Hard to handle

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Hello, we are Stan van Betteraij, Bart van Dijk, Olivier van Duuren and Loek van Haaster. On this website you can find all the needed information about our product called 'Hard to Handle'.

'Hard to Handle' is a result of the Bugged 2.0 project. Bugged 2.0 is about taking an everyday life object and making it interactive by giving it unexpected human characteristics. This 'bugging' is not mend to be an useful function. In the top menu you can find our reflections, the project processes

and a gallery slideshow. Below you will find a concept explanation and a product video.

Content

Brainstorm

In September we started the semester with a brainstorm period. Since this was the first time we did brainstorming for a project as big as the one we just started, it wasn't that much of a success in the beginning. After one week of thinking without any system, we had 5 minor idea's, not even worked out, and at that point, we thought it was a lot already. Our coach told us elsewise though. So we started using the Ideo Method Cards. These are a bunch of brainstorming methods from which we chose two methods at random to work with. These methods briefly were: Think about the object you use and things you do in everyday life and write them down in chronological order, and look around your working space for inspiration. These two method card didn't bring us a lot of useful ideas, but they did give us an idea for a brainstorming technique that gave us a big list of useable ideas.

Our freshly self-invented brainstorm method consisted of four lists. The first list was a list of objects, the second was a list of characteristics and emotions, and the third list was a list of actions. Finally there was the fourth list. This was the list of ideas and concepts. Every item on the fourth list was created by randomly choosing and combining three items from the other lists. The figure below shows a picture of our brainstorming technique. We stopped when we had about 40 combinations on list 4.

Figure 1 Brainstorming technique of the four lists

We took our favorite ideas from the fourth list and worked these out. Some of these idea were: A singing toothbrush, a urinal which would pee back at you, a mirror showing you things different than they really are or things that aren't even there, a door handle giving you a hard time opening a door, and a keyboard giving critics to the things you type. The figure below shows drawing of our favourite ideas.

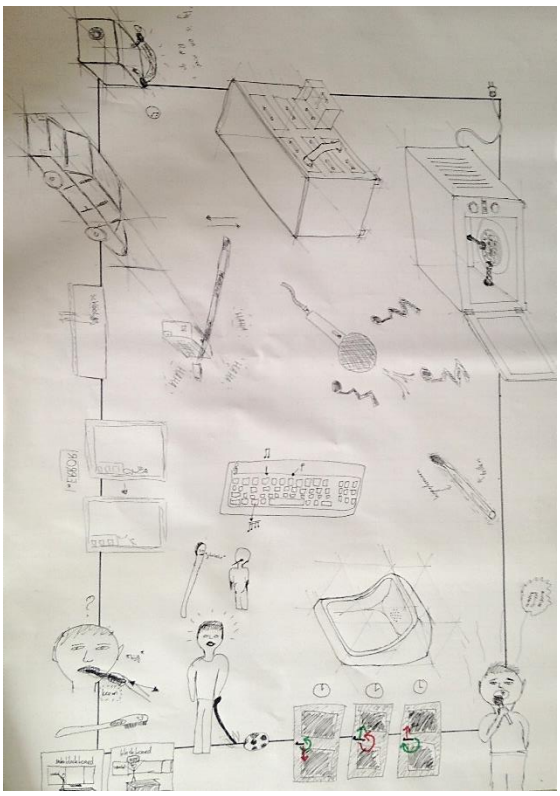


Figure 2 Drawings of our favourite ideas

After we had worked out some of our ideas, we invented two master students (Stijn Zoontjens and Peter de Jongste) for a meeting to give feedback on our ideas. We had a very useful discussion about all our ideas. They were very interested in the door handle and together we talked about further possibilities for it and so we got more and more interested in the door handle ourselves and we decided to make it our project.

After this meeting we started looking deeper into the character the door handle should get. We looked at the different actions a door handle could do and what emotions these action could describe. We made a scheme of emotions and how they are represented.

Emotion	Action	Cause	Solution
General	Normal door movements	Treated well	X
Enthusiastic	Making random moves asking for attention	Not used for a while	Give it attention by opening up the door
Exhausted	Hanging loose	Used to much	Spin the door handle in circles to wake it up
Scared	Quivering You can ignore this and open up the door anyway	Door slammed	Stroke the handle to comfort it
Angry	Making the door handle unmovable You can't open the door in this state	Door slammed when already scared	Stroke the door handle to calm it down

With this scheme we ended our brainstorm part. Though we kept changing parts of the concept during the rest of the design process.

Idea and Concept

As we were building our prototypes, we encountered a bunch of problems (As you can read in the "Building Process" part in this report.) These problems made some of the original actions and emotions we had planned for our prototype nearly impossible so we were forced to skip features such as hanging loose and making the door handle unmovable by force. Also the possibilities in the movement of the door handle were limited, because of the servo's we used. For example, the door handle couldn't move fast enough, so people experienced the movement we intended as being scared as angry. So when the mechanics of our prototype worked as well as they could, we had to try out what movement were possible to be programmed and what emotions the users thought these movements represented. With these conclusions we can make a new scheme:

Emotion	Action	Cause	Solution
Helpful	The door handle opens up the door as it sees someone approaching	The door handle is treated well	X
Angry	The door handle starts shaking as you approach	Someone slammed the door	Calm the door handle down by stroking it softly
Enthusiastic	The door handle makes random movements to get some attention	It isn't used for a while	Walk up to the door

With the possibilities we have now, we can start thinking about the environment where the Hard to Handle door handle can be found and about the character it should get.

