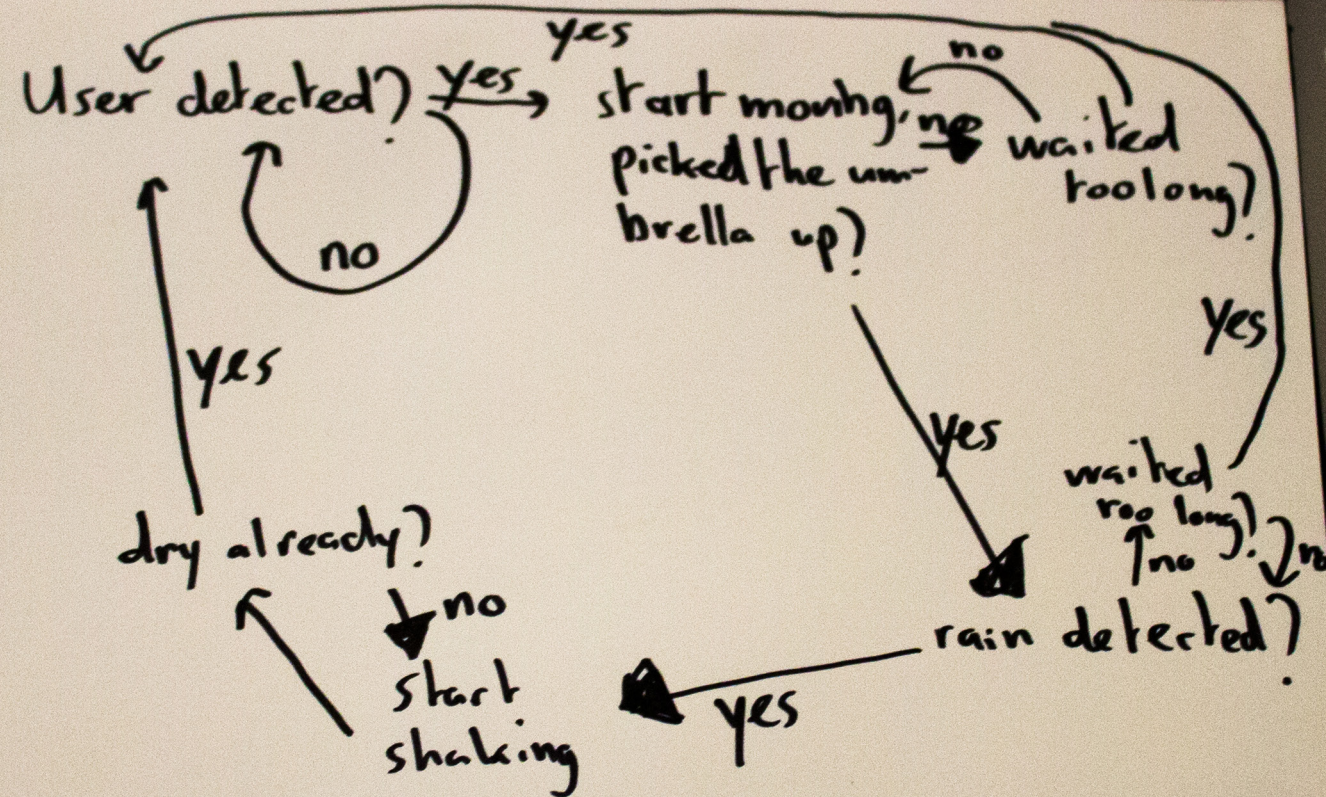
final prototype

Bringing everything together; connecting all steps to create a working, interactive umbrella.

When the components were selected and mounted and all the code was written everything could be put together. This meant creating a shield that could connect all the components to the Arduino and the power supply and finding out where to place all the components on the umbrella.

We made two iterations of the shield, initially we tried making it as small as possible, but this resulted in a shield that wasn't very usable. It was both unwieldy to connect to the Arduino and hard to mount on the umbrella. Our second shield was created to solve both these issues. We made a shield shaped like the Arduino with a small space around it, made to directly plug the Arduino into and with direct connections where possible, instead of finicky headers and wires.

