RESEARCH DOCUMENT
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Lifestyle & Design | Digital Craft
Project: Tangible computer interface

TANGIBLE COMPUTER INTERFACE
RESEARCH DOCUMENT 2016

HOW CAN THE DESIGN OF A TANGIBLE COMPUTER INTERFACE HELP TO CREATE AN INNOVATIVE HANDS-ON APPROACH FOR TEXTILE PRINT DESIGNERS?

INTRODUCTION

What is my craft and the corresponding tools and media?

As a 'Lifestyle Designer' it is of interest to map individuals, cultures or sub-cultures in terms of style. The 'daily life' is an important factor that is constantly being questioned. Lifestyle is a term that defines, creates, communicates, influences and preserve identity. Within this I developed my craft in designing surfaces that elaborate on a certain experience that reconnect people. This is made with both digital and analog techniques, namely through textile materials. Surface design to me is an experience that change and enhance the ambience of an environment or object. An experience that evokes a new kind of relation to its user. Color, tactility, construction and pattern formation are important characteristics of a surface. Surface Design is present across a broad range of design-based subject areas like Fashion, Interior, Product Design and Architecture. I get a lot of inspiration from architecture, nature, cultures/tribes and traditions. Through my Internship at Sparkel Group, I learned how to make art works for packaging design. I found out that I wanted something more than only flat surfaces, I was longing for more sensibility and tactility in my designs. But also in my working process, which is mainly behind a computer. The way I use a computer interface is lacking sensibility in my opinion. I have experiences with digital software like Illustrator, Indesign and Photoshop and using the laser cut machine. During my exchange with Manchester School of Art, I followed the course Textiles in Practice. This gave me insight in making digital prints printed on fabric and screen printing on fabrics. I also discovered how to create textures with the embellish machine, to make my work more tangible. What I liked about it was that I was not only working behind my computer, but was really making something by using my hands. I was working both analogue and digital. It gave me a lot of new inspiration and a different insight on art. I am still developing and exploring my role as a lifestyle designer, and my contribution to the future, but what I do know is that tactility is a term I find very important, especially in the digital world we live in now.

'I DEVELOPED MY CRAFT IN DESIGNING SURFACES'

Nowadays there is less interaction between people in reality. Although on their social media platforms there is a lot going on. People tend to have a bigger connection with their mobile devices than with people in their surroundings. I even catch myself looking at my phone with every step I take, and it makes me wonder if this is effecting my humanity. The question 'how can material experiences reconnect people with tactility in our digitized lives?' was asked by Marie Rouillon for her project 'Daily Haptics Cups'. Originally Marie is a textile designer, but developed in a material designer. She created new tactile experiences in order to reconnect us with everyday routines. This project makes you question sensory ability. Technically they are all cups but they look and feel different. Therefore they are responding to contemporary society's digitization. It aims to re-engage people with tactile, material experiences.[1] Which is something I would like to accomplish with my project too. This collection encourages the idea that visual information alone is not enough, you have to touch the cups to get full information. This way the user is invited to rethink his tactile habits on a daily basis. Over time human actions are being replaced by machines. Everything is being done for us. Our senses are being less stimulated and the eye has become the number one sense to register. I think that it is important that we need to trigger our senses more. Because the interactions that we do have with our digital devices are lacking tactility and sensory experiences.

'INTERACTIONS ARE LACKING TACTILITY AND SENSORY EXPERIENCE'

In 2013 at the Textiel Museum in Tilburg, Lidewij Edelkoort explains that Talking Textiles (exhibition) will expand our perception of where textiles can take us: "After a reaction to the increasingly digital landscape of our lives, a craving for tactility and dimension has led designers to reconsider the cole of fabrics once more.

MARIE ROUILLON

'HIS DESIGNS ARE VERY HUMAN AND LESS DIGITAL'

MAXHOSA

The near future will see the overwhelming return of textiles in our interiors, covering floors, walls and furniture in an expansive and personal manner. These textiles will speak loud and clear to become the fabrics of life, narrating stories, designing pattern, promoting well-being and reviving the act of weaving."[2] I find it interesting that Edelkoort is telling that although we live in this digital landscape, we will crave for more tactility and more sensibility. That's why I think analogue and digital should be blend together. I am curious how textile surfaces will shape our future in Fashion, Interior and Architectural contexts. Laduma Ngxokolo is a knitwear designer with his label MaXhosa, and is inspired by the Xhosa, one of the South African dominant ethnic group. His latest collections captures the beauty of being truly African and proud in a modern context that seeks an eternal way of communicating culture through fashion. This makes his designs very human and less digital. What I like about his collection is that it has a story. It is dedicated to his mother, who taught him how to hand-machine knit and was a great patron of the Xhosa heritage.[3] Another designer that is inspired by her own roots is Nipa Doshi, from the brand Doshi Levien. She created a series of rugs that evoke the sensual and shiny world of tribal folk embroidery of India. Hand crafted embroideries made by Nomadic community of the Rabaris. She had a memory of the embroidery workshop of her aunt. Women sat together on rugs surrounded by jewel like elements that scattered around them as they work. This hands-on working process was her biggest inspiration for this collection.[4] Materials change design, you can find inspiration in materials that suggest new functions. Their context is changed which means the outcome is an innovative reinvention. Borre Akkersdijk experiments with the function of materials and gives new meanings to them. For example, on a circular knitting machine he directly knits the fillings of the clothes instead of adding it afterwards. He calls this new technique 3D-knitting. He got this idea from the mattress industry, where this was done before, but never with clothes. He had to adjust the technique because otherwise the fillings would fall out after cutting the fabric, and therefore he had discovered a new technique.[5] This is coherent to this project: creating new technical solutions with a different way of using materials and focussing on surface design. A surface that invites to touch, a new meaning to the material and a more hands-on approach by the user.

The process of making a textile print can be very hands on. Hand painting or screen printing is one of them. But using digital software is unfortunately not always that exciting. The software is doing it for us. For example, the well known filters are copying human crafts that we once invented, only in a much faster way. I find it interesting when those two worlds are being blend together and benefit each other. Something that is exciting to work with but on the same level and speed as a digital production. Searching for the balance between analogue and digital inspired me for this project. This research document will give an answer to the main question: How can the design of a tangible computer interface help create an innovative hands-on approach for textile print designers?

'SEARCHING FOR THE BALANCE BETWEEN ANALOGUE & DIGITAL'

HOW CAN THE DESIGN OF A TANGIBLE COMPUTER INTERFACE HELP CREATE AN INNOVATIVE HANDS-ON APPROACH FOR TEXTILE PRINT DESIGNERS?

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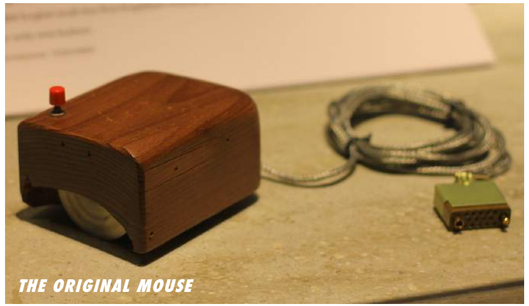
EVOLUTION OF THE COMPUTER INTERFACE

Why should the computer interface we now know change into something different?