For the environment we had to keep some rules in mind about the project Bugged 2.0: The bugging of the product should not make it more functional, and you have to be able to find a way to live with the bugged object. In the very beginning we wanted the Hard to Handle door handle to be for private use for example in a house or in an office. Now this doesn't seem to fit the Bugged 2.0 rules because in private use it will teach you to stop slamming the door, because you will learn that slamming the door will make it harder for you the next time you want to walk through the door. Which can be seen as functional. So we decided that a certain person shouldn't have to deal with this door to often, to make it less functional and more of a surprise every time someone approaches the door. This made us decide that the Hard to Handle door handle should be used in public spaces. For example as door in a museum, or bathroom doors in train stations.

Helpful, Enthusiastic and sometimes mad. These three characteristics could perfectly describe a little girl. Also the name of the project "Hard to Handle" could fit a little girl.

Hard to Handle

“Hello sir/madam, my name is Rosa. Sometimes I get very angry because people slam the door and I don’t like that. Then I get all shaky and I won’t let people open my door. Mommy says I have anger issues so we visit Doctor Pete to find ways to calm me down. Comfortingly stroking me often works very good. I am very sorry for my bad behavior and I hope that you still like me.”

Hard to Handle is our interactive door handle with a slightly childish attitude. At first, she looks really enthusiastic and she will trigger you to use her, but once you have treated her badly, by means of slamming the door, she will turn in some kind of ‘angry mode’. Whenever you approach her again, she will start quivering and you will have to comfort her with maybe a soft touch or a gentle stroke before you can open the door again. After this the door forgets that it has ever been mad again and the next time you visit her, she will be happy to open up the door for you again, just like a little girl.

Building process: Arduino and Electronics

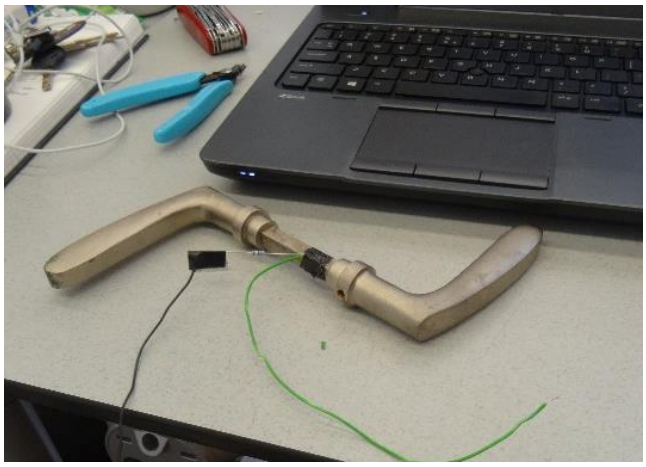
In the first prototype we made hole in the door. In the hole we put all the electronica, so the handle was able to twist and turn. But the electronics were too big to fit in the door, so during the midterm demo days there was a little plateau on the back of the door, where all the electronics were resting on.

We also noticed that when the prototype was powered by a battery, the door handle would go down in the course of the day. This was due to the fact that the servo had to work harder when pushing the handle up than down. When there was a less amount of voltage left in the battery, the servo didn't have enough power to lift the handle up. So the position of the handle would be strange. That is why we had to power the Arduino with the laptop cable.

We measured the stroking of the handle using aluminum foil on the door handle. This foil was very fragile, and because of this it broke during the midterm demo days. So we had to use our backup: a little aluminum pad above the door handle.

In our final prototype we had a lot of upgrades, which caused a lot of problems.

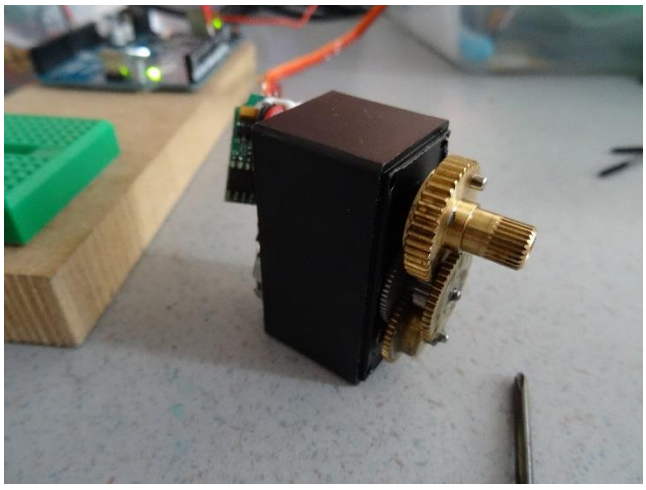
Problem
We used aluminum foil to detect the stroking of the handle. But the foil would break a lot, due to the fact that the foil is very fragile. Because of this the detection of the stroking wouldn't work for most of the time.