The next step was giving everything a place on the umbrella, for the sensors this was easy because their purpose dictated a certain spot, the rain sensor had to be on the fabric for example, and the servo motor was already mounted during the fabrication of the mechanism, and after some testing the vibration motor had the most impact when glued to the fabric as well.

After everything was put together we did some final tweaking to the timing of the code and that concluded the prototyping.
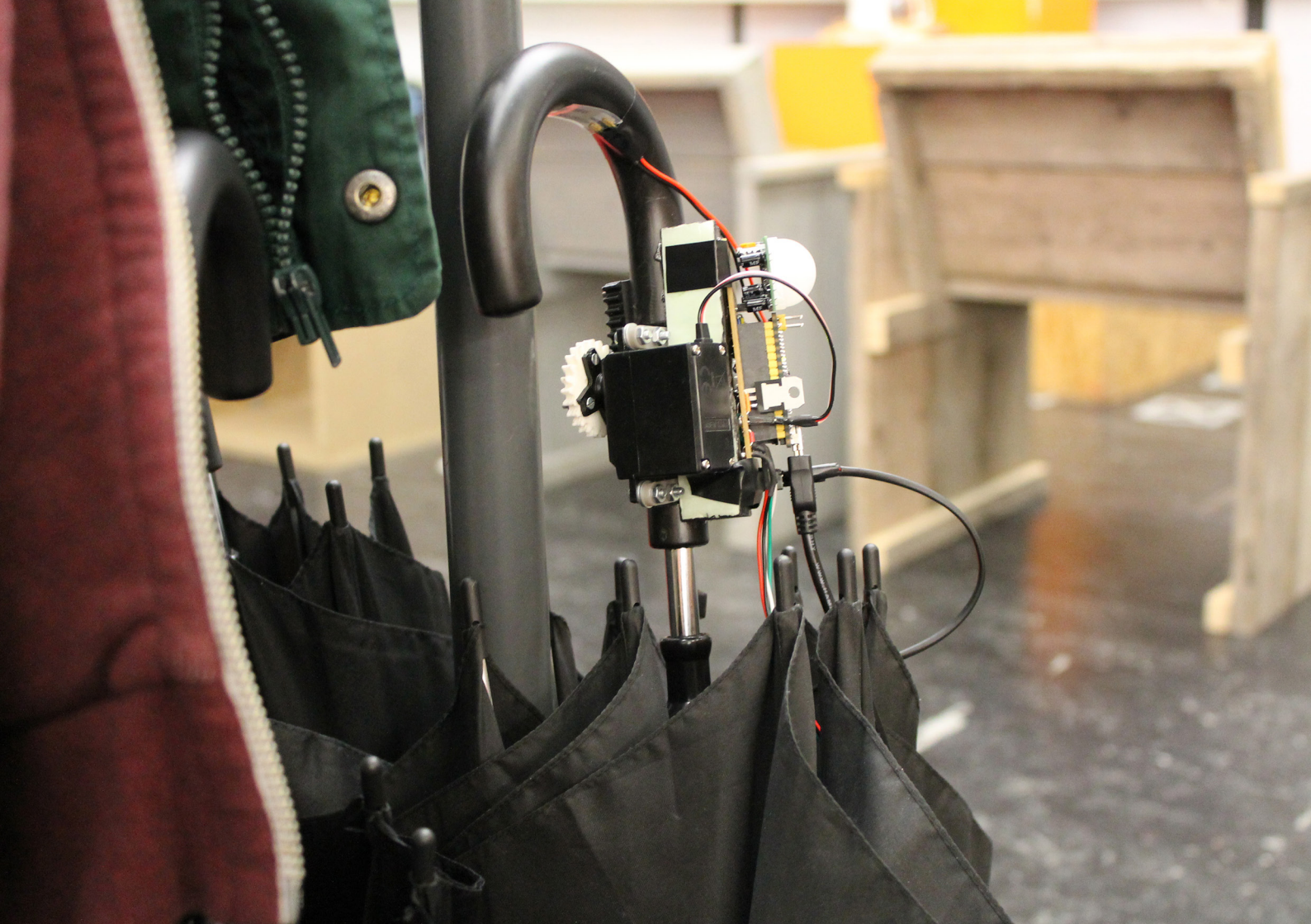
presenting the prototype

What did we want to communicate and how did we want to do this? Posters, prototypes and pitches.