'A BLOCK OF WOOD WITH A SINGLE BUTTON'

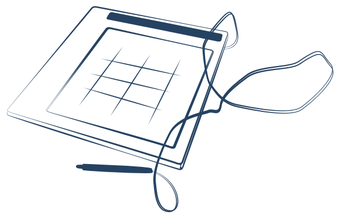
The computer mouse evolved over time. The first useful innovations were creating computer commands available through right and left clicking. Then scroll wheels allowed enhanced control of the computer without having to remove the hand from the mouse. The growing computer culture was fed by a shared experience of controlling a computer with a mouse. Pointing and clicking became common terms. The mouse became a key component to the computing experience.[9]

But first let's go back in time to where it all began. In 1963 at the Stanford Research Institute in Palo Alto, the first computer mouse was developed by Douglas Englebart and Bill English. This original mouse didn't look like our contemporary mouse and it could only move on one axis. It was a block of wood with a single button and two gear-wheels positioned perpendicularly to each other. Later on this was replaced with a metal ball bearing to track movement in 1972 by Bill English and Jack Hawley. The ball enabled the mouse to move in any direction.[6] Englebart did not want to offload rote calculations to machines, but he wanted to help human beings work in smarter, more effective ways. He said "We weren't interested in 'automation' but in 'augmentation'. […] We were not just building a tool, we were designing an entire system for working with knowledge."[8] It was in 1979 when Apple discovered the mouse, invented by Douglas Engelbart. Apple was so inspired by this invention that they scrapped their current plans and redesigned everything around the mouse.[7] In 1980 the optical mouse was developed. It required a special mouse pad and utilized special sensors to detect light and dark. The optical mice of today can work on any surface and use an LED or laser as light source.[6] So, how did the wooden block mouse developed into today's magic mouse? Apple's obsession with mouse buttons is in fact legendary. The single most important feature that sets the Apple Mouse apart from others is the emphasis on a single button control interface.[7] PC manufacturers believed that adding more buttons would increase the user's productivity. Meanwhile, Steve Jobs waged an endless war against the additional complexity that he believed came with having more than one button. All of Apple's current pointing devices don't have any visible buttons, and they offer a huge amount of finger-tapping. A real design characteristic that has now been copied by many of the company's competitors. Over the years Apple's mouse has gone through a vast scale of fabrication techniques. From industrial strength plastic to the current Magic Mouse, which is a combination of glass and metal. Where the rest of the industry settled on plastic from the very beginning. Instead Apple adopted new technologies like laser tracking and capacitive glass. [10] With in 2005 it's iconic design, a mouse with no (visible) buttons.



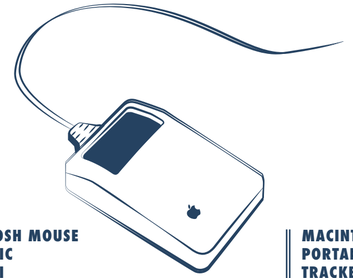
THE ORIGINAL MOUSE

TIMELINE



APPLE GRAPHIC TABLET

LISA MOUSE



MACINTOSH MOUSE
MOUSE IIC
MOUSE II

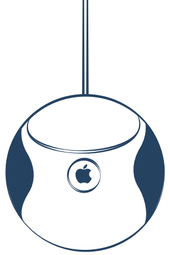
MOUSE

MOUSE IIE
APPLE DESKTOP
BUS MOUSE

MACINTOSH
PORTABLE
TRACKBALL

APPLE DESKTOP
BUS MOUSE II

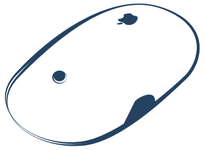
APPLE
POWERBOOK
500-SERIES
TRACKPAD



USB
MOUSE

PRO MOUSE

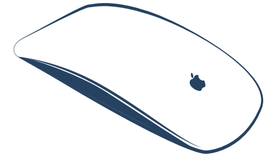
APPLE MOUSE
WIRELESS
MOUSE

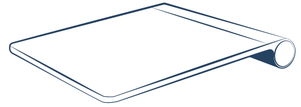


MIGHTY
MOUSE

MIGHTY
MOUSE
WIRELESS

MAGIC
MOUSE





MAGIC
TRACKPAD

MAGIC
MOUSE II

1980 1985 1990 1995 2000 2005 2010 2015

‘THE COMPUTER MOUSE IS SLOWLY BEING REPLACED’

The history of the Apple Mouse is a museum of both design and ergonomics. Though it looks like Apple is focussing more on the design aspect rather then on the ergonomic aspect of their computer mouse’s. Its shape never really felt quite that good in your hand, even the current Magic Mouse is rather awkward to hold. This one issue is something that many competitors have tackled quite successfully. For example take Microsoft’s own line of mice. This includes many models that are extremely comfortable, even when held for long periods of time. Maybe we can conclude that the urge for industrial beauty sometimes causes the company to sacrifice usability and practicality in the name of better looking devices. Also the timeline has shown us that Apple hasn’t introduced a new mouse since the Magic Mouse that came out in 2009. It was followed by the Magic trackpad in 2010, but there aren’t any designs for a new mouse visible. Maybe Apple considers these two devices as its definitive current industrial design language of glass and metal. Or Apple laid of its eyes and focussed more on their mobile devices.[10] But there is also another option that can be coherent here. Is the revolutionary age of the computer mouse coming to an end? It was the development of laptop controls that caused the computer mouse down its current path towards insignificance. Trackpads had become more sensitive to touch and plugging an internal mouse into a laptop became far less necessary. Because the trackpad offered a more intuitive control experience in a much simpler design. Nowadays trackpads allow users to click anywhere and eliminating buttons from any part of the control scheme. The computer mouse was once a part of the laptop experience, but now it’s no longer a key component. Trackpads might be taking over a bit of the mouse’s territory, but the real threat comes from nowadays smartphones and tablet spaces. This touchscreen technology is simply making the computer mouse less and less appropriate. Because computer users benefit from a shared command experience wether using a smartphone, tablet, laptop or desktop. According to Noah Levine (writer at dental products report) touch is the best way to achieve this shared experience. He says “touchpad like surface controls or even no touch, gesture controls such as Xbox Kinect are a perfect cross-platform solution”. The computer mouse has led an essential career but is now slowly being replaced. By what is yet to discovered, but computers will be controlled by voice, gesture and touch on a far more literal meaning.[9] With the focus on stimulating our senses more. There are already some projects that are introducing new ways of interacting. Like the Google Project Jacquard, which is a large single piece of fabric with conductive yarn woven in that works like a trackpad.

APPLE’S MAGIC TRACKPAD

The loom of the Jacquard can weave a regular conductive fabric into a single piece of textile. This conductive surface uses low-power Wi-Fi to communicate with devices. This project is still in development but already looks promising for the future.[15] The Leap Motion Sensor for Mac and PC is an interface without any physical contact. It lets you use your computer in a whole new way. The only thing you have to do is swipe, grab, pinch, or punch your way through the digital world. The Leap Motion Controller tracks your hands at up to 200 frames per second using infrared cameras, this is giving you a 150° field of view with 8 cubic of interactive 3D space.[18] Another interesting interface is the one from artist Graham Fink. He draws digital portraits with nothing but his eyes. The technology he is using is an eye tracking software, provided by Tobii Technology. It uses infrared light to track Fink’s eye movements, that then are translated into lines on a screen.