Solution
Now we use Capacitive Sensing, or CapSense. This is a method with two wires connected to the door handle. And one directly to the Arduino, and the other one through a large resistor. The difference in current when you touch, or stroke, the handle can be measured by the Arduino.

During the midterm demo day we also noticed that the servo we were using was making a weird noise, and soon after, it broke.

Problem
The original servo we had, didn't have enough power to turn the door handle and the sliding contacts.

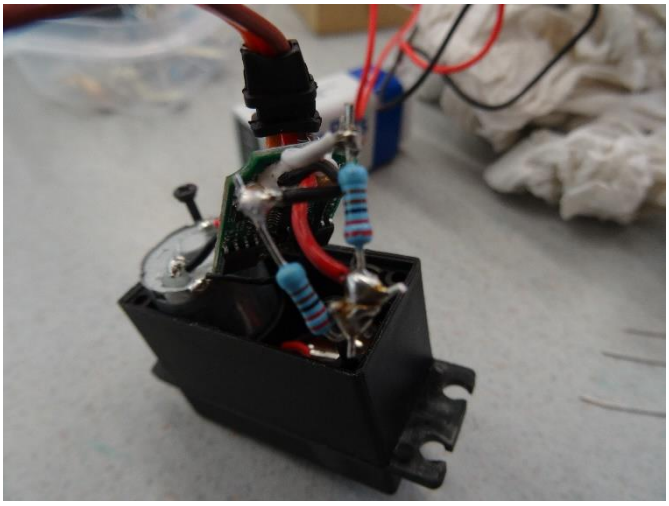


Solution
We bought a stronger servo.

But when we bought this new servo, we immediately encountered another problem:

Problem
There is no servo strong enough to lift the weight that is continuous that we could buy in the time (and money) we had.

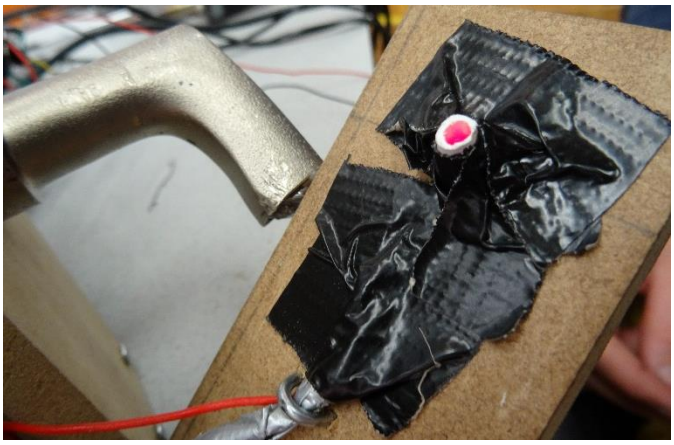
Solution
We bought a 180 degree servo, and hacked this servo in order to make it spin 360 degrees.
We changes the gears to delete the 180 degree limit.
The internal potentio meter preventing the servo from overturning had to be hacked using resistors. Otherwise the potentio meter wouldn't let the servo turn any further.



Because we modified the servo, we had another problem. Because we wanted to doorknob to make random motion, we were not able to check in what position the handle would be using the code.

Problem
Because we demolilshed the internal potmeter in the servo. There was no way the servo would know where it is during the program with random functions.

Solution
We made a hole in a gear, and put a LED on one side. And a LDR on the other side. The LDR could notice the light of the LED through the hole in the gear. And this gave us the opportunity to measure in what position the servo was, during the program.



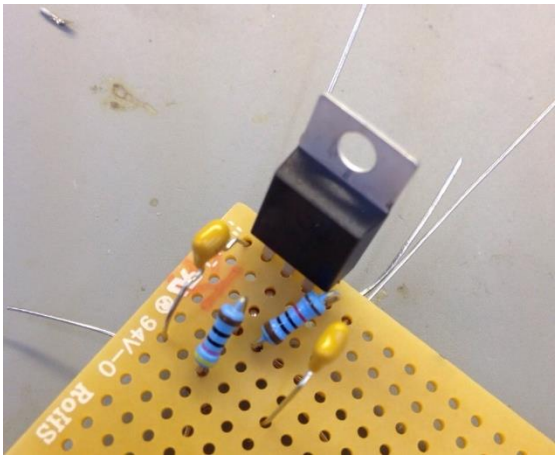
Using a battery wouldn't work due to the voltage drop over time of a battery. So we had to use an external power source. Another reason for this was that we encountered another problem:

Problem
When the direction of the hacked turning servo is changed. A small leftover current is transferred to the Arduino due to the magnetic field and the coil. The Arduino doesn't expect this current, notices this, and shuts down. Than restarts, and so the program is restarted. Which is off course not what we wanted.

