Research document

Digital Craft Minor

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Foreward

Even though my choice to follow the Minor Digital Craft can be seen as a minor detour from my usual track of operating my focus hasn't changed. On the contrary, I have gained new experiences and insights that allowed me to interpret my way of working in a broader sense, while still using it as primary functional guide.

At first sight, digital technology and its applications seems quite distant from working with tangible materials that can be transformed into equally touchable design products. But, actually, a parallel can be drawn. Most people are able to imagine how a tree trunk is cut to produce timber that is then used as building material for a large range of products. Even, how iron ore is transformed into steel for similar applications. Digital technology is more difficult to grasp so that the idea does not occur to approach digital technology as if it concerns material. In essence it can be seen as ground material for artistic work, just like any other material.

Computers commonly use interfaces. These function as translator between computer language and every-day language, readable and understandable by humans. However, if we look beyond the interface we find the actual raw material that we can fabricate. If we compare digital technology and tangible materials like wood and iron one can, for instance, imagine timber as an interface. Hidden behind it is the tree, as raw data, c.q. the source material. The tree itself, by its specific nature, feeds us with information and provides a display of what products can potentially be made with it and what tools will be needed. Wood can be sawed, glued together to a larger structure, shaped on a lathe, carved, etc. If the computer interface is seen as a stage between the raw source material and the final product the concept of using the digital interface as such can inspire artists and designers, and open-up new possibilities and technological applications.

My craft is exploring the essentials of materials, reinvention them through acquired knowledge and repurpose them in contemporary society. Conventionally, these materials were 'naturals' like wood, metal, and stone. The Minor Digital Craft has extended my way of thinking: digital technology can be processed in a similar way as physical materials.

Abstract

Humans have a tendency to gain control over natural processes. Overcoming our inherent limitations has become a communal goal and is embedded in our culture under the denominator of 'progress' for justifying our actions. Thus, the development and application of new technologies has become quintessential for our human-made, fabricated, society. Pursuing this goal has disconnected us from the natural. How do we experience the 'real' nowadays? Many of us have become comfortable with an augmented reality, viewing the world from behind a computer screen. The distinction between the natural world and the digital world has become increasingly blurred.

This project aims to explore our current relation with nature and technology.

A tree in its natural environment can be seen as a pure form of nature. Our response is to turn it into lumber, even more so to grow trees for the sole purpose of producing lumber. The trees are taken out of their natural environment, cultivated, and harvested when they have reached the dimensions that fit our standards. Those standards are no longer dictated by nature. We cut and process the trees to lumber fitting commercial sizes. The new geometric form is disconnected from its natural source. It has become a dead Artefact.

Though, the dead artefact still bears the marks of its pre-processed identity, it will never regain its original appearance. This is where our control over nature ceases.

Would there be a way to employ our human ingenuity and resurrect the tree starting from a piece of lumber using digital technology?

Nature

Mankind

Technology

Central question

Can virtual reality substitute nature? Can the virtual image surpass the natural? Or are humans so tightly connected with nature that there always remains a desire for the sublime natural?

Relevance of the topic

As the boundary between the 'natural' world and the digital world becomes increasingly blurred new questions arise.

What is still original and what is fabricated? Does it even matter if things are original or a surrogate?

With the exponential growth of digital technology we are creating a copy of the world we are living in and even robots with a human like appearance, with artificial intelligence, and capacities exceeding our owns.

According to Next Nature Network, the virtual world driven by rapidly evolving -digital- technology is a new nature on its own (Next Nature Network). How we respond to that new nature is a matter of debate.

Hypothesis

Reconstructing and simulating lost identities is something very common in archaeology.

Digital technology has enabled the imaging and reconstruction of ancient species based on excavated skeletons. Likewise, digital technology has been a powerful tool for reanimating ancient historical places and cultural objects that went lost through ravages of time and war. Moreover, digital technology is facilitating the worldwide sharing of re-constructed images and research results, and easily draws attention to a subject.

My working hypothesis is that the tree reconstructed from lumber by digital technology attracts more attention than its natural counterpart. The surrogate has a value on it's own.

Research approach

Formulation of thoughts
Because of the Minor's theme and personal interest, I want to give humans, digital technology, nature and virtual mimics a central role in my project.

First research activities
Born and raised in an era of vastly developing digital technology, the first planned action is searching the Internet for topics wherein digital technology, human perception of nature, and materials merge.

Follow-up research activities
I decided it had to become a case study according to established research methods, with the relation between humans, nature, and technology as research subject. The contextual content had to come from data collection using various sources.
The case started from a personal interest and was ignited by observation. Strolling through a hardware store it occurred to me how strange it actually is to look at lumber solely as if it were building material. Lumber is sold in many measures of standardized length, width, and thickness, for common applications that have nothing to do with the shape nor with the dimension of the tree they came from. However, even a rectangular piece of wood still shows where the branches used to be. What would the tree have looked like when it was still an element of nature? I wondered: Would it be possible to reconstruct the tree using digital technology, and doing so raise deeper awareness of the relation between mankind and nature through digital technology?

At this point a number of other more basic research questions needed to be answered. What is a tree other than a stem with branches and leaves? How does it grow and how do the branches sprout from the stem? How do you capture the wood knots of lumber, and how do you derive the position of the branches from it? What kind of apparatus would be needed to digitally scan a piece of lumber as project source, and how to convert the digital scan into an image of nature? The most challenging question is how to realize a project manifestation that highlights the relation between humans, nature, and digital technology in an artistic way.