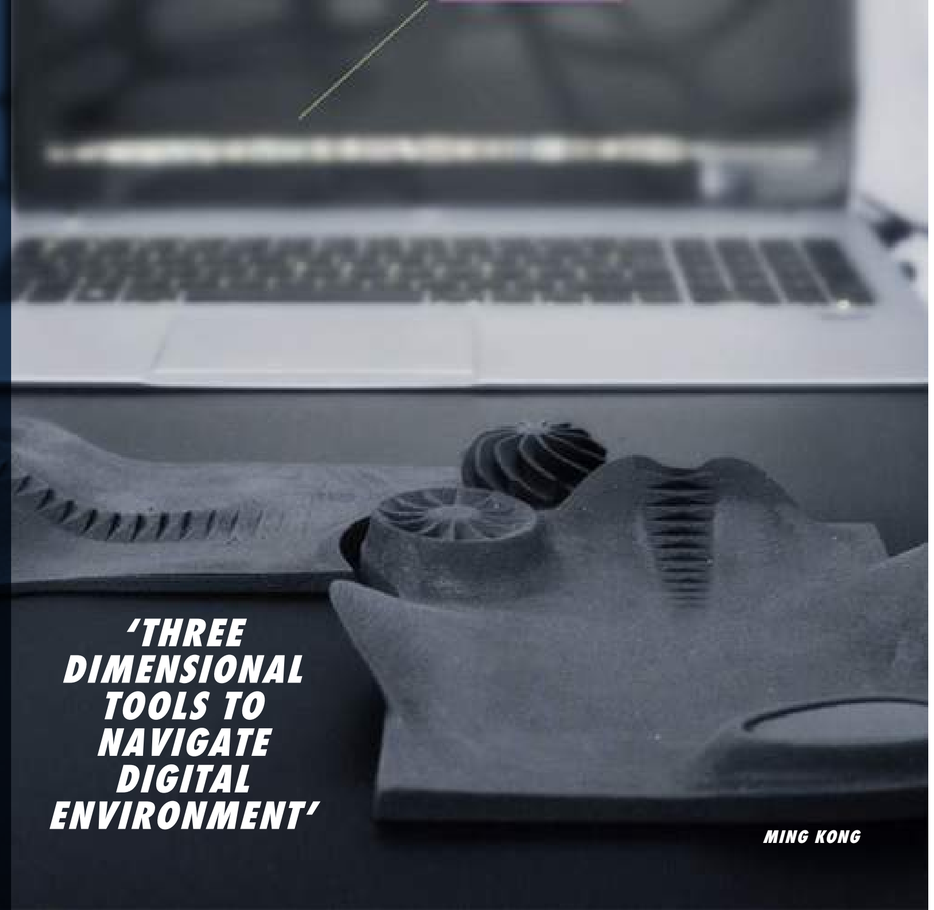
LEAP MOTION CONTROLLER

GRAHAM FINK

These are just examples to show that a computer interface doesn’t have to be a trackpad or a mouse. I would like to see an interface wherein the maker has to put in more effort and attention then only clicking and dragging. An interface that is exciting but also not that precise like the digital world, but causes the outcome to unique every time. In the second chapter I will discuss on what the relation is between a textile print designer and the digital production. And what interface would fit them the best.

TEXTILE PRINT DESIGN

How can the relation between a textile designer and the digital production be improved?



'A MIX OF ANALOGUE AND DIGITAL'

Textile printing can be best described as the art and science of decorating a fabric with pattern or design, according to Brooks Tippett. Tippett is the Vice President of Operations at Pantone LLC. In 2004 the majority of all textiles were printed using rotary screen print machines. It was the most widely used method of traditional textile printing. Rotary screen printing is a technique where color is pressed through holes on a cylindrical mesh tube onto a substrate to give a printed fabric design.[24] But indeed the world of textile printing is rapidly changing. Luckily digital productions of printing textiles is now possible. Currently, 60 percent of digitally printed textiles are produced in Bangladesh, India, Indonesia, Pakistan and Vietnam.[25] The biggest drawback of rotary screen printing is machine efficiency. A pattern setup can take up to an hour and clean op one or two hours. Because of this short print runs are not economical. One of the biggest benefits of digital printing provides the reduction of downtime. They can theoretically print 24 hours each day. On a digital production machine, the printer can produce are little as one repeat of several patterns using multiple color ways, all in a few minutes.[23] Printing fabric digitally is to textiles as 3D printing is to product manufacturing. Rather than using large cylinders to lay down each color in a fabric design, it allows designers to create unique, one-of-a-kind prints that incorporate images with more complexity and nuance than traditionally manufactured fabric. Designer Alexander McQueen was one of the first to use the technology, which is coming down in cost and going mainstream.[26]

This project is about a hands-on/analogue relationship with a digital production. That digital printing has been taking over the field of textile print, is something I want to embrace. Tough this toolkit is a mix of both analogue and digital mediums, for new possibilities to appear. It is the working process of the designer that I want to see change. Why should a computer interface for designers be a trackpad or a mouse? Often very creative and tangible things are being created through digital mediums. Why should the making process of this be less exciting than the actual outcome? For me this tool is a form of resistance against the digital environment, although I don't want to exclude this completely. That's why this tool is a mix of both analogue and digital approaches that are in balance with each other. I want to add more value to the way digital things are being made, by making it more personal and playful. Also I want this tool to raise questions within the design field and the way how we approach creation. The purpose of this tool is to trigger the need for a new design movement to come up with new advanced possibilities. There is a big difference in experiencing the making of an analogue print or a digital print. There are multiple hands-on approaches to create textile surfaces such as: screen printing, hand painting, dyeing, embroidery and tufting. But even with these productions the maker is nowadays being replaced by machines. I find it interesting when the maker becomes part of the job again. And when the relation with the production process benefits from it. Luckily new inventions are already being found in the relation between the maker and the digital production.

An interesting project is the haptic interface for manipulating digital models and files by Ming Kong. Kong developed an elastic conductive material that can be moulded into different shapes to create a tactile interface for digital modeling. He saids about his project that "it explores the possibility that a new form language could be a useful technology itself". He wanted to create three-dimensional tools for navigating digital environments. But to achieve this he needed to invent a new material. Kong developed a conductive silicon-based material that can sense touch and directional movement across its surface, without sensors or wires embedded within. This material is pleasant to touch and also conductive, which enables the sensing ability. The touch sensors

that are detected are transferred along a wire from a connection point in the material to a computer or chip. And then processed by Kong's algorithm and translated into instructions for specially designed software. He created a pair of sculptural trackpads, which can be used to manipulate digital models in a computer aided design (CAD) environment in response to simple hand gestures.[17] This way the experience of the working process is much more exciting and will lead up to new ideas. Another coherent project is the augmented modeling tool called 'Tactum'. It lets you design 3D printed wearables directly on your body.

With the use of depth sensing and projection mapping it detect and displays touch gestures on the skin. The user can simply touch, poke, rub or pinch the geometry projected onto their arm to customize ready-to-print/ready-to-wear forms. Tatcum has been explored through two research prototypes.The first one used a Microsoft Kinect to detect and track skin gestures. While the second one switched to a Leap Motion Controller for skin gestures. This embeds a level of ergonomic intelligence into the form. Wearable designs are inherently sized to fit the designer.[16]

The evolution of digital design has given printed textiles a new direction. The creative process for a printed textile often starts with a loose artwork. This concept is then developed by CAD, Illustrator or Photoshop into repeat and the scale is adapted. At this point a variety of options can be considered. Color placement and separations will also be evaluated, as color can also create focal points and imbalances in a design. The repeat can be developed in form and layout as well as in color and consequential repetition of color creates rhythm and drama to the design.[20] According to Alex Russel, looking back at printed textile design, he concludes that one of the major factors affecting changes in the style of pattern is because of the technological development. Alex Russel was one of my teachers from 'Textiles in Practice' at Manchester School of Art. He wrote the book 'The Fundamentals of Printed Textile Design' in 2011. New printing methods tend to have an effect on the way practitioners work. If the technology involved means that something new is possible with print and pattern then it's obvious new designs appear. From a digital perspective it is important to recognize the influence that software has on the design process. And however open and flexible any software is, it still has a fixed set of routes through which the process of manipulating an image is carried out. Clearly digital technology is having an impact. Styles have appeared in recent years that are a direct consequence of vector-based software. [22]

My all-time favourite textile print company is Vlisco. Because it has a truly unique design signature that I find amazing. They are known for their fearless illustration and bold color combinations, created by their beloved designers. It is a brand with an African heritage, existing for almost 170 years. Technically their working process is very unique. Their machines are custom built and many parts of the complex process are still carefully finished by hand. That's why the bond between the design and craft is unique, something I would like to achieve with this toolkit as well. It is also a brand with a rich history.

The wax fabrics would be arriving off the boats and unloaded at the docks straight to the markets across West Central Africa. That is where it all happened and they became known as Wax Hollandaise referring to their country of origin.[27] Maybe it's because of my own roots, half Dutch half Surinamese, that Vlisco's prints always appealed to me. But I am attracted to the immense combinations of shapes and colors as well as the story that each print tells. These characteristics will always inspire and influence me when I am making my own prints.

INSTRUCTIONS OF THE TOOLKIT

What are the core elements of the toolkit and it's instructions?

