# Submission of Written Work

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**Course manager:** Ole Kristensen  
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**Supervisor:** Laura Beloff

<table>
<thead>
<tr>
<th>Full Name</th>
<th>Birthdate (dd/mm-yyyy)</th>
<th>E-mail:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Emil Brogaard</td>
<td>08/03-1994</td>
<td><a href="mailto:emib@itu.dk">emib@itu.dk</a></td>
</tr>
<tr>
<td>2. Peter Zander Havggaard</td>
<td>28/04-1994</td>
<td><a href="mailto:pezh@itu.dk">pezh@itu.dk</a></td>
</tr>
<tr>
<td>3. Liam Alex Sonto Poulsen</td>
<td>18/08-1996</td>
<td><a href="mailto:liap@itu.dk">liap@itu.dk</a></td>
</tr>
</tbody>
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THE ROGUE HAND
Experience the twitter syndrome

Table of contents

Introduction - Shake hands with the Rogue Hand 2
Inspirations and Related Works 3
Design, Material Explorations and Construction 5
Reflections 8
Closing Remarks 11
References 12
Introduction - Shake hands with the Rogue Hand

The Rogue Hand serves as a robotic replacement of the human hand. The hand was created to explore the externalisation of bodily control, and is therefore not controlled by the wearer. Furthermore we sought to investigate the way digital elements affect the experiences and aesthetics of art. The intention was to create a feeling of a limb that the wearer has little to no control over, and in a sense ‘has a life of its own’. We realized this by controlling the movements of the hand through twitter. By tweeting at the hand’s hashtag, #Roguehand, you can control whether or not the hand tightens or loosens its grip. Thus in a sense democratizing the control of the hand to all of the users of Twitter. To create a feeling of uncertainty, where you never know when your hand will grip or release, and explore how this changes the way you interact with the world. For instance, do you have to drink your coffee very fast because you never know when the hand will drop it? How long do you have to wait for the hand to grip the coffee cup in the first place, provided you do not tweet at it yourself?

We realized this by building a robotic wearable consisting of a 3d printed hand prosthesis, mounted to a wrist guard with a handle that the wearer holds unto. Thus when wearing the Rogue Hand, you are not able to use your own hand. The electronics of the hand are controlled by a Raspberry Pi, that monitors the Twitter stream through a python script. When it finds a tweet containing the hashtag it is monitoring, it will then start the motor, and move the hand to the opposite state of the one it is currently in. The hand functions as a completely independent unit, running on batteries and communicating with twitter using wifi. This was important to create the hand as a ‘replacement’ of your own hand, instead of an installation or a stationary piece, with a lot of wires tethered to it.
Inspirations and Related Works

The ideas behind the design of the Rogue Hand draws inspiration from numerous projects and pieces, in the fields of art, biology, science fiction and gaming culture.

The main focus of the design was to give away control. The idea of democratization of bodily control was influenced by the way the game streaming service Twitch handles co-operative play on massive scale. A twitch user created an event known as Twitch Plays, in which all viewers of the stream decide how the game plays out. As an example, one event featured the game Pokemon. During the stream, every viewer had a chance to input actions into the game by writing them in the chat. At its peak, the event had over 100.000 players, all inputting commands at once (Ramirez, 2014, p.1). Naturally, having thousands of different inputs at once, led to a somewhat erratic form of gameplay, and the way of input was later changed to one based on voting (Ibid, p.2.). Now, the game would pause for a few seconds, and ask for an input. The next command input into the game would be the one with the most votes from the viewers. After 16 days, the game was completed (Ibid.). This event served as an insight into how numerous people can act together, and control a single artefact co-operatively, as well as the balance between order and chaos in such a system.

The idea of having numerous people deciding on a single input, became a central cornerstone of the development of the Rogue Hand. But instead of having people control a digital game, we wanted them to control a physical object, more precisely, a human hand. Originally, we envisioned The Rogue Hand as being equipped with a webcam, that would stream from the hands point of view. The viewers would then be able to decide whether the hand should open or close in a given situation. In the end the constructed prototype was however not equipped with a camera nor controlled by Twitch, but was instead controlled by Twitter. Since the twitter api was much easier to use, and implementing a webcam was low on the list of priorities, we went with twitter instead, as sending text commands to the hand is somewhat similar on the two platforms. This allowed us to rapidly construct a prototype.