Key references

To conduct my research and comprehend the multiple facets to which the project relates, I structured my study around a few key references.

Nora Al-Badri and Jan Nikolai Nelles, The other Nefertiti, 2015

Similar technology has been used to create artistic work. A project that also simulates the original artefact is the work 'Other Nefertiti' by German artists Nora Al-Badri and Jan Nikolai Nelles. What they've done is making a 3D scan of the sculpture of the Egyptian queen Nefertiti inside the Neues Museum in berlin. They shared the 3D file online for everybody to download and 3D print. The file was downloaded over a thousand times within 24 hours of its release. (Jan Nikolai and Al-Badri)
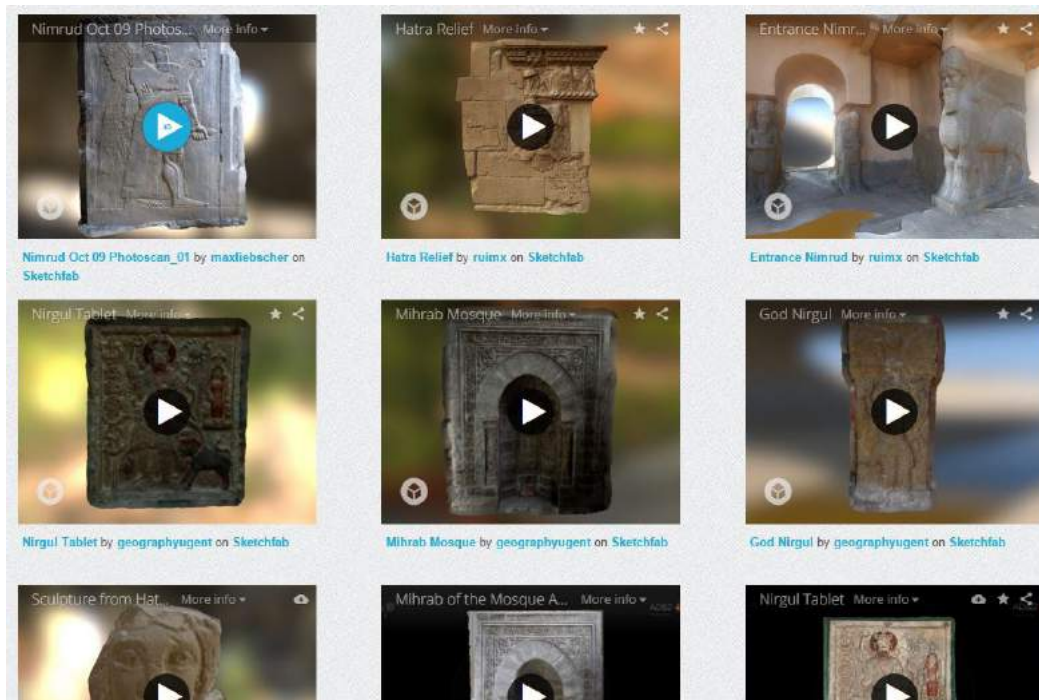
Project Mosul, Rekrei 2016

Another more recent work is project Rekrei. Rekrei is an online muse-
um of digitally restored Artifacts that were destroyed by ISIS during their
iconoclastic attack of the Mosul Cultural Museum in Iraq. Through images
from visitors from before the destruction, the pieces have been simulated
as a 3D representation of the original work. (Rekrei)

In both the Nefertiti and the Mosul project the restored objects probably got way more atten-
tion than the original pieces.

The digitally constructed pieces are in that sense equally or perhaps even more valuable
then the physical objects.

Giuseppe Penone, Tree of 12 Metres, 1980

"Tree of 12 Metres" was made by scraping away the wood from a felled tree, which had first been roughly sawn into a beam, to reveal its internal structure of narrow core and developing branches. Penone's aim was to return the tree to the form it had had at an earlier stage of its growth, making visible natural processes which are normally hidden. He made the first of his Albero or Tree works in 1969. In 1970 two Trees of 12 Metres were made as performances in the Moderna Museet, Stockholm, and at the Aktionsraum, Munich. These early Trees were still partially attached to the industrially-sawn beams into which they had disappeared and from which they now emerged like sculptural reliefs. In this semi-emergent state they were supported horizontally or propped diagonally against the wall in the space in which they were exhibited. With experience, Penone was able to work on increasingly thicker beams which contained the tree's entire core and to cut all the background support away, freeing the tree's centre so that it could stand vertically on its own. In the early 1980s he began to leave short lengths of the beams untouched to provide free-standing bases, from which the forms of the younger trees arise. In this version of the Tree of 12 Metres the artist has left top and bottom ends still trapped inside the beam. A cut at the vertical mid-point has converted it into two pieces, each of which stands on a base formed by the remnant of the beam. The top part of the tree is thus inverted. (Tate)

Lex Pott x NewWindow, Diptych, 2014

Every Object from the Diptych1 series comes from the same douglas fir, therefore carrying the branded '1' on each product. This particular tree was planted on the Dutch grounds of the Veluwe around 1960 and cut down in 2013. All the processing of the material took place in the Netherlands, making this a project deserving the title ' Made in the Netherlands '. The title Diptych refers to the juxtaposition within each object of geometric and organic shapes, open and closed parts, control and freedom. The patterns are created by covering parts of the objects with rubber stickers during the sandblasting process. You can see the life of the tree in the wood: good summers give a wide annual ring, harsh winters a thin one. By sandblasting you blow away the soft rings of summer, leaving a gap. Within the wood there are different colours: heartwood has a reddish hue, sap-wood is more yellow. (van Haaften and Pott)