At the midterm demo-day we wanted to get feedback on which persona was the best to pick and maybe get some new in- and output suggestions.

Because we didn't have much of a prototype yet, we decided to make two posters. One eye-catcher to get people's attention and an informative poster to explain the three personas we were considering. We chose a minimalistic design to be clear, recognizable and aesthetically pleasing.

We also had two prototypes at our stand to show two of the movements we were considering. One prototype showed the flapping and the other one ability to shake.

And finally we had small cards, one with a brief explanation of our project and the feedback we were looking for and another one to give feedback.

At the final demo-day we had our prototype standing in a coat rack with a sign giving a brief explanation of the project attached to it. This showed the umbrella in setting we intended it to be used and made it more present because the umbrella was quite small in itself.

We hid a camera behind it in order to film people interacting with it. At our stand we had an eye-catching poster similar to the one at the mid-term demo-day. A short film showed what our concept was about and we also had a sketch of what our umbrella would look like if we would develop it into a marketable product.

evaluation

An important part of the learning process is looking back on what we learned.

Whilst going through the design process, exploring it one step at a time, we continuously reflected on the steps we took and what the impact of those steps was. Looking back at all these separate reflections can teach us a lot about what works and what doesn't in a design process.

We started identifying the separate steps of the process and looked through all of our reflections and divided them amongst all of the steps. We then looked at these groups of reflections and experiences and found some lessons to be drawn.

choosing a direction

What we learned from the process of ideation and narrowing down our ideas to a well defined concept.

Starting our project with a pressure cooker and co-operating with third year bachelor and master students was a very good start. In one afternoon we were able to do about as much as what later took us, four first-years, three weeks. They showed us that it's sometimes better to not deliberately consider every option but to just move on and see where it brings you.

Starting the process ourselves we were constantly triggered to do things we wouldn't have thought of by the weekly DG000 lectures and assignments. Getting these external triggers was very helpful, but at times also distracting from what we were trying to do. Although we now know what does not work for us when ideating, we weren't able to really explore the process ourselves.

The several methods we used, like the IDEO cards and Thinkertoys, at first seemed a bit self-evident, but through using them we found out they were really useful in creating ideas from thin air.

What worked for us was starting with one of the methods and then taking the output we generated and seeing which parts of it could contribute to reaching our goal.

Using the feedback of the demo day and a list of criteria we had made earlier, made it easier to come to a conclusion. Developing a clear vision of what we wanted to reach was an important step and very useful to the process.

mid-term demo day

The first time presenting our ideas and getting feedback.

The mid-term day came at exactly the right time, we had enough ideas but were still trying to generate more. Having to present one, maybe two, ideas at the mid-term demo day forced us to focus and choose for one idea. The momentum we generated working to be finished in time for this deadline showed us that we could do much more than we thought.

At first we just wanted to show what he had created so far, but a lot of B2 students told us that our main focus should be generating feedback. At that time our biggest concern was the persona of the umbrella, so we decided that to be the core of our presentation.

Because of this our most important way of presenting was through posters, we printed them at A0 size, but found out that didn't work.

Looking at the stands of more experienced students we saw they all printed them at A3 and glued them to cardboard, so they could be presented upright on a table.