Solution
Using an external power source, the extra current is transferred to the external power supply. And so the Arduino doesn't restart. There also was a wire needed from the ground of the Arduino to the ground of the external power source in order to close the loop, with the wire that gives directions to the servo from the Arduino.

The fact that we decided to use an adapter brought us to another problem:

Problem
We had two adapters. One of 9 Volts and one of 6 Volts. The servo we were using needed 6 Volts. But the adapter of 6 Volts was only able to deliver 0,5A. And the servo we used needed more than 2 A! So we had to use the 9V adapter, producing 2,5A max. We had to drop the voltage, because with 9 voltage the servo would get very hot. At a certain point the servo was unable to preform well due to the high temperature.



Solution
We made a voltage divider, bringing the voltage back to a clear 6,1V

But also the voltage divider had a problem that we had to solve, the servo just wouldn't do what we wanted, and we couldn't figure out why. We had another problem we had to solve:

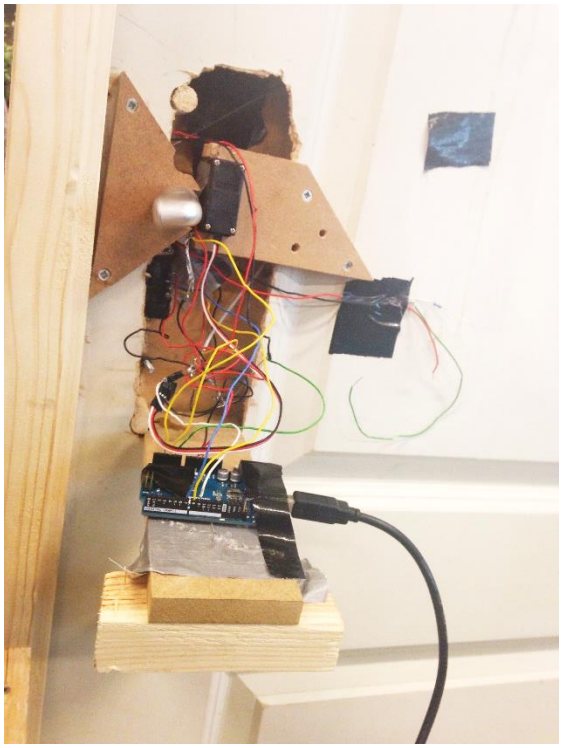
Problem
The servo didn't work, even with the new voltage devider that we solderd with components and a scheme from e-lucid. We found out that the components were maxed at 1,5A. Which is a lot less then what we needed. We put a lot more through the components, and that is why we broke them and the reason that they didn't get them to work as how they should.

Solution
We bought a brand new adapter from the internet. Giving us 6V and 2,5A, solving the problem with ease.

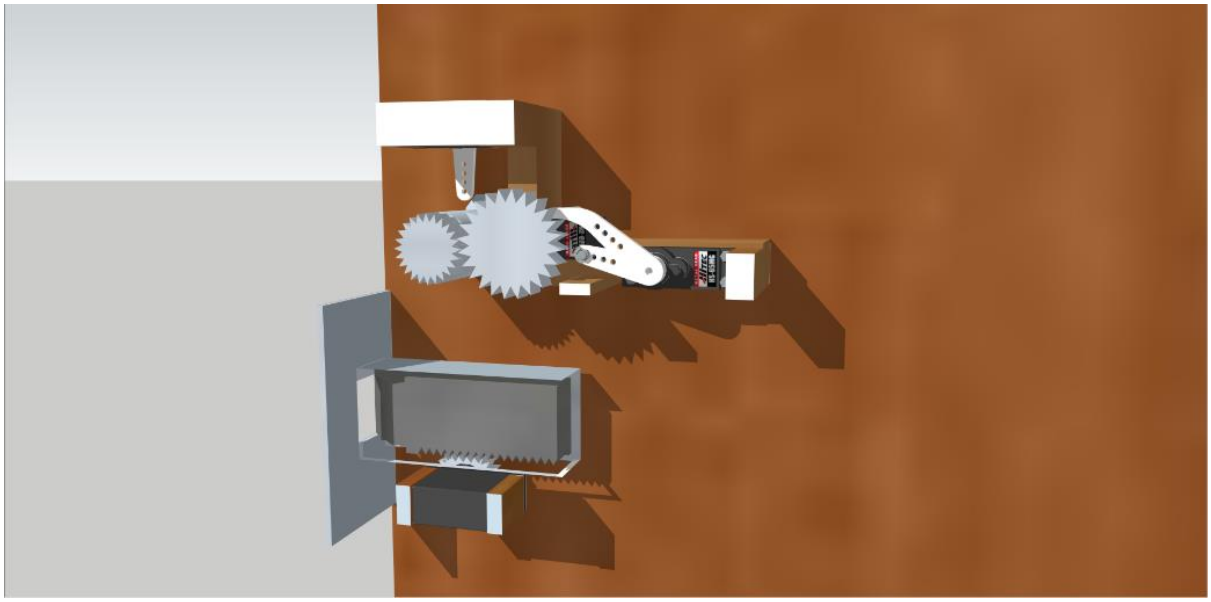
Building process: Mechanics

Our first prototype we have constructed is made with Little Bits and pretty much Duct tape. Because of this prototype, we discovered that we were able to reduce the force that the servo had to supply by the use of a counterweight.