Next Nature – The Nature Caused by People: Koert van Mensvoort at TEDxDanubia 2013

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Koert van Mensvoort. The Nature Caused by People, TEDx Danubia, 2013

Koert van Mensvoort MFA MSc is an artist, designer, writer & engineer. His work revolves around the idea that humankind, in its attempts to cultivate nature, causes the rising of a next nature, which is wild and unpredictable as ever. (Koert van Mensvoort)

Studio Drift, Fragile Future, 2007

With Fragile Future III Studio Drift fuses nature and technology into a multidisciplinary light sculpture. The sculpture contains real dandelion seeds, which were picked by hand and are connected seed-byseed to a LED light. This labor-intensive process is a clear statement against mass production and throwaway culture.

The Fragile Future series questions whether the rapid technological developments of our age are really more advanced than the evolution of nature, of which the dandelion is such a transient and symbolic example? And could those two evolve together and meet in the future?

Studio Drift proposes a vision of that future in their signature aesthetics; a distinct mix between hi-tech and poetic imagery. This series is about conveying emotion while simultaneously referring to the fact that light lies at the basis of all life. Every unique sculpture is designed to organically adapt to its specific context.

Fragile Future III is a modular work. It consists of three-dimensional bronze electrical circuits connected to light emitting dandelions. The project can be seen as a critical yet utopian vision (Studio Drift)

Lambert Kamps, Reversor, 2006

A tree is clamped in a hydraulic mechanism. It is sawn between two parts of this machine so it can hinge. Now it is possible to put the tree down, but also back in to its upright position. If you regret cutting down a beautiful tree, you can now easily recover the error. (Lambert Kamps)

Wannes Goetschalckx, Toothpick, 2011

During three months, a poplar with a length of 14 meters, a circumference of 2,5 meters and a weight of 4,5 tons is manually transformed into a real sized toothpick. (Wannes Goetschalckx)

Literature

The project relates to a number of key concepts that are explored in the following texts:

'The new sublime"

Sublime refers to an incomprehensible form of aesthetics. The term specifically refers to greatness beyond any measure, without any limitation.
Deeping my understanding of this term through reading has taught me how the perception of 'the sublime' has changed over time. According to Mario Costa: "the concept of the sublime should be examined first of all in relation to the epochal novelty. (Sublime)

The 18th century conception of 'the sublime' considered nature as the ultimate sense of beauty that one could experience. The concept was inspired by revolt against the industrial revolution that was in full swing during that time causing migration of rural workers to metropolitan areas. Romanticists who were against this revolution emphasized the inherent and immense beauty of nature that could become forgotten and overruled by the changing environment. Many art works of that period, from painting to poetry, depict humans immersed in untameable scenery.

As a result of the industrial revolution the concept of 'the sublime' changed from being natural to being metropolitan-industrial. The modernist appropriation of the sublime was to abstract the natural beauty into calculated proportions and geometric forms.

The broad introduction of digital technologies into present day society is causing another shift in our conception of 'the sublime'. According to Wikipedia, Mario Costa argues that new technologies are creating conditions for a new kind of sublime: the "technological sublime". The traditional categories of aesthetics (beauty, meaning, expression, feeling) are being replaced by the notion of the sublime, which after being "natural" in the 18th century, and "metropolitan-industrial" in the modern era, has now become technological.

Examining the shift in notion of the sublime has helped me understand where Digital technology stands to day. It has become a phenomenon on its own, and for many of us a sense of controllable and adaptive aesthetics, whilst for others an uncanny force.

Virtual versus Real (Simulacra)

"The simulacrum has long been of interest to philosophers. In his Sophist, Plato speaks of two kinds of image making. The first is a faithful reproduction, attempted to copy precisely the original (mimesis). The second is intentionally distorted in order to make the copy appear correct to viewers." (Simulacrum)

"Postmodernist, French social theorist, Jean Baudrillard argues that a simulacrum is not a copy of the real, but becomes truth in its own right: the hyper-real." (Simulacrum)

"Hyper-reality is an inability of consciousness to distinguish reality from a simulation of reality, especially in technologically advanced postmodern societies. Hyper-reality is seen as a condition in which what is real and what is fiction are seamlessly blended together so that there is no clear distinction between where one ends and the other begins. It allows the co-mingling of physical reality with virtual reality (VR) and human intelligence with artificial intelligence (AI). Individuals may find themselves, for different reasons, more in tune or involved with the hyper-real world and less with the physical real world." (Hyperreality)

Almost every form of natural life has been documented digitally, and on online; The Internet is a library full of imitations.

New media art

This form of art refers to artistic projects that have been created using contemporary media such as digital technology. It distinguishes itself from traditional art forms that are more guild and crafts oriented (New media art).

"In the book Postdigitale, Maurizio Bolognini suggested that new media artists have one common denominator, which is a self-referential relationship with the new technologies, the result of finding oneself inside an epoch-making transformation determined by technological development. Nevertheless, new media art does not appear as a set of homogeneous practices, but as a complex field converging around three main elements: 1) the art system, 2) scientific and industrial research, and 3) political-cultural media activism." (New media art)

In analogy to Maurizio Bolognini's view my project could be framed as New Media art, as is symbolises my own relation to new technology within the present day world, wherein, digital technology becomes more and more commercialized and omni-present.