This idea of a ‘rogue limb’ that has a life of its own was inspired by the illness known as alien hand syndrome (Panikkath, 2014: p.1). The illness causes the hand of the person to behave on it’s own, against the will of said person, often resulting in the hand exhibiting dangerous behavior. Where the actions of the alien hand syndrome is caused by the person’s subconsciousness, the actions of the Rogue Hand would be decided by a mass audience. We wanted to play on the idea of this illness, and gave the project the subtitle “Experience the Twitter Syndrome”. By naming it after the illness we wanted to hint at the lack of control, and involuntary movement for the wearer.

By creating the rogue hand, we sought to create a replacement for the human form. While the notion of developing the human form has been discussed and researched numerous times before, three concepts stood out to us as particularly relevant, namely being Stelarc’s bodily augmentations, exoskeletons, and the field of biohacking.
As can be seen in the pictures above, the artist known as Stelarc has created a third hand, that can serve beside his two existing hands. The hand is controlled by different muscle regions on the wearer’s body (Stelarc, 1980), and was an attempt at exploring the further development of the human body. In the performance Re-Wired/Re-Mixed(Stelarc, 2015) Stelarc’s visual and auditory senses are disembodied, as he sees and hears things happening elsewhere. His body is augmented with an exoskeleton on his right arm, that is controlled by the audience over the internet, letting them pose his arm as they choose. We found the that the idea of adding on to the human body, as in the case of robotic exoskeletons served an intriguing approach to our concept. Combined with the field of biohacking it was a central source of inspiration in our design process. The field of Biohacking concerns itself with furthering the human body, through food, technological implants, and lifestyle changes (Daugaard, 2013). The idea of changing the human form, for better or for worse, was what led us to the temporal aspects of The Rogue Hand.

In terms of aesthetics, we found inspiration in Nintendo’s Power Glove, released in 1989. The somewhat bulky design of The Rogue Hand was a result of two different considerations. First of all, we had to place a lot of electronics on it, which would be difficult to construct in a sleeker way. More importantly however, we sought to avoid the uncanny valley. As we knew we couldn’t create a perfect replica of a human hand, we wanted to create something that was still recognisable as a hand, while at the same time avoiding it becoming eerily creepy.
The uncanny valley describes the familiarity a person would feel towards another object, or being. The scale goes from low to high familiarity, the closer the object or being gets to looking human. As an example, an industrial robot would score low in both human likeness, and familiarity, while a teddy bear would be closer to human likeness, and thus score higher on the familiarity scale. However, the familiarity chart drops quite dramatically at one point. This point is know as the Uncanny Valley, and exist where an object or being is very close to human likeness, while still being just not quite right (Shea, 2016; Mori, 2012). In order to avoid this we sought to create an object that would remind people more of the likes of the Power Glove, rather than an actual hand. We didn’t seek to confront our perception of the human body, rather we sought to bring attention to our control there off. We feel that hitting the uncanny valley would interfere with this goal, which is why the hand is very ‘technical’ in its look.

We were inspired by critical design (Dunne et al., 2013) in the sense that the robotic hand replacement serves no practical purpose, as we all have both our hands. Instead the hand seeks to explore and provoke the relation between technology, notions of control and our bodies, as well as technological determinism related to social media - do we control social media or does social media control us?

**Design, Material Explorations and Construction**

One of the first ideas we had early in the process was a robotic parasite that was living in symbiosis with the user. It would feed off of the wearer’s movement and therefore demand the wearer to exercise or go outside, and in exchange charge the wearer’s devices. The Rogue Hand was born out of the idea of wearing technology you do not control and that has a life of its own.

The Rouge Hand resembles and mimics the functions of a ‘normal’ human hand, where we define normal as having five fingers with a limited freedom of movement. The shape, function, and the temporal aspects of the hand were important for delivering the intended experience and aesthetic to the wearer. We got the design for the hand from an open source project dealing with affordable 3D-printed prosthetics (Gyrobot, 2014).