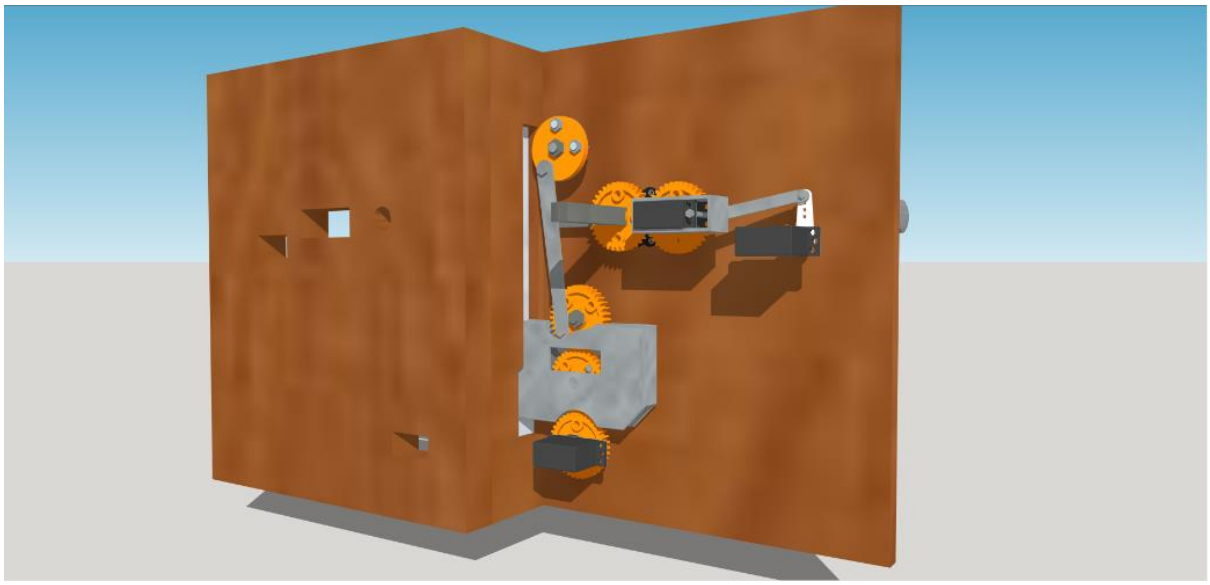
Our second prototype was a mess, we had not thought about where who would post something, so we screwed shelves on some places to hold everything in place.



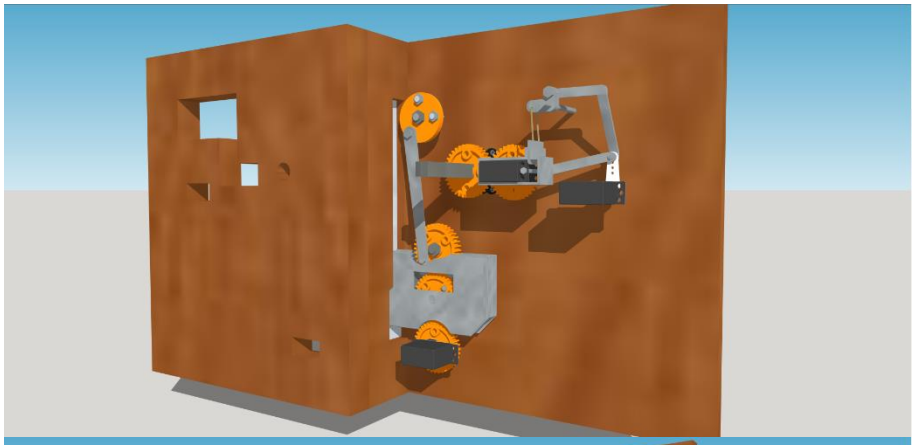
After we presented our second prototype at the Midtherm Demoday, we made a plan for our third prototype and improved it.



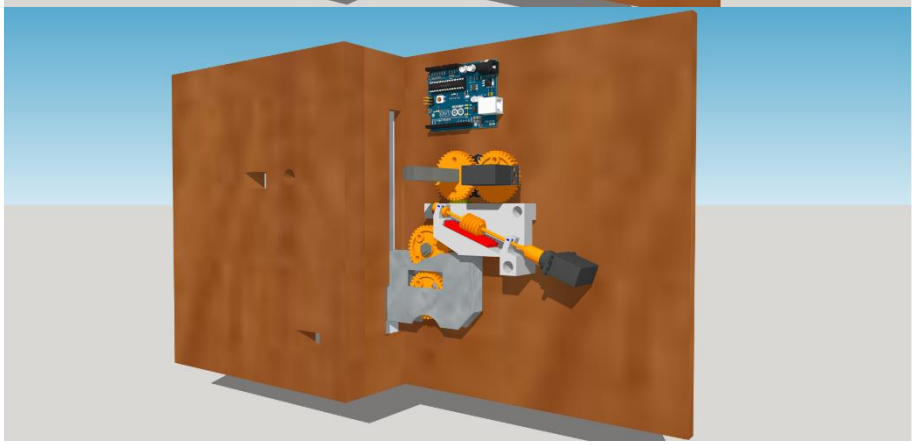
We devised a number of systems to portray our elected emotions. There had to be a gear on the axis of rotation of the door handle and a servo which drove this gear. First, we wanted to make the system so that we could untie the door handle from the servo. Another servo would slide the first servo away. In addition, we figured out that the lock can shift to outward by means of a rack and pinion.