"Next nature"

These notes are taken from an essay by Koert van Mensvoort entitled:
 "Real Nature is Not Green" (Koert van Mensvoort).

Do we still realize what real nature is? As an example, Koert Mensvoort refers to a telephone mast disguised as a pine tree and raises the question of whether we are still living in pure nature or accepting a picture of it.
Expanding the topic, he argues that humans have actually laid out every square meter of ground in the Netherlands. It goes so far that humans even transform natural species by genetic manipulation.

 "Nature in the sense of physical matter, unaltered by humans, hardly exists anymore. There's precious little nature left that has remained untouched by humans: perhaps a bit here and there on the ocean floor, the South Pole, or the moon. Old concepts like nature and culture, human and animal, and body and mind seem inadequate for understanding ourselves and the technological society we live in".

What we are calling nature is influenced by the cross talk between humans and nature. Influenced by cultural trends and technological advancement, the perception of nature can change over time. Humans can also add to nature: "…hypernatural nature is always just a little bit prettier, slicker and safer than the old kind. Let's be honest: it's actually culture in disguise".

"Culture is whatever human beings invent and control. Nature is everything else. But much of the 'so-called nature' in our lives has taken on an artificial authenticity" When nature looses its natural character, Koert Mensvoort says, it enters into the realms of culture.

The key message of the essay is that the line between nature and culture is fading. As an example of this human made, genetically modified, tomatoes are presented as part of our culture, whereas a computer virus can be seen as a natural phenomenon.

This essay by Koert van Mensvoort was helpful for my way of thinking about natural nature as opposed to fabricated nature guided by cultural and technological developments.

Experiments

The theme of the exhibition concluding the Minor Digital Craft was: How to be Human? To formulate an autonomous project fitting this theme I started reflecting on the various activities fulfilled during the minor. Did they conform to my way of working? What new knowledge did I acquire, and what new technology was I exposed to? How could these elements be brought together to fit the exhibition theme best?
The results of these first exercises were used for writing an essay in which a concept project proposal was presented. Based on positive feedback the next step was to improve the concept and simultaneously start experimenting with materials and thinking about physical appearance and technical realization of the art object followed by testing.

Insights from experimentation are described in the next paragraph while trouble shouting during the actual realization of the project is incorporated in the paragraph on Realized work

Insight from experimentation

The first project of the Minor, whereby I collaborated with Jeroen, was about human ideology regarding perfect measures. The measuring instrument that I fabricated did its job, but demonstrated that hardly any of the people it was tested on met the ideal measures of the Vitruvian man (golden ratio). Perfection is relative!

The second project was about sensing. For this project I collaborated with Alex and we explored heat sensitive paper. We were confronted with technical challenges from which we learned and nearly solved.

In the third project, with Philip, we compiled a series of tests teaching us the basic principles of artificial intelligence programs.

Project four with MICA exchange students resulted in the installation of a chair and a pot with plants dancing on radio music. They stopped dancing as soon as people came too close, as if they were shy. From that project I learned how a basically simple installation can have a strong effect and decided to implement that element in my project proposal.

Choice of materials

Raising awareness about the source of materials, confronting humans with real versus virtual nature, was the aim of my project proposal. What current day products can be re-transformed to their natural source?

The source of metals like aluminium, copper, bronze, steel, etc. is ore. We buy the metals in the format of tubes, bars, foil, etc. Stone slabs are cut from rock, but what is the source of kitchen tiles or roof tiles, and where do bricks come from? Wood comes from a tree, but we buy shelves, shingles, poles, underlayment, beams etc.

A wood product became my choice, as it is rich in information about its source. Wood reveals annual rings, knots, and colour, whereas metal products give away hardly any information of their source. Important for my project, wood products are derived from living material.

Having decided on a wood product as medium, I investigated the suitability of 'semi products' like beams that are quarter-sawn or heartwood-sawn, planks that are plain-sawn, and plywood that is rotary-sawn. I concluded that quarter-sawn and plain-sawn wood didn't incorporate enough information to re-construct a tree and continued to explore the suitability of a heartwood-sawn beam and plywood.

Plywood: the unfolded tree

Plywood is made of thin layers of rotary-sawn wood that are cross-stacked and glued to-gether. The layers reveal the position of the knots where the branches were sprouting. Rolling the sheets back up again could be a way to re-construct the tree. By partially removing the layers, I could show how plywood is made. The cross pattern of the layers reveals itself and the story of the tree comes to life with every layer in fact being an unfolded tree.

Although I quite liked the aesthetic value of the peeled plywood I doubted that it would be the best material to embody the concept.

The heartwood-sawn beam; the core of the tree

The heartwood-sawn beam does not reveal much more details of the tree it came from than the plywood, but provides a stronger visual perception. I figured, the pure dimensions of a wooden beam compared to those of a plate of plywood would give the project installation more radiance.

Scrolling through a pine tree

To test the concept, I made a scrolling device that when moved across a beam navigates your view up and down an online image of a tree. The interaction between something natural and something digital appeared quite interesting, however, I wasn't convinced this setup was the most appropriate way to present my project.