But the most important lesson we learned from the mid-term demo day is about the pitch, most of us were not very confident in presenting and pitching so that didn't go as smooth as we wanted it to. Properly preparing the pitch, not word-for-word but preparing the topics you want to discuss beyond three keywords is very helpful in confidently presenting a pitch.
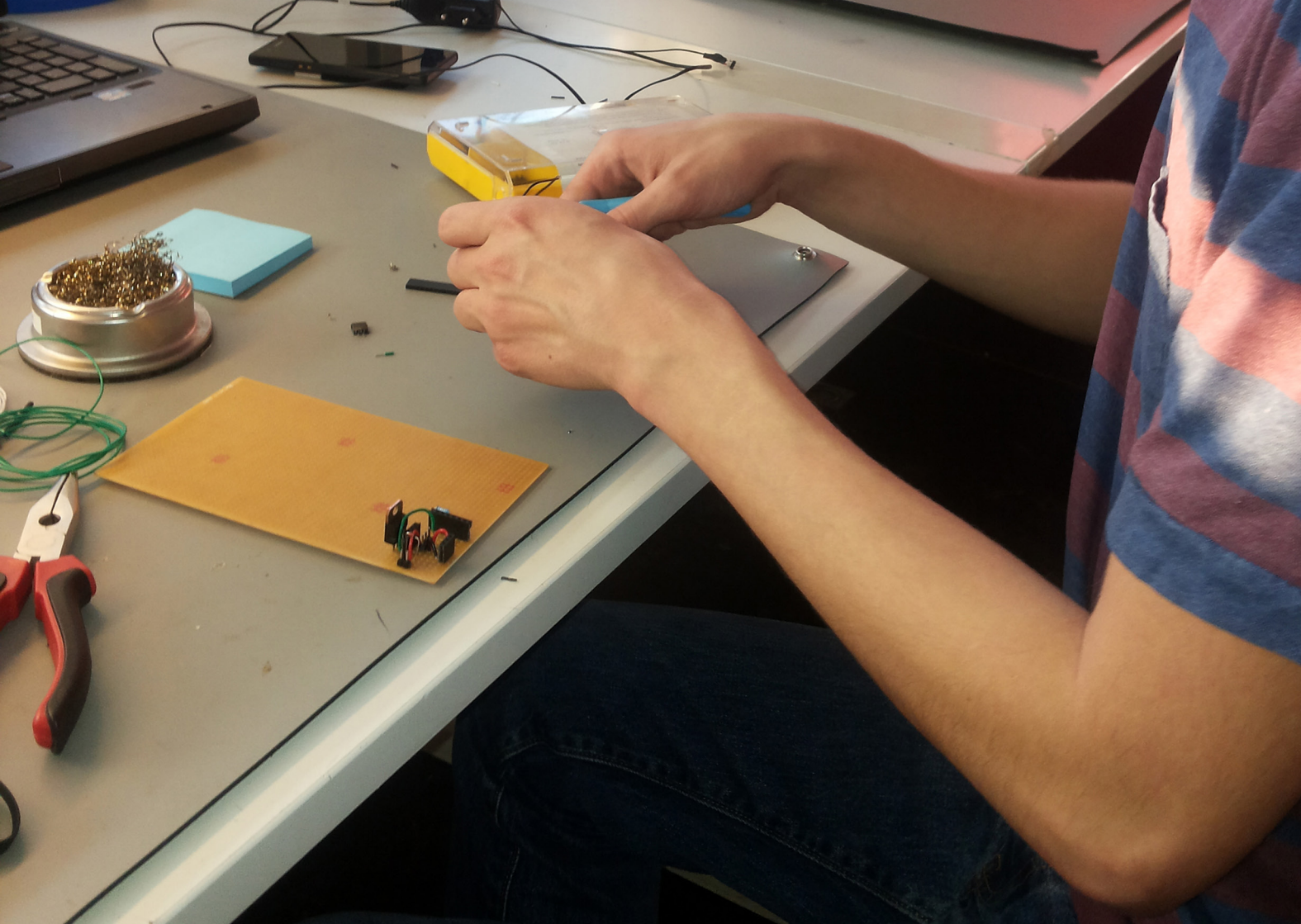
prototyping

What we learned from materializing our ideas and the skills
we learned during this process

We have spent a lot of time and effort in this phase of the project and therefore have a learned about it. Starting to prototype and therefor materializing your idea was very satisfying and insightful. Because we could clearly see progress being made.

We also explored a lot of different ways of prototyping, we worked with wood, plastics, foam and metal. Learned all kinds of skills like 3D-printing, laser-cutting, soldering, coding and general fabrication skills like drilling, milling and sawing. The skills we learned will be invaluable in all our future prototyping projects.

Doing all this we noticed the most effective amount of people to work with is two, this is because working prevents you from making unnecessary mistakes you're prone to make when working alone.

But does not prevent the progress as much as working with all four of us would, because making a decision requires less debate when working with two. Bi-weekly meetings to give each other feedback was enough to filter out big mistakes without hampering the progress.