After some testing with paper prototypes, we came to the conclusion that the invented system was not working quite smoothly, so we came up with a slightly different system to unmount the gears. Furthermore, we have thought of a system in order to maintain the feeling of opening a door, because the lock and the door latch are no longer in contact with each other.



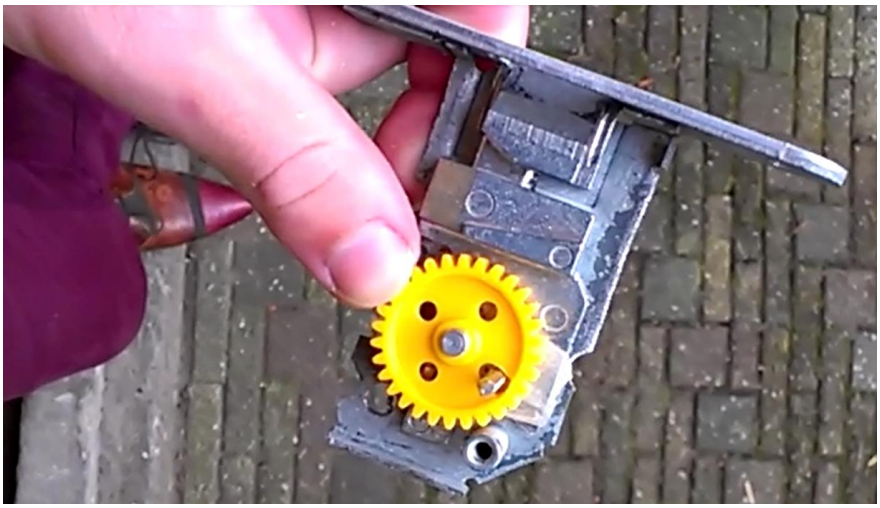
Again an improvement in the disengaging of the gears. We have also added drag contacts to the sketch.

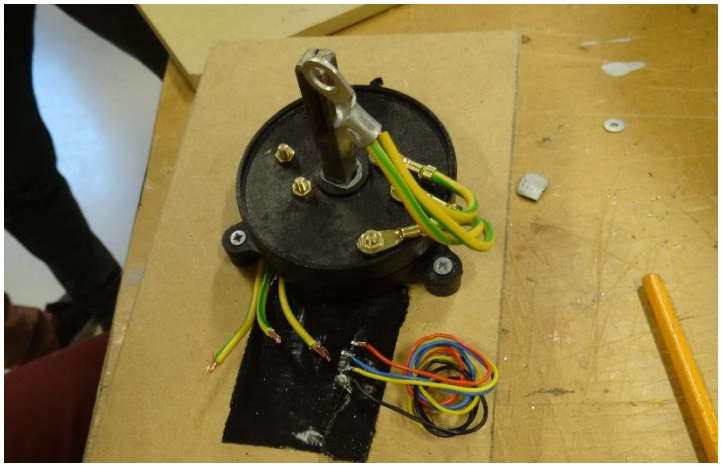


In this image is our last sketch we've made. We have yet another disengaging system. This system lets you turn the lock go in and out by yourself. As a result, the feeling of opening a door is maintained.

Ultimately, the result is turned into something else. For example, we do not have a disengaging system and the lock is moved by a separate servo.

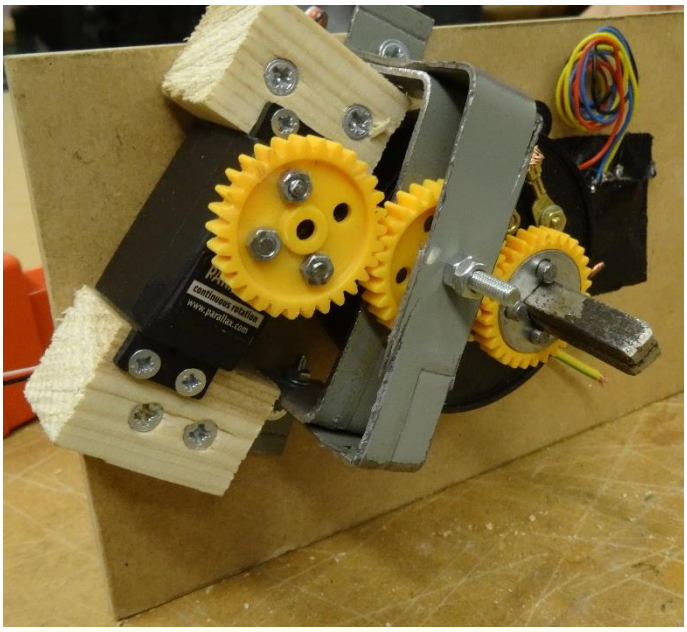
The servo rotates the yellow gear in the picture, making the lock go outwards or inwards.