'THE TOOLS SUIT THE SHAPE AND STRENGTH OF A HUMAN HAND'

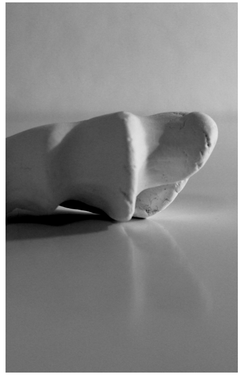
THE CLICK OF MOUSE, THE TAP OF KEYBOARD OR THE STROKE OF THE TRACK PAD ARE THE ONLY WAYS ONE INTERACTS WITH SOFTWARE WHEN DESIGNING DIGITAL PRINTS. WHAT WOULD HAPPEN IF DURING THE MAKING PROCESS THE PRINT COULD SENSE IT'S MAKERS TOUCH? HOW WOULD IT REACT WHEN PINCHED, STROKED OR PUSHED? AND WHAT DESIGNS DOES ONE MAKE WHEN ONE DOESN'T TAP, BUT PULL. OR FLEX RATHER THAN CLICK? A TOOLKIT TO STIMULATE A DIFFERENT INTERACTION BETWEEN THE MAKER AND THE DIGITAL WORK FLOW.

This toolkit exists out of multiple tools with different functions. Those functions are being put into practice by hand gestures. The design of this toolkit is made to achieve total comfort and user friendliness. After an investigation of the hand and its gestures, ergonomic shapes were chosen that suit the shape and strength of a human hand. The first tool has a round shape with several components and is used to stroke or pinch. The second tool has a rectangular shape with cuts on two sides and is used to flex or curve. The third tool has a triangular shape with two layers and is use to press or pull. The tools are made out of flexible polyurethane foam. This type of foam is already been used to comfort the human body. It is used for padding in mattresses, furniture and car seats. But also used as sponges, medical dressings, filters and soundproofing systems. Polyurethane is part of the polymers or plastics. It can be solid or have an open cellular structure, in which case it is called foam. Foams can be flexible or rigid.28 For this project flexible foam seemed to fit best. Because of its flexibility the user is able to deform the tool and play with it in different ways. This allows us to control a computer in a more natural way.

The first experiments were only focussed on form and shape, made out of clay. Clay can be shaped by hands. Some of the shapes are literally created by a hand gesture. Other shapes were made to see in which way the surface of the clay could deform in something that was interesting to touch. The results were very diverse and because they were rigid once they dry up, there wasn't much space left for interesting interactions. This is why the second experiments were made out of polyurethane foam. These were cut and fold by hand to investigate in what way this foam could be formed. The results were satisfying and this experiment was given to Denise for the Sinterklaas surprise. In the unboxing video Denise explains that her first impression was, what to do with these little objects? Then she started to feel and play with them in different ways to come up with the purpose of it. The simple shapes she found less interesting than the more difficult shapes. At once Denise said 'maybe this is a computer mouse'. All this information gave more insight on what to do next. After a few days the foam was turning yellow. The market owner at Rotterdam Blaak where this material is from said, that because of oxygen and sunlight the foam will slightly color yellow. For the third experiment a laser cut machine and white textile paint was added. The laser cut was used to get more clean lines. It melts the material so it is going to color yellow and brown in certain areas, white textile paint will cover these up. Although textile paint is flexible, once it dried on the foam it did start to tear when it got touched and bend in certain ways. For the final tool kit pieces, the best way seemed to be foam that hadn't been in much daylight yet and was cut and fold by hand.

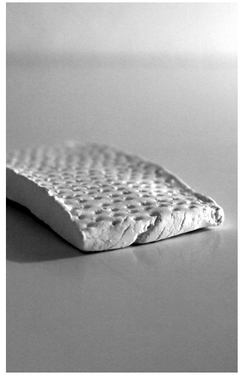
CLAY EXPERIMENTS

The first experiments were made out of clay. The results were not completely satisfying.



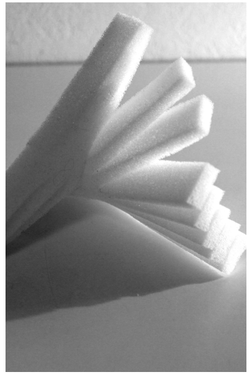
CLAY EXPERIMENTS

The material does not react on strength and touch, the sizes are too small.



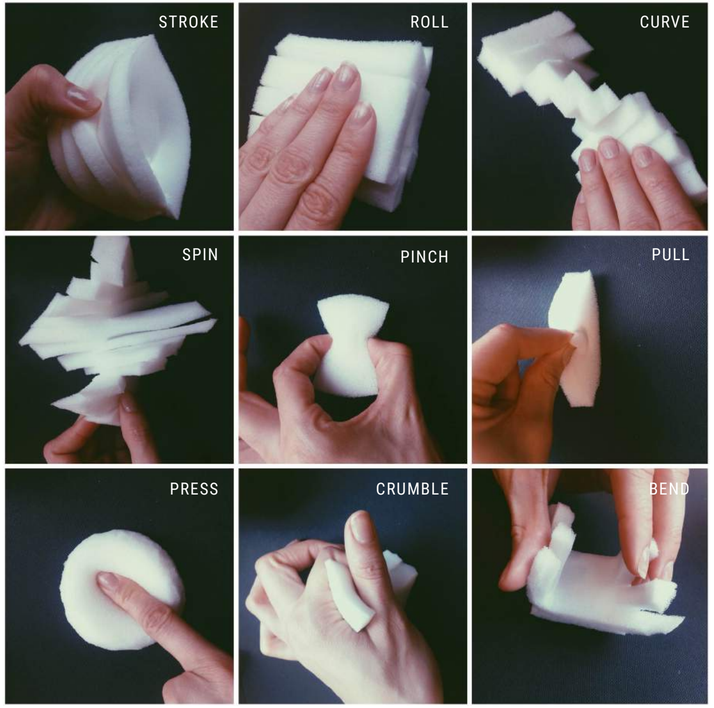
FOAM EXPERIMENTS

The second experiments include an investigation of the material polyurethane foam.



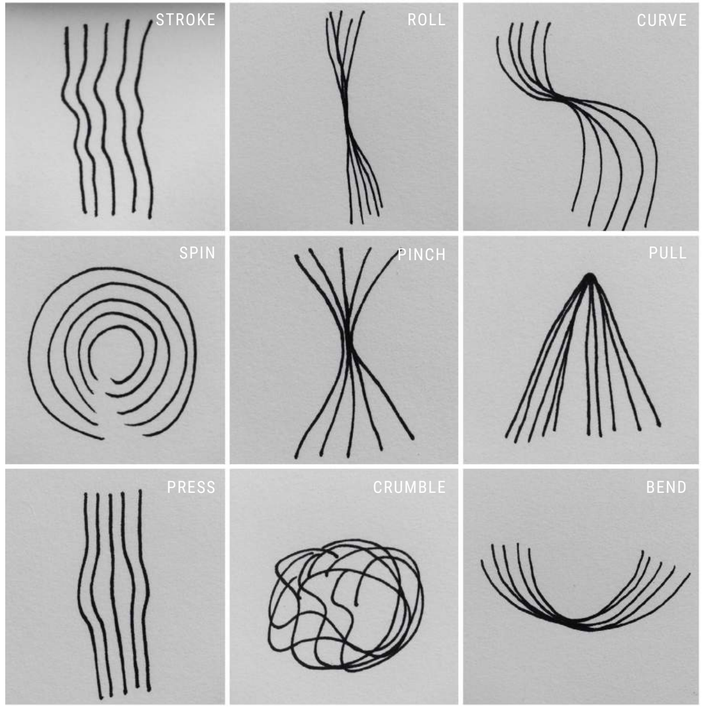
FOAM EXPERIMENTS

The polyurethane foam has been cut, fold and glued together by hand. To see which shapes can evolve from this.



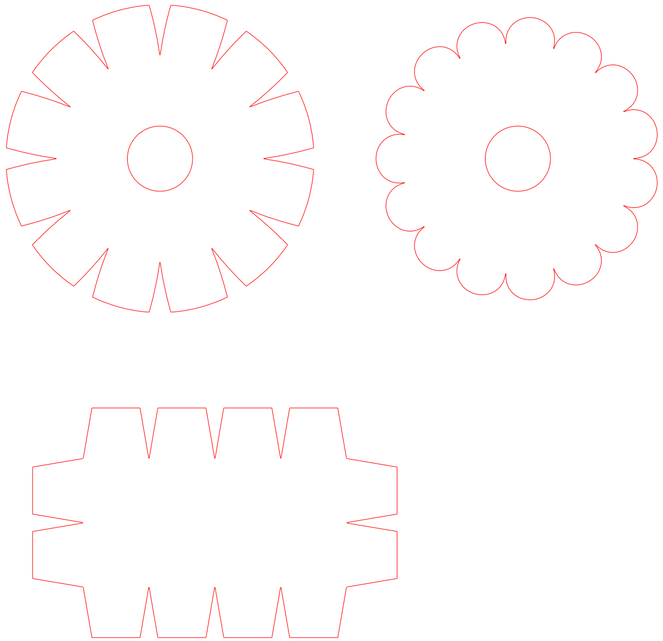
INSTRUCTIONS

With the second experiments some instructions were made.