The installation

To re-connect a wooden beam with nature it had to be transformed into an image of the living tree it came from. To achieve that, I applied the knowledge and experience that I acquired during the Minor Digital Craft, and assembled a para-functional machine (Anthony Dunne) mimicking the properties of a scanner and connected to a computer to simulate real time data processing. A small-scale prototype provided good insight. It provoked the suggestion of transcoding a physical object into digital files for making a virtual image of past nature: a dead tree coming to life.
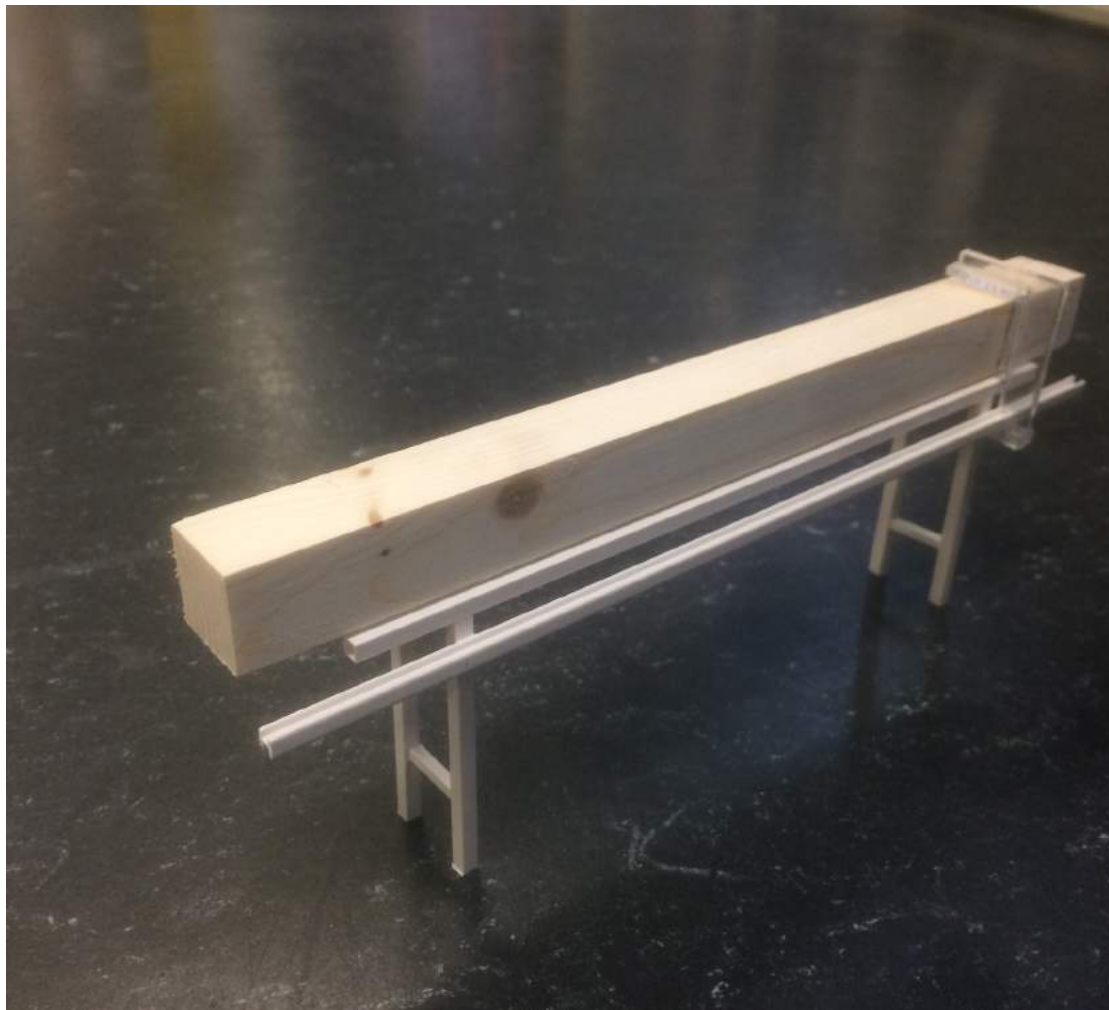
Artistic principles

One of my major criteria in the design process is the message; artistic work needs to be self-explanatory. Another criteria is that products are well crafted and pleasant to the eye. To me that means that extreme care has to be given to every detail of the design; even to those that perhaps nobody will notice.
This project was building on human's eagerness of controlling natural processes and overcoming any limitation through technologic development in an unbiased way

Design proposal

At present, digital reconstruction technology is commonly used for reconstructing ancient archeological artifacts and sites into images that represent their original appearance. I intend to use that technology to simulate the re-construction of a tree starting from lumber to confront humans with virtual nature versus real nature.

Realized work

The realised work is best described as an installation. It became a para-functional machine clearly referring to readily recognizable digital technologies, equipment, and processes, but yet not meant to demonstrate the latest of human inventions but to explore human's relation with nature and technology.
A detailed description of the process of making is provided as Supplement.