In the electronic circuit, two wires are soldered on the door handle, but since the handle rotates, it wraps on the threads. To prevent this, we used the sliding contact.

Because the sliding contact has a fairly large diameter, it was necessary to construct an additional gear. We made a bow between the servo and the rotation axis of the door handle.



User testing process

We decided that Olivier should be responsible for user testing, because he was the one most interested in this part. He set up a questionnaire for users at the very beginning. Unfortunately, this questionnaire is never used because of the prototype, which was never able to be tested until the final demo days itself.

We did not have to change the outer look of the door handle, because we simply wanted to create the most unexpected situation. So that caused that we did not have to do research on what appearance fitted the most on our user. We neither had to test our project on a certain target group, what again saved researching time.

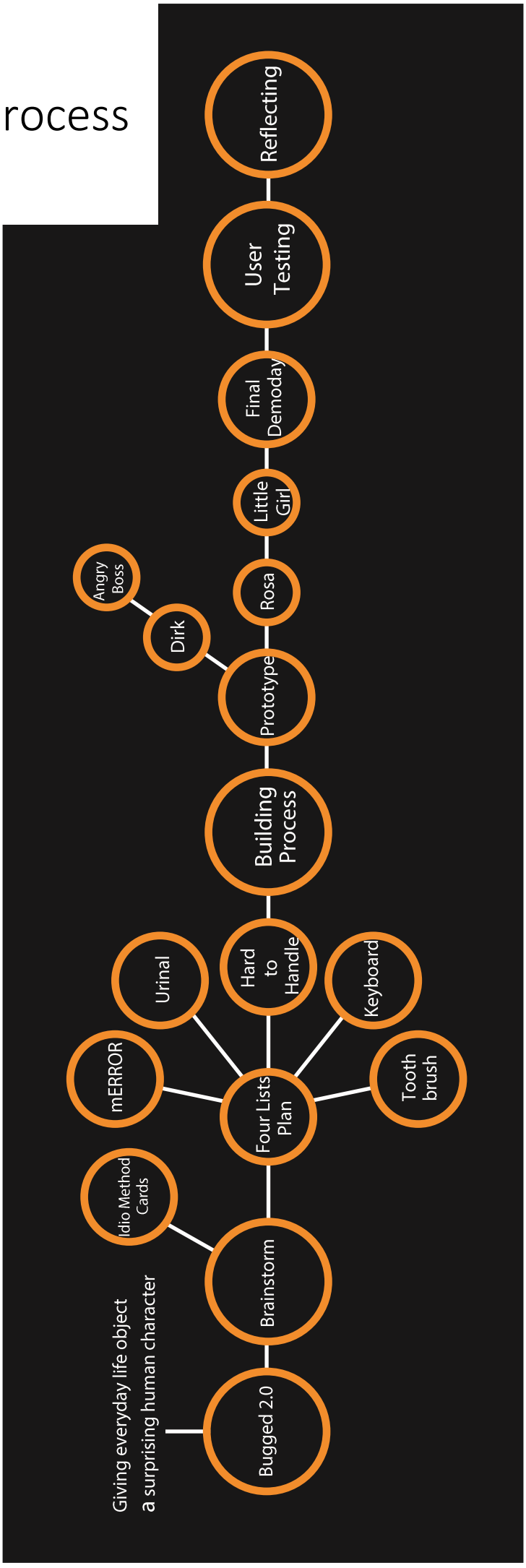
We did ask feedback in several stages about the movements our prototype made. As a result of that feedback we fine-tuned our design. Firstly, we had to create movements which suited the opinion of the tester. The user did not always get the feeling we wanted our design to give. The angry door handle has to make a shorter and faster vibration than it initially had. Editing the program in Arduino simple fixed this. So after each improvement we asked for feedback and that eventually led to the final movements of the prototype.

Secondly, people tended to move down the door handle, which is a very logical response, but this would wear out the gears inside the servo controlling the door handle his position. So we had to make sure the servo rotated the door handle further downwards when it opened up, to stop people from pushing it down themselves.

After noticing that the door automatically fell open if it unlocked, we concluded that it could prevent the wearing out of the gears even more because people did not have to open up the door at all anymore. This was caused by a string pushing the door out of its post when it unlocked. The string was initially used to fix the slanting doorpost, which caused the door to drag along the floor. Happily our hypothesis come out true in the user tests afterwards.

During the final demo days we made a lot of user testing videos. The first demo day from one side and the other demo day on the other side. We thought that different perspectives could improve our final user testing video. This video is divided by two groups of users: Users who did not have a clue of our door handle his interaction and users who did.