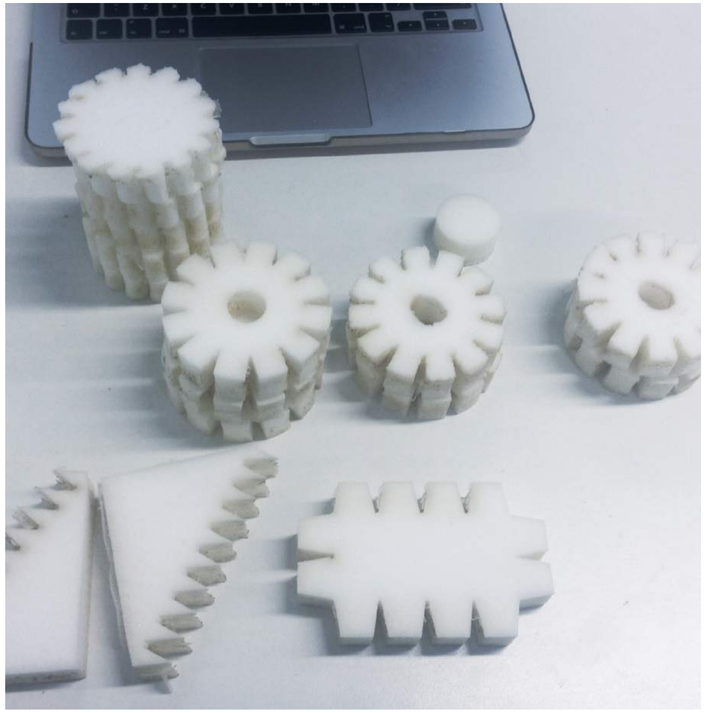
RESULTS

Investigating how a digital print would react when it could sense human touch and strength.



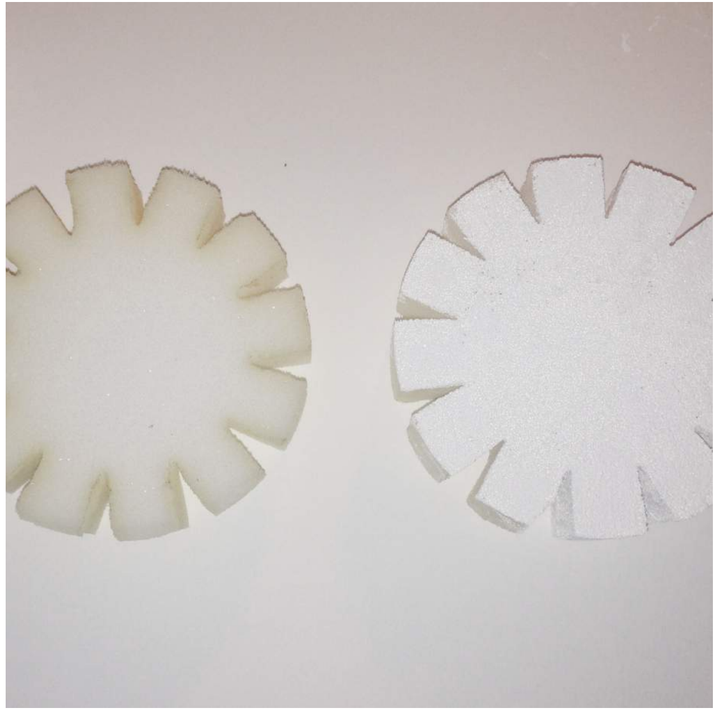
LASER CUT DRAWING

The third experiments were done with a laser cut machine. Because there were no default settings in this machine, several attempts failed.



LASER CUT RESULT

After the right settings the lines were more smooth, but the foam was getting brown and yellow at the edges.



PAINT EXPERIMENTS

Because the foam did not stayed white, textile paint could possibly be a solution to this. The paint changed the structure of the surface, it looked like something rigid, though it's not.

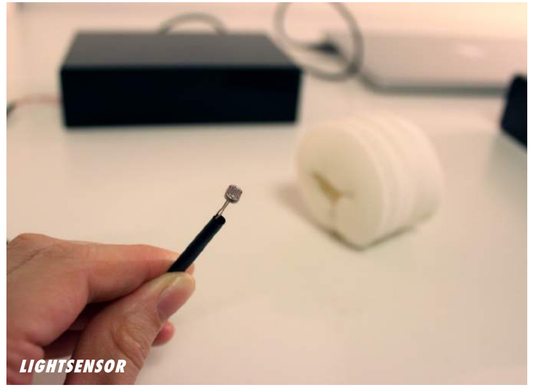
PAINT EXPERIMENTS

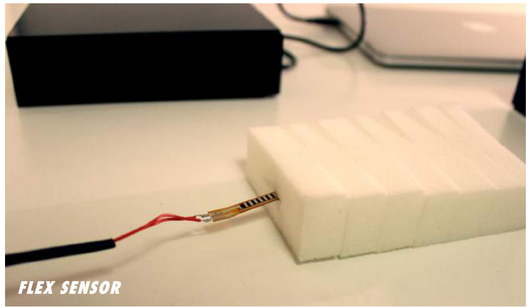
Textile paint is flexible, but it still teared up after using the tools. There are coatings for this type of foam, but for this project I kept it by cutting and folding the final pieces by hand.

TECHNICAL SPECIFICATIONS

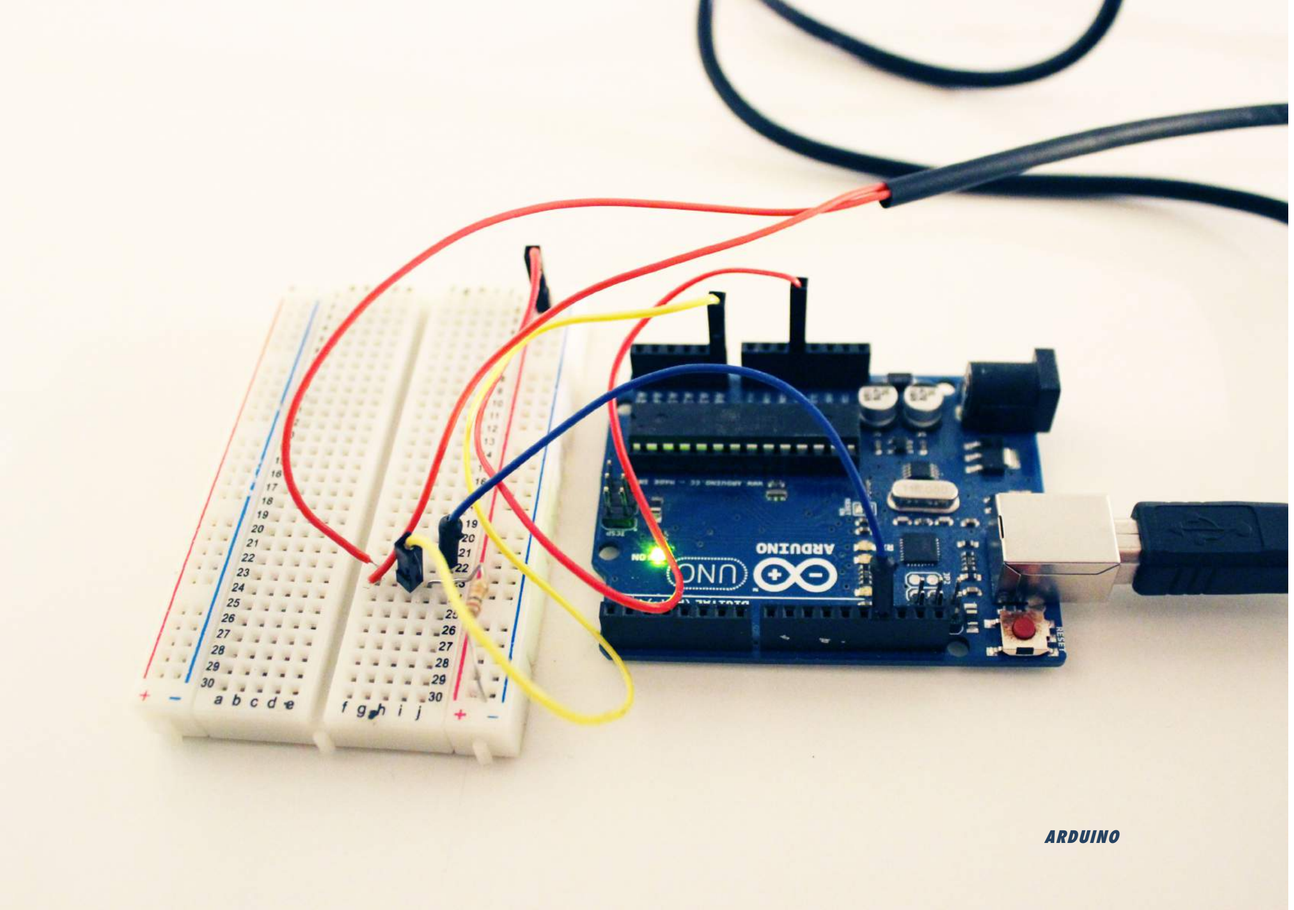
What is the description of technical work that is done in this toolkit?