In short, the realised work is a para-functional 'scanner' controlled by digital technology for mechanical steering and data processing. The entire process is visualized on a computer screen. What the 'scanner' does is simulating the scanning of a lumber-beam of 20x20x300 cm over its entire length on all four sides simultaneously. The scanning result is captured and visualised by a computer that subsequently assigns coordinates to the knots and year rings and then re-constructs the tree where the beam came from. The re-construction process is an animation that will probably not be experienced as real, but the installation as a whole is expected to draw attention without further explanation and elutes on the theme of humans being confronted with virtual images of nature versus real nature.
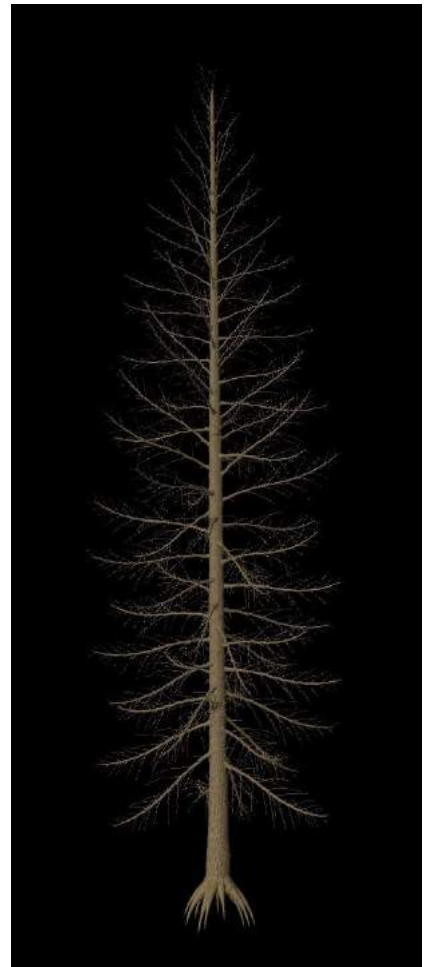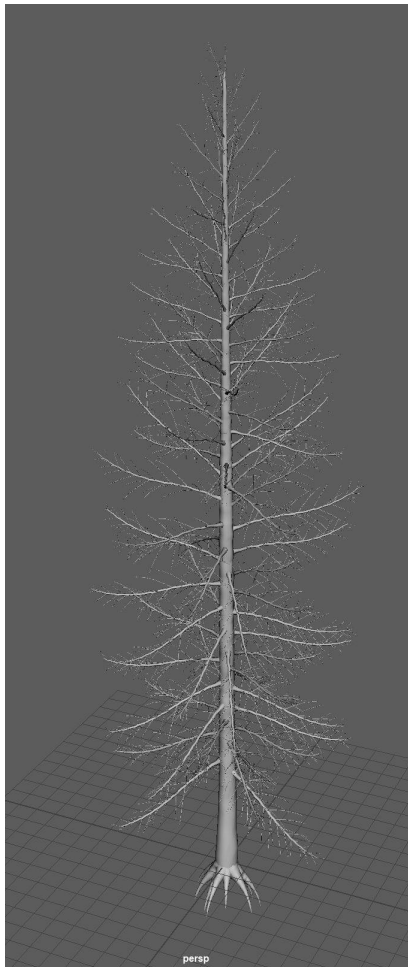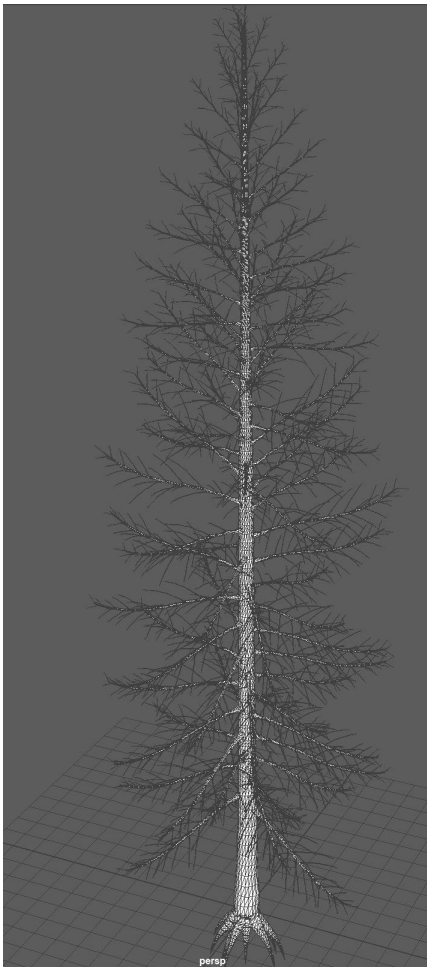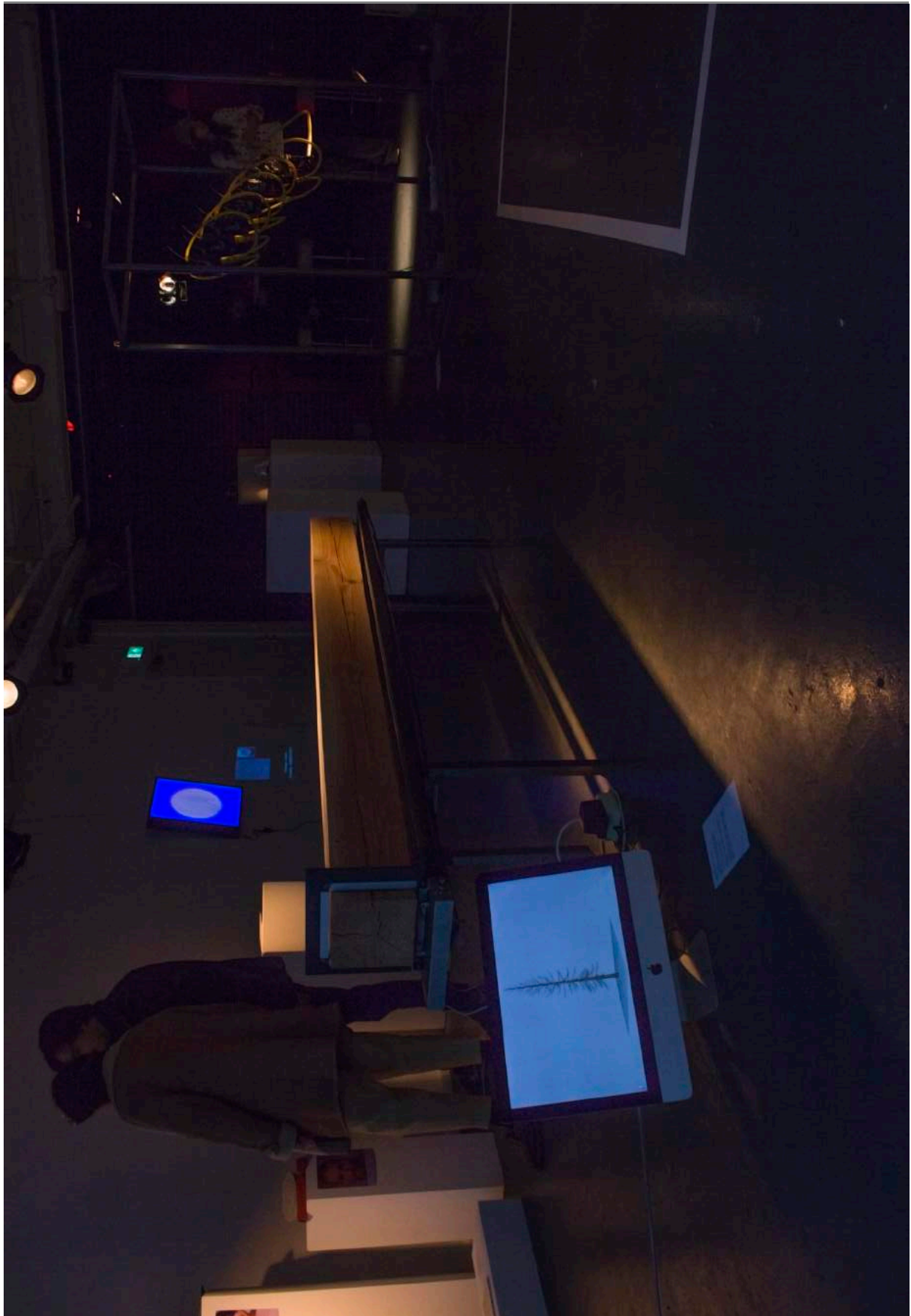
Final conclusions