We chose a design for the Rogue Hand that looked like a normal human hand because we wanted to focus on the experience of external control. Designing a hand with a radically different shape or functionality might take the focus away from the experience, or would likely create a different experience focused on the affordances of this radically different design. The Rogue Hand had to resemble and mimic a human hand in function as much as possible to immerse the wearer into using it as their own hand.
What we created is a 3D-printed prosthetic of a hand. It consists of a number of different components: The base of the hand and the fingers, the silicone and 3D-printed bendable joints, the wrist where the user holds the prosthetic and where the electronics are placed. As none of us are missing a hand we designed the wrist guard with the handle to allow us to ‘wear’ the hand, and to have space to mount the motor and electronics controlling the hand. To control the prosthetic we are using a Raspberry Pi Model 3B. Other components include a Nema 17 stepper motor, a L298N motor controller, batteries, laser-cut mounting brackets and gear, and thick fishing line to pull the fingers.

The hand went through many different material iterations, as we familiarized ourselves with 3d-printing, laser cutting and silicone molding.
Material Iterations
Throughout the design process we have been through multiple versions and changes on the materials and designs of The Rogue Hand. For our first version we tried to use silicone sealant for the joints, but this turned out to be messy and difficult to use. The hand base we printed had the wrong angle for the thumb resulting in a wrong grip. We also created a wrist guard consisting of five acrylic surfaces for the motor and electronics. This wrist guard was however too big and not very comfortable.

We changed the material used for the joints to two different kinds of 3D-printed flexible filament, these worked quite nice and the movement of the hand was very lifelike, but they had too much resistance for the motor to close the hand. The white 3D-printed flexible filament worked the best since it was more flexible than the green material while still being rigid enough to pull the fingers back to their ‘open’ position. We also 3D-printed a new hand base with the correct thumb and a new wrist guard. The new hand base had imperfections in the holes for the fishing line and was thus not useable and the wrist guard was too small.

As the 3D-printed flexible filament had too much resistance for the motor, we laser cut a mold for the joints and molded new joints using a two part silicone solution. These new silicone joints worked well with the motor, but they lacked the rigidity of the plastic ones, as they would not snap back into the open position after being pulled. We also 3D-printed a new hand base with holes all the way through for the fishing lining.
As the silicone joints were too flexible we tried printing the joints in a new flexible filament with as little infill as possible. These were too thin and did not work well. We also tried molding flexible filament into the silicone, but these were problematic as well.

For the final iteration we combined the silicone and 3D-printed joints to achieve a satisfactory hand movement. We used flexible plastic for the bottom joints and for the rest of the joints we used silicone. The flexible plastic joints were used to pull the fingers back in a neutral position. We also created a new wrist guard, which was larger than the first 3D-printed one and had mounting space for components and the motor, and had ‘guiding tubes’ for the fishing line to put the line at an ideal angle for the motor to pull.

Reflections

The Rogue Hand is not a finished product and there are still multiple aspects in which further development and improvement is possible. For future development it is both possible to improve or change the current experience and aesthetic of The Rogue Hand.

We held an exhibition where we showcased The Rogue Hand and got questions about the design and idea. The questions included the likes of why it looked like a human hand, how a different form would affect the experience, to questions about the function, the chosen hashtags, and the use of Twitter. Based on these questions we have since reflected on how different approaches would affect and change the experience and aesthetic of The Rogue Hand.
Hand. Before and during the exhibition we also learned about which parts we could improve and fix in further development without changing the original experience.

**Improvement Ideas**

Improving on the hand means fixing the problems we have encountered while still maintaining the current aesthetic and experience of The Rogue Hand.

The motor we are currently using is not strong enough and the battery is not big enough. The motor can not pull all five fingers and the hand can therefore not close as intended. To fix this problem we could use a bigger motor and battery as this would give the hand the power it needs to close properly. Another improvement that could be made would be to add something like silicone to the fingers and to the palm of the hand to give the hand a better grip. This would also help increase the emulation of the human hand, as the human hand has numerous biological features which gives us a better grip.

Instead of improving the current features of the robot hand, we could also add new features while still keeping the same experience. Integrating touch sensors into the hand and combining it with haptic feedback would give the wearer a sense of touch, and further enhance the immersion of the experience.

**Changing the Experience**

Further development could also be to explore how changing different features would change the experience and aesthetics of The Rogue Hand.