This toolkit exists out of three tools. Sensors are built within each tool. This way three prototypes really worked. The sensors that are used in this project are the flex-, force- and light sensors. The sensors are all very small, so the prototypes cannot be too big. The sensors were bought from antratek.nl and are part of the 'Essential Sensor Kit'.[29] The sensors are in connection with the computer through an Arduino. Only one code has been used for all of the three sensors, to use them separately. Simon de Bakker helped me with the code, since working with an Arduino was new to me. Arduino was chosen to work with because there needed to be something that can read the sensors and send this data to the computer.


LIGHTSENSOR


FLEX SENSOR

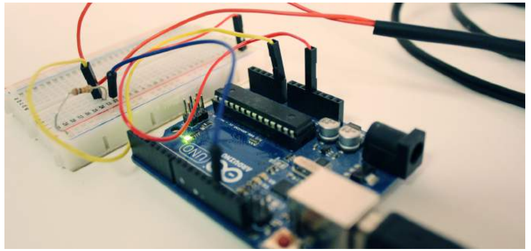

FORCE SENSOR



ARDUINO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. It's intended for anyone making interactive projects. 30 Arduino boards are able to read inputs and turn them into an output. So a finger on a button could be the input, and the Arduino will turn this in an output through turning an LED on for example. What these in- and outputs are is something we can control. Via the Arduino programming language and it's software, we can send a set of instructions to the micro controller. The nice thing about it is that it is an open source and so there are lots of ways on the internet to learn it, but also codes and data sheets are set online.

This is the Arduino code that was used to read the sensors. The sensor pin = Analog in 0, with a 10K resistor to +5V. Serial communication is the process of sending data one bit at a time, sequentially, over a communication channel or computer bus. The pins can act as input, so they can read voltage from something. They can also act as output so they can apply an amount of voltage. The ground gives you access to the lowest voltage on the board. With this code all of the three sensors can be applied separately.

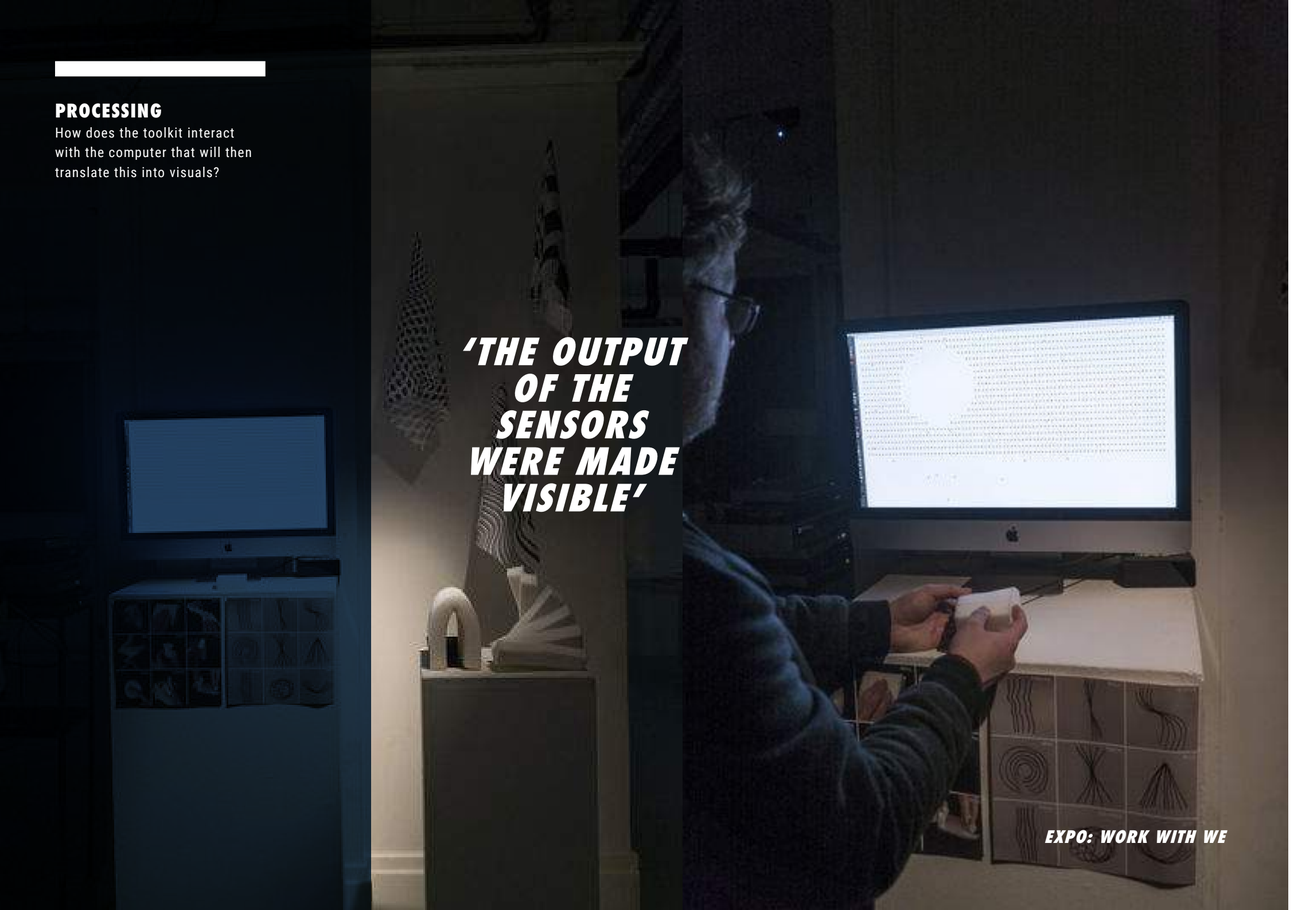


sketch_jan05a

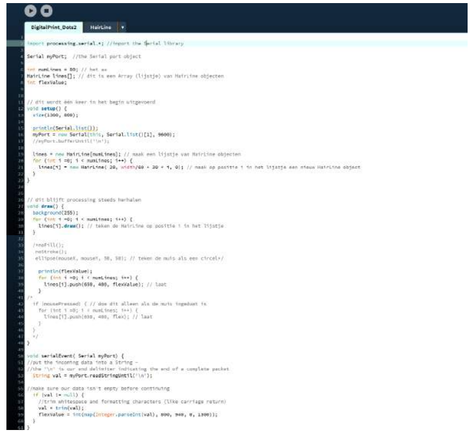
```
// Sensor pin - GND
// Sensor pin - Analog In 0, with 10K resistor to +5V
int LedPin = 13;     // LED connected to analog pin 13
int SensorPin = A0;    // Sensor connected to analog pin A0

void setup()
{
    // initialize serial communications
    Serial.begin(9600);
    pinMode(LedPin, OUTPUT);
}

void loop()
{
    // read the voltage from the voltage divider (sensor plus resistor)
    int sensor = analogRead(SensorPin);

    int output = map(sensor, 745,900, 0, 255); //

    // print out the result
    //Serial.print("analog input: ");
    //Serial.print(sensor,DEC);
    //Serial.print(" output: ");
    Serial.println(sensor, DEC);
    //Serial.println(output,DEC);

    analogWrite(LedPin, output);

    // pause before taking the next reading
    delay(100);
}
```