With my background in Product Design, I started out with a very limited set of skills and knowledge of digital craft. That was challenging, but nice. I felt like being on a learning curve again.

What I have learned during the Minor Digital Craft are new technical skills like how to build an electronic circuit, how to measure current flow, the functioning of electronic switches, how to use an Arduino, and insight in simple computer language.

I have also learned from the simple fact of being exposed to students from different disciplines, doing projects with them, and being influenced by them; even more than that combining skills and knowledge in a practical way to expand the possibilities.

My awareness of the crossroads between product design and artwork has grown. Reading Chapter 3 of Hertzian tales (Anthony Dunne 43) contributed to that. The term Para-functionality applies to my project. The installation does not have a real function, but evokes the impression of having a function and attracts attention to the underlying subject.

The installation that I realized is more than all other projects that I finalized during my study an art-object rather than a useful product. The Minor was refreshing and induced a new way of working that I intend to further explore in my Major.

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Supplement

The Process of Making: the hardware
The actual process of making started out with determining the dimension of the lumber beam. It had to have substantial length and thickness to remind of a huge tree and attract attention in the exposition area. At the same time, the look of lumber had to be maintained to strengthen the re-transformation from lumber to tree: definitely square as opposed to round. On the drawing board, the measures were set at 20x20x200 cm. At the lumber-yard, confronted with the real image of the beam, I felt I had to correct the measure of the beam to 20x20x300 for aesthetic reasons. Once the size of the beam was fixed, I went back to the drawing board to create an AutoCAD image of the full size installation, based on sketches and small scale models that I previously produced, but now using appropriate (nature and functionality) construction materials.

Doing so I came across essential details of the craft. The weight of the beam required a strong, yet slim, supporting frame not diverting the eye from the central object. It had to be made from steel. The height of the supporting legs had to be in harmony with the length of the beam and the frame positioning the beam at agreeable height: too high is unnatural for a long and heavy beam, too low distracts the eye from the object to the floor.
As the machine is supposed to scan the lumber beam from all sides enabling reconstruction of the tree, the scanning device should either scan all 4 sites of the beam simultaneously or one by one whereby either the beam or the scanner have to change position. The solution was found in the construction wherein the beam was freely suspended for nearly one hundred percent allowing the scanner to capture all four sides at once.
Construction of a real scanning device based on components of a commonly used flatbed scanner with associated software turned out to be too complex; especially transformation from A4 to 20x300 cm format and four sided scanning including data collection.
*This obstacle opened my eyes as I realized that good artwork has a power of its own.*
The underlying technology in my project was in part essential, but replacing some of the non-essential technology by illusion could evoke the same effect (suspension of disbe-lieve). Thus, I assembled the key elements of a scanner that are registered by the senses, i.e. i) the light beam, ii) the typical high pitch scanning noise, and iii) the motion, into one slender device constructed from Plexiglas, aluminium U-profiles with LED strips mounted inside. The capture of data was also faked in that pictures were taken from all four sides of the beam with a high-resolution photo camera. In a later stage, these pictures were elec-tronically processed to mimic real-time scanning.