As we are using Twitter and hashtags as the input, the chosen hashtag was of course a very important and conscious choice. We chose to use the dedicated hashtag #Roguehand as it then meant that every tweet was with the intention of moving the hand, and so there was a meaning with each movement. Changing the hand to listen to, for example, popular hashtags would have made the hand move randomly without purpose, and would then instead become some kind of data visualization of the activity on Twitter.

We only used one motor to control all five fingers which means the robot hand only is capable of opening and closing. For a future project we could add a motor for each finger, which would enable the hand to make gestures. However this changes the experience and moves the focus over to making gestures, instead of using the hand as a ‘practical’ replacement, used for grabbing and lifting things. We have created The Rogue Hand after a normal human hand, but it could be interesting to change the shape of the hand, both enabling different ways to bend and move the limbs in non-human ways, as well as radically different hand designs that have no resemblance to the human hand. It would change the experience, as the hand would no longer be as immersing, at least in a different way, but could instead enhance, or have more functions, than our own hands. We also discussed making the hand customisable, enabling the wearer to choose different colors and perhaps even modularity with different kinds of hands.

Changing the input from Twitter to something else would also change the experience and aesthetics. The hand could instead of listening to Twitter be measuring light for example, and react to the lighting of the room the wearer is in. Using an input like lighting would still remove the wearer’s control of the bodily functions, but the control would not be externalized.
in the same way. Another input we could use is linked to one of the first ideas we had in the design process. The idea was adding a camera on the hand and livestreaming it to a streaming service like Twitch. The Rogue Hand could then use a voting system like in Twitch Plays, which would democratize the control of the hand even further. The use of a camera and livestreaming would add aspects of voyeurism and exhibitionism which would be interesting to explore in the relationship between the wearer and the audience.

Usage
The Rogue Hand does not afford any practical nor rational reasons to wear it. It could therefore be interesting to add some feature or function that affords some reason to wear it. This could be making the wearer stronger, more flexible, or have a better grip, as it then would enhance the human body and you would then have a reason for using the hand even if the wearer is not in direct control.

Restrictions are central to the Rogue Hand; the user is not the one controlling their own hand, and the hand can only grip or let go. Though restrictions are not necessarily negative, as they can force the user to be creative in their use of the hand. Only being able to open and close your hand and being dependant on Twitter force the wearer to act creatively about how they interact with the world around them.

The Creepy Hand of Plastic
Earlier in the report we mentioned our goal of avoiding the uncanny valley when designing the hand. Looking back at the exhibition, we realize that we did not fully reach this goal. This mainly presented itself as a result of our desire to mimic the functions of a human hand. Reflecting on the process, we developed the hand under the influence of some conflicting ideas. The idea of avoiding the uncanny valley did somewhat clash with the idea of giving the hand human like functions. Furthermore, we did not want to create a design that was so radically different from the human hand, that it would take away from the feeling of externalizing control. As a result of this, several of the visitors at the exhibition found the hand somewhat creepy to look at and feel.

Upon further reflection, we have realized that hitting the uncanny valley was not necessarily a problem in itself. In fact, it could even underline the feeling of loss of control that we wanted to convey. The experience of losing control seemed unpleasant to both us as designers, and the visitors who tried wearing The Rogue Hand. The fact that the Rogue Hand was deemed as creepy in itself, actually wound up enhancing the feeling of loss of control. We therefore realized that we should not necessarily view the uncanny valley as something to be avoided, perhaps rather as an interesting direction to explore further.
Closing Remarks

With the Rogue Hand we wanted to explore externalization of bodily control and investigate how digital elements affect the experience and aesthetics of art. Through the design choices and our experimentation with different materials we have explored externalization and the feeling of loss of control over bodily functions. We have achieved our intended experience as the wearer can not use his or her own hand and has to rely on other people on Twitter to control the hand for them.

The digital elements of the hand are very important for the experience, and changing them would also change the experience. Completely removing the digital aspects of The Rogue Hand would also drastically change both the experience and aesthetic as it needs the technology to function and to ‘have a life of its own’. Thus the digital aspects of the design are essential to both the aesthetics and experience of the piece.
References


Hand completed in 1980.


Performed in 2015.