Mežs

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Abstract

Mežs

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Digital Arts and Experimental Media (DXARTS)

“Mežs” is an artistic research project that explores the use of artificial intelligence (AI) and machine learning (ML) algorithms in generative art. This dissertation project, namely, investigates how creating a custom training dataset, which is an ML system, can generate audiovisual and textual material that can form the basis of the artwork itself. The dissertation consists of a series of artworks: the first work is an interactive online archive of trees and their soundscapes; the three future iterations are a time-based works that demonstrate how the world could look like with the new generated tree species; an augmented reality iteration; and a book archiving all the previously generated materials.

In my dissertation, I am researching a repertoire of artists who created their works with the help of AI, and specifically on artworks that deal with artificial ecology, speculative futures, and critical design. The research of my dissertation investigates artists creating art machines and speculative futures, collaborating with generative organizations and artificial life in the field of critical ecologies.

Acknowledgments

I wish to express deep gratitude to my supervisor Afroditi Psarra, who constantly inspired me and pushed me to explore fields beyond my interests. The help, expertise, and extensive knowledge of professors James Coupe, Rebecca Cummins, Audrey Desjardins, Paul Berger, Richard Karpen, Juan Pampin, and Tivon Rice have also been invaluable during my time at DXARTS.

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Introduction

Overview

The dissertation looks at “Mežs”, a speculative digital media artwork that uses artificial intelligence and machine learning algorithms to explore machine creativity and speculate on the future of forests. The project has multiple iterations that consist of three phases: creating a dataset, generating material based on the dataset, sorting through results. The selected material is organized in an online archive, which becomes a botanical archive of speculative future plants and their environment.

The dissertation consists of three main chapters: Literature Review, Previous Works, and Mežs. The literature review has five subchapters providing theoretical and methodological context. These chapters are Art Machines, Generative Organization, Artificial Life, Speculative Futures, and Critical Ecologies. The second chapter, Previous Works, looks at 3 of my artworks. “Woodpecker” is a group of artificial beings that hit a tree to produce vibrations to maintain the tree’s wellbeing by altering insect behavior patterns. “Corvoid” is another group of artificial beings where I experiment with salient movement using muscle wire. “Anniu” is a ship that produces ice cubes to slow down the melting of Antarctica due to climate change, and the final chapter describes my dissertation artwork “Mežs”, that begins with inspirations that helped develop the concept, followed by a methodology, and finally concluding with conclusions of the work.

1. Literature Review

This chapter outlines five research topics of my interests leading up to the “Mežs” dissertation. The theoretical subjects and referenced artworks provide a framework for the artistic intention and methodology. They are categorized into five topics:

1. (Art) Machines

2. Generative Organization

3. Artificial Life (A-Life)

4. Speculative Futures and Alternative Times

5. Critical Ecologies

1.1 (Art) Machines

This chapter covers multiple artworks that are built using machines, machines that become artworks, and machines that make artworks; investigating works by artists Hans Haacke, Jean Tinguely, and Panayiotis Vassilakis (Takis). My interest in machines lies in their capabilities to sequence movements and autonomy. I thus review artworks exploring not only through machine functionality and movement, but also the effects on everyday interaction on human life, the struggle with nature and nature's struggle with industry and technology, and human-machine relationship, and in some cases emphasizing a system that a machine is executing over itself.

> *“These systems, which included transfers of energy, matter, or information, operated for the most part independently of the viewer. Not entirely unlike living organisms, they took on lives of their own, living “in time”. The artworks functioned as “visual analogs” for “the world as a dynamic system”.*[1]

A work that initially interested me in this field is Hans Haacke’s “Ice Stick”. It is a steel refrigeration unit on a copper base, six feet high, that is turned on during visiting hours. During this period, work gets covered with ice from water molecules in the air until it is so thick that refrigeration becomes ineffectual and condensed droplets start to run down the outside of the ice column. During the night when the work is turned off, the ice melts completely, and in the morning the process begins again. This artwork's simple aesthetic and cyclic interaction with the surrounding environment is something that has raised my interest in the relationship between technology and the environment. Another aspect that occupies my curiosity is the fact that the sculpture never looks the same, and noticeably changes over time, making people come back or stay at the sculpture for a longer period of time. From my perspective, spending time and waiting to see changes in an artwork is a meditative experience. Implementing that a viewer has to wait for changes in the artwork is one of the aspects I introduce in my artwork “Anniu”, described in chapter 2.3.

[1] Haacke, H. (2016). Introduction. In *Working Conditions: The writings of Hans Haacke; ed. by Alexander Alberro* (pp. 11). essay, MIT Press.