The motion of a scanner is precisely controlled, and also this aspect needed to be embed-ded in the design. The scanner had to move along two perfectly straight rails.

The Process of Making: the motion

The supporting frame build from strong steel did not provide the necessary preciseness. Any irregularities would cause the mechanism to fail. Commercially available rail systems did not fit the design. After some testing, a solution was found by mounting aluminium profiles that are commonly used for edge finishing to the steel frame and by mounting 4 V-grove ball-bearing wheels to each of the two sides of the scanning device. Motion could be achieved by a stepper-motor. The first idea was to move the scanner along a trapezium tread connected to the stepper-motor, but the 3 meter distance turned out to be too long to achieve a stable construction. A 6 meter long plastic-rubber belt (loop) did the job. Distance was also a problem when connecting the scanning device with the electronic steering system mounted at one end of the supporting frame. Electric cords were either too flexible or too stiff to follow the scanner over the entire scanning distance. Weighing a rather stiff cord down with metal disks and connecting it to thin metal lint solved that problem.
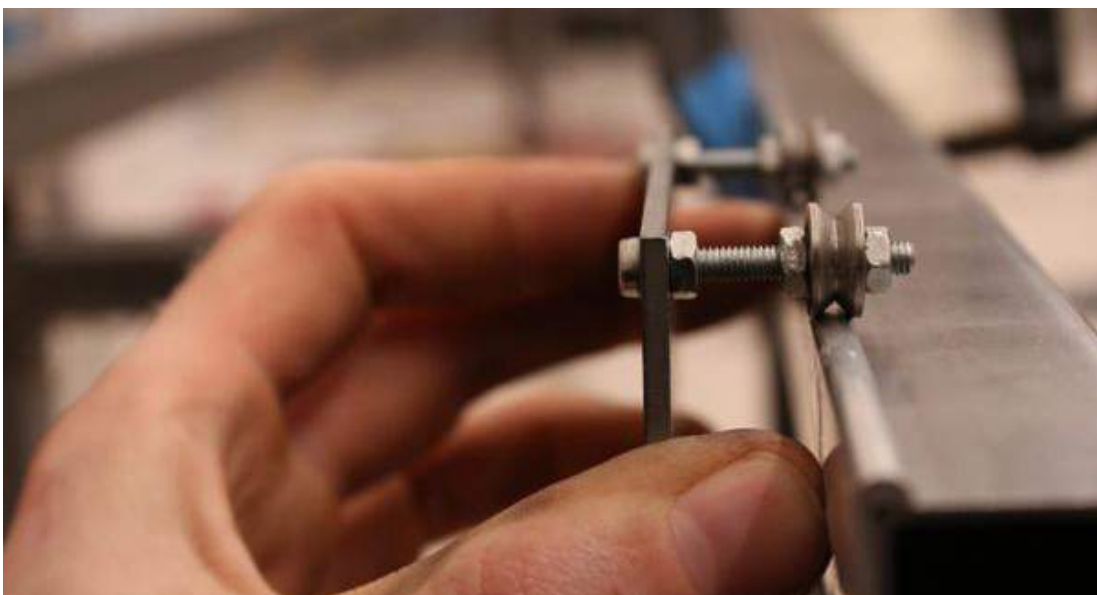
The Process of Making: animation

The lumber beam had to be re-transformed into a tree to communicate the essence of my project. For my former projects I had always relied on own knowledge and expertise. I realized that certain skills were required for this project that I could impossibly acquire within the projected timespan. I explained my project to Colin Dassen, also student at WDKA (in the field of animation), and asked him if he would be willing to help me out with the simulation. How to reconstruct a tree starting from lumber? We discussed how to do that in the most realistic way. It thereby helped learning about how 3D software programs are organized. The animation process was divided over consecutive steps. The scan result is shown first: an exact copy of the beam appears live on screen while the scanner is in motion. Secondly, the information is processed: both the knots (position of branches) as well as the year-rings are identified and marked. Based on this information, the program then starts to calculate the internal structure, the width and height of the tree it was derived from and shows the position of the beam in a first-stage reconstruction of the tree. In the next step the primitive virtual tree expands from the core and branches develop led by the coordinates of the knots. At that stage, the virtual image of the tree consists of polygons connected to a system of coordinates. Finally, a 3D software program would select and add the texture of bark to the virtual image to mimic the real tree even better. Likewise for my project, this had to be the final animated action shown on the computer screen.

The Process of Making: programming

No Digital Craft without programming; another problem on the list! A program had to be written to engage the stepper-motor of the scanner and switch-on the LEDs, while at the same time starting the simulation on the computer screen. I figured out that I needed a combination of Arduino and Processing software for this. However, I had close to zero experience with these tools. Guided by some tutorials, help from peers, and a lot of trial and error, I managed to make the motor rotate clockwise. Turing the LEDs on and off was in fact pretty simple. However, I did not succeed combining the two actions and switching the direction of the motor at will. What I did discover during my trials is that I had to implement two limit switches in the wiring for sensing the start and stop positions of the scanner. They had to send start-stop commands to the computer simulation program, on-off commands to the LEDs and the stepper-motor, and also control the rotation direction.

Having spent multiple days on the programming I felt I had learned a lot but realized that the machine would not work without expert programming assistance. On the very last day before the presentation, staff from the interaction station helped me solving the programming problem.