PROCESSING

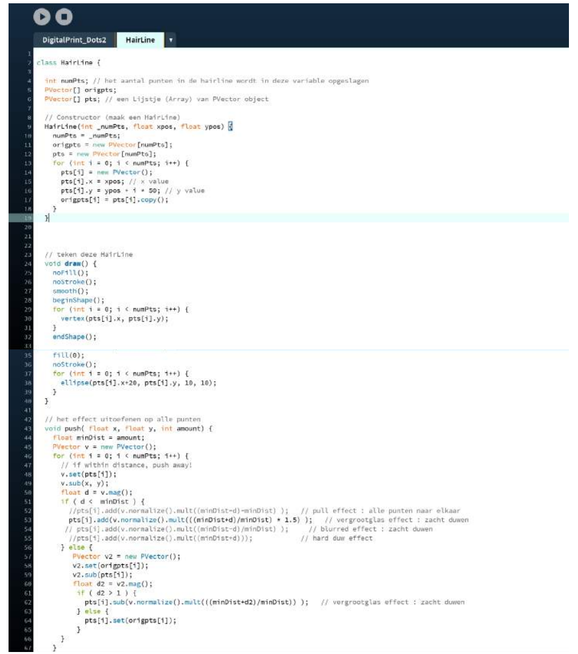
How does the toolkit interact with the computer that will then translate this into visuals?



Processing is a flexible software sketchbook and language for learning how to code within the context of the visual arts. 31 With processing the output of the sensors were made visible. After an investigation of the hand gestures and how a digital print could possible react to this, the codes were made. With some tutorials online I managed to make a simple code with a bezier curve. It responded on the sensors only it could turn in one angle, and was not that sufficient enough. With the help of Tim Knapen the right code existed. Where in a list of dots was placed, and these dots were connected to each other, so it looks like a stroke (hairline). When a sensor is being used the dots are being pushed away, blown up, dragged along etc. This all looked much more real then the first code.



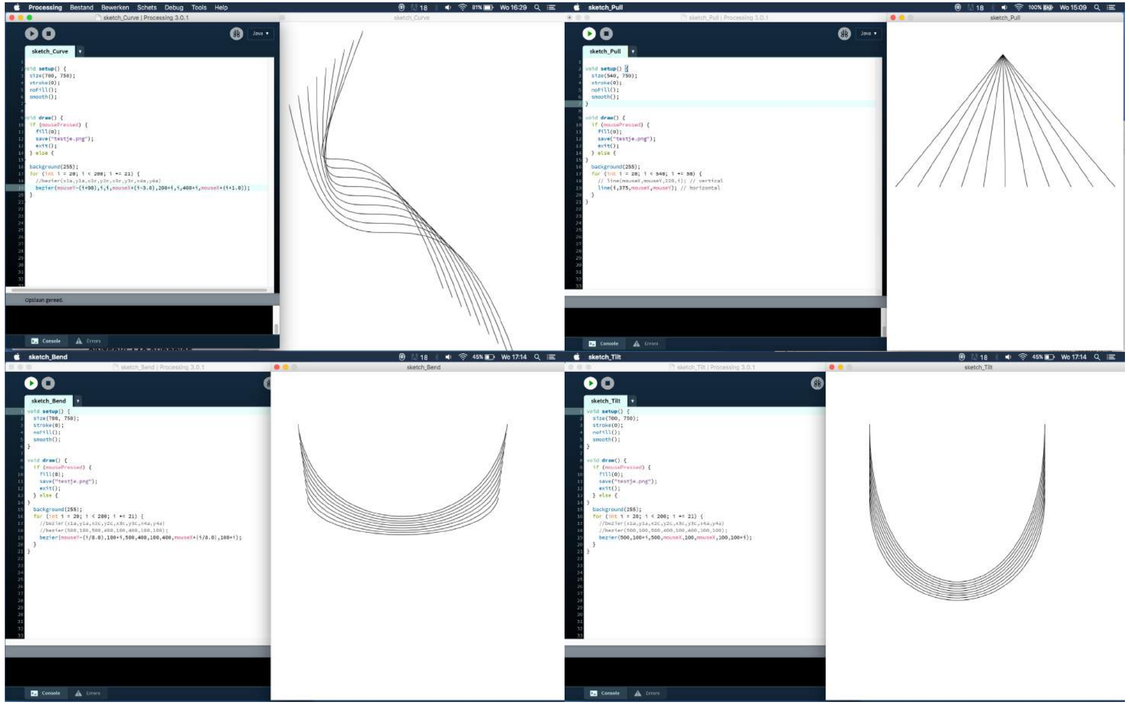
```
DigitalPrint_Dots2 | HairLine

import processing.serial.*; //import the Serial library

Serial myPort;  //the Serial port object

int numLines = 99; // het aa...
HairLine lines[]; // dit is een Array (lijstje) van HairLine objecten
int flexValue;

// dit wordt één keer in het begin uitgevoerd
void setup() {
 size(1300, 800);

 println(Serial.list());
 myPort = new Serial(this, Serial.list()[1], 9600);
 //myPort.bufferUntil('\n');

 lines = new HairLine[numLines]; // maak een lijstje van HairLine objecten
 for (int i =0; i < numLines; i++) {
  lines[i] = new HairLine( 20, width/60 * 20 + i, 0); // maak op positie i in het lijstje een nieuw HairLine object
 }
}

// dit blijft processing steeds herhalen
void draw() {
 background(255);
 for (int i =0; i < numLines; i++) {
  lines[i].draw(); // teken de HairLine op positie i in het lijstje
 }

 //noFill();
 //strokeWeight(1);
 //ellipse(mouseX, mouseY, 50, 50); // teken de muis als een cirkel+/

 println(flexValue);
 for (int i =0; i < numLines; i++) {
  lines[i].push(650, 400, flexValue); // last
 }

if (mousePressed) { // doe dit alleen als de muis ingedaan is
 for (int i =0; i < numLines; i++) {
  lines[i].push(1000, 400, flex); // last
 }
}
*/
}

void serialEvent( Serial myPort) {
//put the incoming data into a String -
//the '\n' is our end delimiter indicating the end of a complete packet
String val = myPort.readStringUntil('\n');

//make sure our data isn't empty before continuing
 if (val != null) {
  //trim whitespace and formatting characters (like carriage return)
  val = trim(val);
  flexValue = int(map(Integer.parseInt(val), 890, 960, 0, 1300));
 }
```



```
DigitalPrint_Dots2 | HairLine

class HairLine {

 int numPts; // het aantal punten in de hairline wordt in deze variable opgeslagen
 PVector[] origpts;
 PVector[] pts; // een lijstje (Array) van PVector object

 // Constructor (maak een HairLine)
 HairLine(int _numPts, float xpos, float ypos) {
  numPts = _numPts;
  origpts = new PVector[numPts];
  pts = new PVector[numPts];
  for (int i = 0; i < numPts; i++) {
   pts[i] = new PVector();
   pts[i].x = xpos; // x value
   pts[i].y = ypos + i * 10; // y value
   origpts[i] = pts[i].copy();
  }
 }



 // teken deze HairLine
 void draw() {
  noFill();
  noStroke();
  smooth();
  beginShape();
  for (int i = 0; i < numPts; i++) {
   vertex(pts[i].x, pts[i].y);
  }
  endShape();

  fill(0);
  noStroke();
  for (int i = 0; i < numPts; i++) {
   ellipse(pts[i].x+20, pts[i].y, 10, 10);
  }
 }

 // het effect uitoefenen op alle punten
 void push( float x, float y, int amount) {
  float minDist = amount;
  PVector v = new PVector();
  for (int i = 0; i < numPts; i++) {
   // if within distance, push away!
   v.set(pts[i]);
   v.sub(x, y);
   float d = v.mag();
   if ( d <  minDist ) {
    //pts[i].add(v.normalize().mult((minDist-d)*minDist) );   // pull effect : alle punten naar elkaar
    pts[i].add(v.normalize().mult(((minDist*d)/minDist) * 1.5) );   // vergrootglas effect : zacht duwen
    // pts[i].add(v.normalize().mult((minDist-d)/minDist) );      // blurred effect : zacht duwen
    //pts[i].add(v.normalize().mult((minDist*d)));               // hard duw effect
   } else {
     PVector v2 = new PVector();
     v2.set(origpts[i]);
     v2.sub(pts[i]);
     float d2 = v2.mag();
      if ( d2 > 1 ) {
       pts[i].sub(v.normalize().mult(((minDist*d2)/minDist)) );   // vergrootglas effect : zacht duwen
      } else {
       pts[i].set(origpts[i]);
      }
   }
  }
```