A big pa.rt of prototyping is having the right components, materials and tools and we haven't always managed to do that. By starting prototyping sooner we will be able to sort these things out earlier and make for a smoother prototyping process.

final demo days

Using the experience of the mid-term demo day to properly communicate the goal of our project.

Our final demo days were completely different from the mid-term demo day. This time we had a prototype to show and didn't really need much feedback on the product anymore. Because of this all the media we used, posters, sketches and a short movie, were supportive of the prototype.

Because we knew what to expect we were able to prepare our pitches and we also had more to tell about the subject. This made pitching much easier and it went smoother than on the mid-term demo day.

Another big improvement over the mid-term was that we had a short movie showing how to umbrella would ideally react. This made small kinks in the performance of the prototype less big of a deal.

We hoped for more discussion and feedback on our project than we got, and are not sure how we could have evoked this without fundamentally altering the product. This is something we'll have to find out in future demo days.

The biggest challenge was letting the prototype work outside of the setting we designed it for, it didn't function properly in the big crowd who constantly triggered it and the short presentations which called for a quick succession of the actions. For the next time we'll have to write an alternative program which makes it easier to show the several functions of the prototype without the delays and correct triggers.
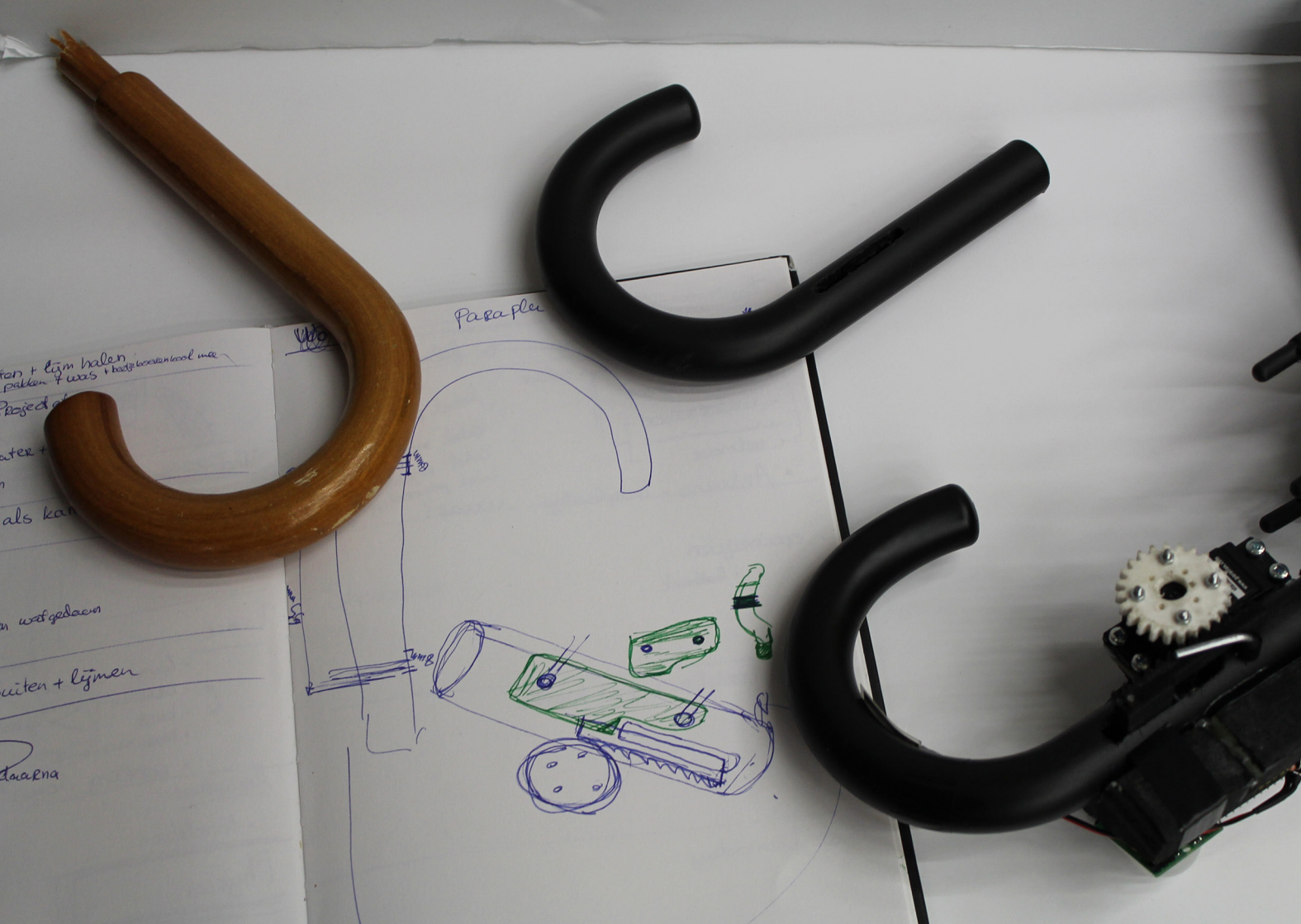
the process