Design Process



Reflections

Stan van Betteraij

I think that for the B1.1 semester Bugged 2.0 is a great project. In Bugged 2.0 you are not trying to create a product which will do great on the marked, which gives you the opportunity to make it in some way less serious. Because of this you can create almost anything you can think of, nothing is to much or to strange. I believe that thinking and working this way for a whole semester taught me to be more open minded in later projects. In Bugged 2.0 I learned that most of what you can imagine can actually be made and put to practice.

Another thing I learned in Bugged 2.0 is to tell a story behind a product. Why is it doing what is does? For myself, I tried to keep our product as close to the story behind it as possible and if that wasn't possible, I tried to bend the story more towards the product. In that way I focused on the concept of the product.

To me, the things lacking in the Bugged 2.0 are for example factors like User Focus, because the products you create in this project aren't really focused on a certain group of people, also they are not mend to be useful so it doesn't really matter what the user thinks about it. The only way in which the user focus is involved is that the product has to give the user the feeling that you want it to give.

All together I think we had a great first semester as a great team and we all learned a lot, together as well as from each other. I think that Bugged 2.0 is a great starting off project for every Industrial Design student to fun around and learn a lot in practice, and it gave me a lot of positive motivation for the future semesters.

Bart van Dijk

I personally think that Bugged 2.0 is a perfect project to start your bachelor at the faculty of industrial design. At this project you have no restrictions, in this project everything is possible. This project really helped me to have the courage to say everything that comes to mind while brainstorming. During the introduction weeks I found this very hard, and I think bugged really improved this.

I really enjoyed the building phase of the project. Starting with a duct tape and little bits prototype, going all the way to a fully operational Arduino door handle with sensors and everything. During the project I took the job of the Arduino and electronics building upon myself. I didn't have any experience with programming or Arduino. So at first is spent nights working on the project, just learning the basics of Arduino all by myself. I think this really helped in the development of my integrating technology. During the building process, we encountered various problems: Mechanical and electronical ones.

Because of all the encountered building problems, we had to work until the last minutes before the demo day. But everybody of the group was motivated and worked very hard. The teamwork in our group went really well by itself. We could communicate perfectly and we could critique each other with no problems at all.

Due to the problems, we didn't have enough time to do all the user tests we wanted to do. And this is a shame, because bugged 2.0 is a perfect project to do a lot of user testing: Does the emotion come across that you want to reproduce? We did a few tests, and modified the prototype a bit for the next demo day. But I don't think it was enough. In my next project I would really like to develop the UFP competency more since I barely developed the competency during this semester.

Olivier van Duuren

I thinks this project has been the best way for me to learn. It is much better than learning out of a book, which is in my opinion not even possible with technological design. At first helped this project me to improve a lot of different competences. Working in a team concerns automatically the teamwork and communication competence, but our teamwork reached, in my opinion, a high level. Therefore I am very happy to have such a team. A team who cooperate with the same high ambitions as I had initially. This high ambitious were eventually too high, but it helped us to keep working very hard. Because we wanted so much we worked hard until the last minutes before our presentation. Besides this competence I developed my User Focus and Perspective competence. Although we have not done very much in that designing area, I did prepare and that was enough for now. I do hope that the next project can be tested so I could develop this competence even more.

Loek van Haaster

This semester I started in complete confusion. Industrial Design; what should I imagine. After I had chosen project Bugged, I needed about two months to figure out what Bugged completely content. This coupled with my first design process led me to this confusion. When I look back on this half year, I see that I have learned so much. For example, I learned how to behave in a brainstorming session; say whatever comes to mind. In fact, think aloud. Me and my group members found it difficult to make this step. We asked two senior students to give us a nudge in the right direction. We brainstormed with them for half an hour, this gave us a lot of energy and after that we came to some Bugged concepts. The two senior students just showed how aloud thinking looks and what kind of wild fantasies you can have.

While brainstorming, we focused more and more on the concept of the rotating door handle. We built with Duct tape and Little Bits prototype 1. Building pleased me very much and I was trying to build a nice prototype with help of my technical understanding.

At one point we decided to actually make the rotating door handle. We bought a door through Marktplaats and a pole at the D.I.Y.shop. I wanted to be in the building crew, because I get a lot of pleasure from. Along with Olivier, I made the pole and learned something about constructions. How does the door remains stand and how does it not pry? After the pole was made I took the mechanics on me. I devised various systems and outlined them with Google SketchUp. This I learned to make very detailed computer models. Furthermore, I learned the use of different types of gears. I made a paper prototype to see if my ideas were quite practical. Eventually while building it turned out that my ideas were too difficult to work out well. In this area, I have learned a few important things; there was a problem I wanted to solve, but because it took so much time and it ended up not working as well, my group could not work all the time on the door. On top of that I was all day disappointed in myself, because that what I had made wasn't working. I set a goal that I have to discuss a lot better with my group about decisions I want to make. I choose too much my own path. I feel that I have improved myself in it right way by discussing my new actions or decisions first.

The next semester I want to do some things differently. I want to pay more attention to the planning, we hardly had time to user-test the door. This is unfortunate because our third prototype was excellent to do these tests. Next semester I want to accelerate the construction, the building of the door was often too slow.