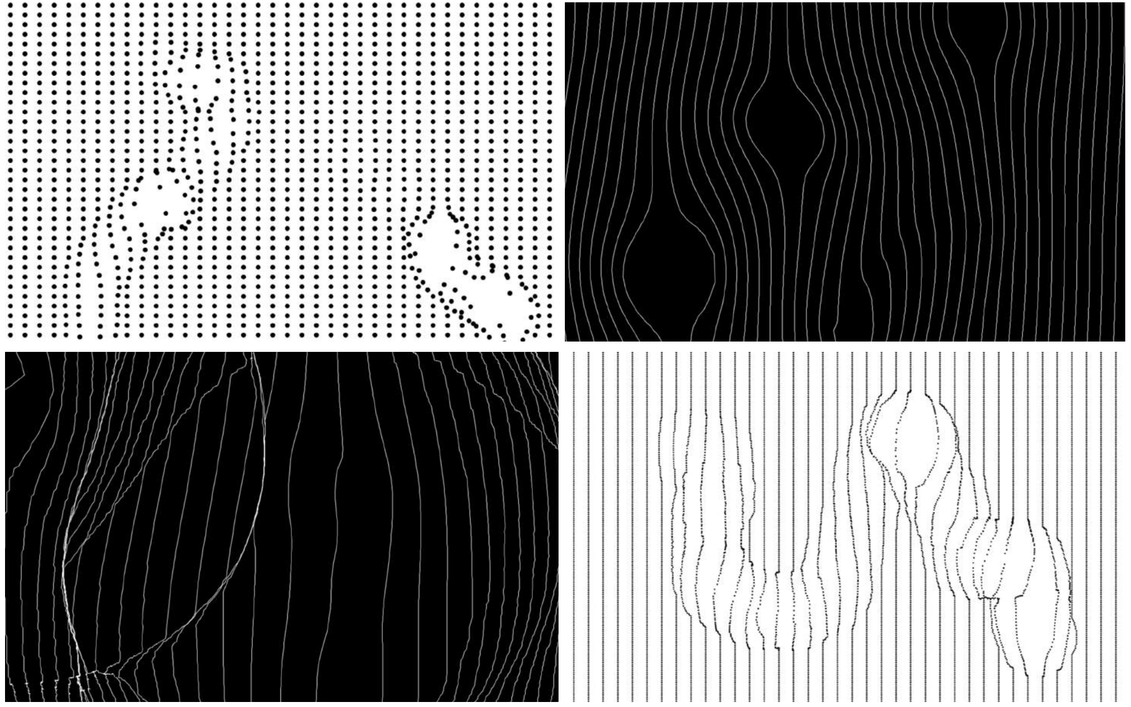
PROCESSING EXPERIMENTS

Using the bezier curve code. Looks staged and is unfortunate that the curve only turns in one angle.



PROCESSING RESULT

Using the hairline code. Gives a more natural effect, and feels really as an interaction.



CONCLUSION

What is the purpose of this tool-kit and it's impact on the working environment?

'THE EXHIBITION WAS A SUCCES IN SO MANY WAYS'

EXPO: WORK WITH WE

REFLECTION

This toolkit is actually a prototype for something better and bigger. The concept of interacting with a computer in such a different way, can be expanded in various ways and not only to digital prints. The fact that the digital print, in this case, can sense human strength and power is very interesting. It takes us to another level. I started out this project searching for a more hands on working process to create digital prints. Throughout my process it has been clear that changing the conventional computer click or trackpad stroke is more interesting then I thought in the beginning. It has been a bit of a struggle to understand the Arduino and the language of Processing, but I do understand the basics and because of this I can see that there are lots of opportunities for this concept. This prototype is hand size, but probably different things will happen when this is being scaled up to human size. The amount of strength and sensibility will then change into unseen matters. Textile print is only one option this tool can be used for. This tool can be connected onto a music software for example. In which you can play with the notes and melodies by touching the tools. Or it can be connected to an architectural design software, where in buildings can feel and respond to human strength. Something that can only be done digitally. But also in the animation field, playing with motion by moving and touching the sensors. Also on a social level this tool could be come in handy. People that have struggles with communication or with expressing their emotions. Playing with these tools may indicate and emphasize their intentions. There are plenty of possibilities to think about. All with the same goal in mind. To make the border between analogue and digital smaller and blend both the worlds together.

THE EXHIBITION WAS ALSO A SUCCESS IN MANY WAYS. I GOT A LOT OF FEEDBACK AND COMMENTS ON MY PROJECT, AND A LOT OF INPUT THAT MADE ME THINK ABOUT THIS PROJECT IN DIFFERENT WAYS. IT WAS SO FUNNY TO SEE THAT EVERYBODY WANTED TO PLAY WITH IT, AND WANTED TO KNOW WHAT IT WAS FOR. PEOPLE STARTED TO FILL IN THERE OWN QUESTIONS AND STARTED WONDERING WHERE THIS COULD BE USED FOR. I AM VERY SATISFIED WITH THIS PROJECT AND END RESULT, AND WILL PROBABLY TAKE THIS CONCEPT INTO GRADUATION.

SOURCE LIST

01. www.marierouillon.com
02. www.textielmuseum.nl
03. www.maxhosa.co.za
04. www.doshilevien.com
05. www.byborre.com
06. www.livescience.com
07. www.en.wikipedia.org/wiki/Apple_Mouse
08. www.theverge.com
09. www.dentalproductsreport.com
10. www.macworld.com/article/2137503
11. www.macworld.com/article/2029597
12. www.history-computer.com/ModernComputer/Basis/mouse.html
13. www.commons.wikimedia.org/wiki/File:Douglas_Engelbart
14. www.maccayellow.nl
15. www.engadget.com/2015/05/28
16. www.madlab.cc/tactum/
17. www.dezeen.com
18. www.leapmotion.com
19. www.geekologie.com/2015/03
20. Textile Design: Principles, Advances and Applications by A. Briggs-Goode and K. Townsend, Woodhead publishing 2011 (book)
21. Hertzian Tales: Electronic Products, Aesthetic Experience, and Critical Design by Anthony Dunn (book)
22. The Fundamentals of Printed Textile Design by Alex Russel (book)
23. www.brookstippett.com/docs/Print2002-BGT.pdf
24. www.magictextiles.co.uk/rotary-screen-printing
25. www.topfair.de
26. www.ibtimes.com
27. www.about.vlisco.com/nl/10-facts-about-vlisco/
28. www.europur.org/applications/what-is-polyurethane-foam
29. www.antratek.nl
30. www.arduino.cc/en/Guide/Introduction
31. www.processing.org
32. Patternity, A new way of seeing by Anna Murray & Grace Winteringham (book)

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