Looking back on the entire process, what worked and what do we want to different next time?

Looking back on the entire process we are content with how it went; we have learned a lot and have created a prototype we're proud of. After a turbulent beginning, being constantly triggered to do things different from what we were planning, we were able to compose ourselves and go through the rest of the process without any major problems.

Whenever we got stuck in a certain phase we were able to generate new ideas and angles to get going again. Because of this we were able to quickly switch between the several phases of the design process, allowing us to retain our momentum and keep the process going.

But there are some things we want to do differently in our next project. The start-up phase took longer than we wanted to, mostly because we weren't confident in our ideas and kept on trying to find a perfect idea. Now we know the idea can still change a lot during conceptualizing and prototyping we will move on to and between the other phases sooner.

Starting prototyping sooner will solve another problem we had as well, because we weren't sure of the direction we wanted to go we ordered the wrong components. And by the time we knew what we wanted to do we had to wait for the components before we could really start.

And finally we want to be stricter next time, both to ourselves and to each other. We could have been more efficient if we would have been stricter in our internal dead-lines and division of tasks.

personal comments

Everyone's thoughts on the process and what they took away from doing Bugged 2.0 in this group.

Pleun

Personally, I learned a lot of this project, although it was really open-ended. Getting stuck and finding solutions was horrible and fun at the same time. Although we had some hiccups I think we helped and motivated each other in working better and achieving the best. I think we did even better than that with the time and capabilities we had.

Tijmen

To me the most important lesson of this project was learning to see the value in quickly switching between the several phases of the design process. I think fully implementing the reflective transformative design process will allow for better generation of feedback and through this a better product.

Lana

I have to admit the bugged project was very abstract. I do think it was a great way to help you think outside of the box. And this is very useful for later projects. Still I wouldn't chose this project again because I like to create something that has a function and could even get on the market. But I had fun and learned a lot.

Thomas

For our project I mainly focused on coding, it was the first time that I have ever coded. I immensely enjoyed this project because it was a very unlikely and unique one. The cooperation with me and my teammates went smoothly although I have to admit that I apart from coding did not do in my opinion enough for the project.
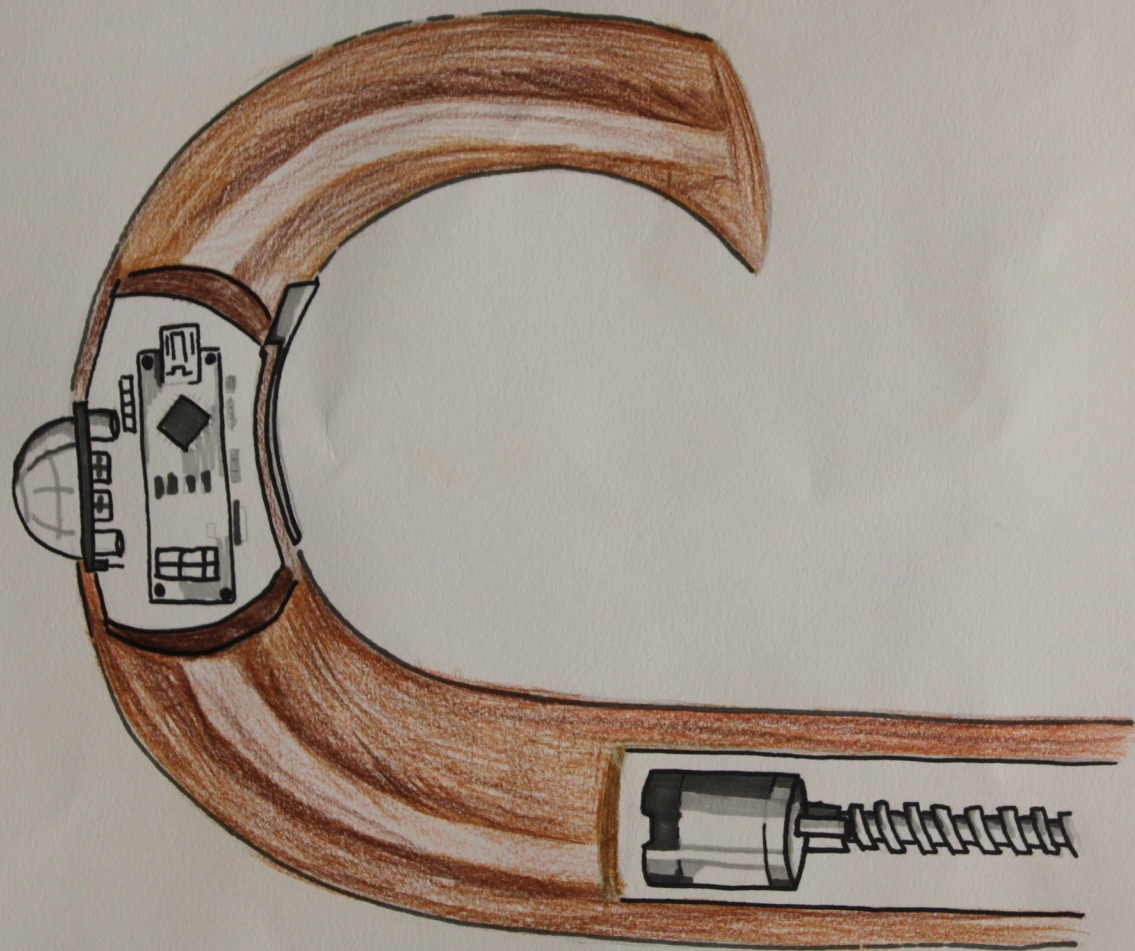
future of the product

What changes would we need to make to turn our prototype into a marketable product?

If we were to market this product our number one priority by far would be making it look exactly like a regular umbrella. The key to Bugged is the element of surprise and having big servos and sensors sticking out of the umbrella would immediately ruin the product.

To achieve this we would have to fundamentally change the mechanism used to make the make the umbrella move up and down, one solution would be using a tip attached to a leadscrew, this would allow us to have the motor in-line instead of perpendicular to the axis. And to make sure the umbrella jumps instead of sliding up and down we could use a spring loaded mechanism like the ones found in a retractable ball-pen.

The sensors and microprocessor could be molded into the handle to hide them and to improve the ergonomics of the handle. The rain sensor could be made using conductive paint on the fabric of the umbrella, making it look like a simple decal. The vibration motor would be replaced with small units on all the legs, to both improve the rumble and to make them invisible.

The core functionality of the code wouldn't change, most of the work would go into tweaking the delays and intervals to improve the interaction and optimizing the code for the motors to create a natural and fluid movement.

conclusion

What were the most important lessons of doing the Bugged 2.0 project?

Looking back on the project we are content and proud, we managed to fulfil the goal of the project whilst still staying true to our own goals. The open-endedness of the project triggered us to not only look at the solution but also at the problem and this will be a useful mind-set in future projects.

The broad goal and countless possible solutions taught us to the importance of brainstorming and more importantly the importance of knowing when to quit brainstorming. Looking back we may have switched to late, but at the same time this was a good learning opportunity.

Working together has enabled us to explore the several roles one can take in a team-process and allowed us to find out which roles we prefer. The division of tasks didn't go swimmingly, but we gained a lot of insight in how we want to do this in the future.

references

This a list of the used resources, we used several websites for troubleshooting and read some books for inspiration.

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