Figure 1: Hans Haacke's artwork “Ice Stick” (1966).

Source: http://www.artda.cn/cehuadangan-c-11328.html

The kinetic sculpture artist Takis was fascinated by the waves of invisible energy that he saw as communication between materials, which led him to explore how to use energy and movement in his sculpture. The artwork “Magnetic Fields” is a primal example of his research on telemagnetics. This work consists of a group of flower-like structures that are brought to life by magnets swinging over them and creating natural movement that resembles tall grass moving in a windy breeze. We are used to seeing movements accompanied by sound. With “Magnetic Fields” however, whilst watching the artificial

grass move in silence creates a space for a viewer to fantasize about a sonic world that could surround the work.

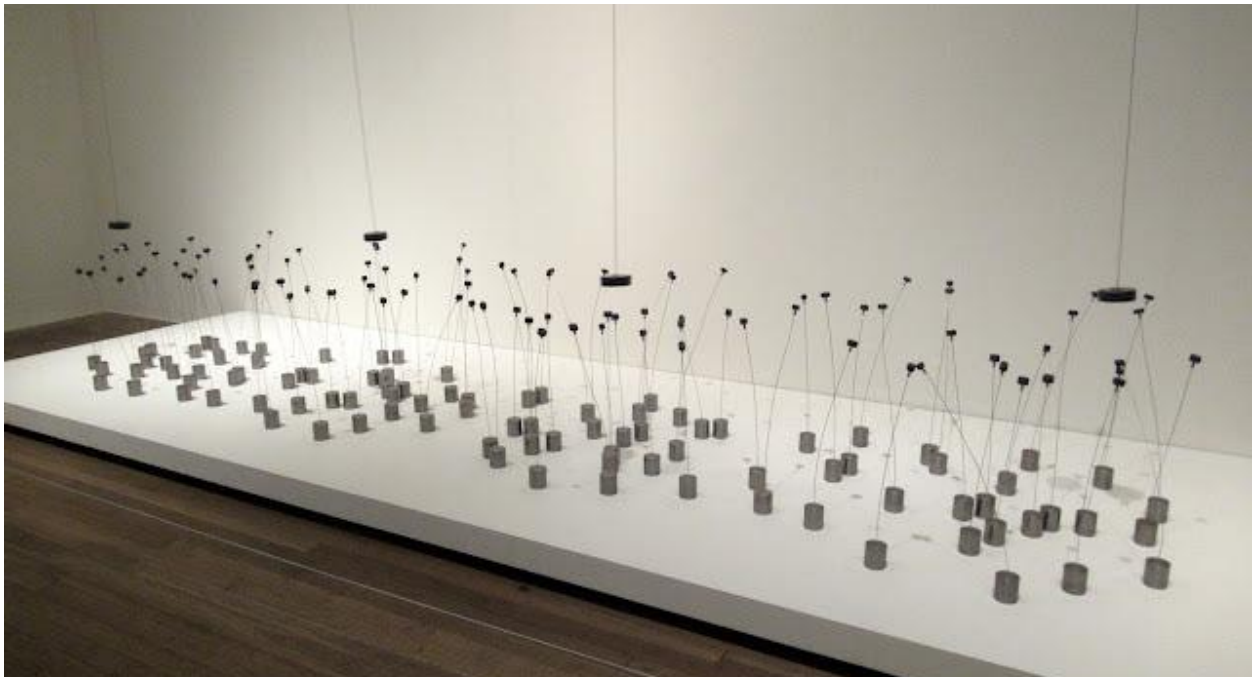

Figure 2: Takis "Magnetic Fields" (1969).

Source: http://a-place-called-space.blogspot.com/2019/12/takis-at-tate-modern.html

An artist who is most associated with machines as artworks is Jean Tinguely. For him, machines are instruments for creating poetic and absurd artistic machines to produce a free machine. One of his most recognized works, "Homage to New York" was a machine performance that he called "self-constructing and self-destroying work of art." The work was composed of motors, bicycle wheels, a piano, a bathtub, a go-cart, and other objects. The machine was turned on before an audience at the MoMA Museum. During its operation, colored smoke was discharged, paintings were created and destroyed, a balloon inflated and burst, and bottles smashed. There is a recording of the artist explaining his work, with a competing shrill voice correcting him playing back, whilst

piano and drums provided the cacophonous soundscape to the machine's self-destruction. Shortly after turning it on, the artwork caught on fire and the show was stopped by a fire department.

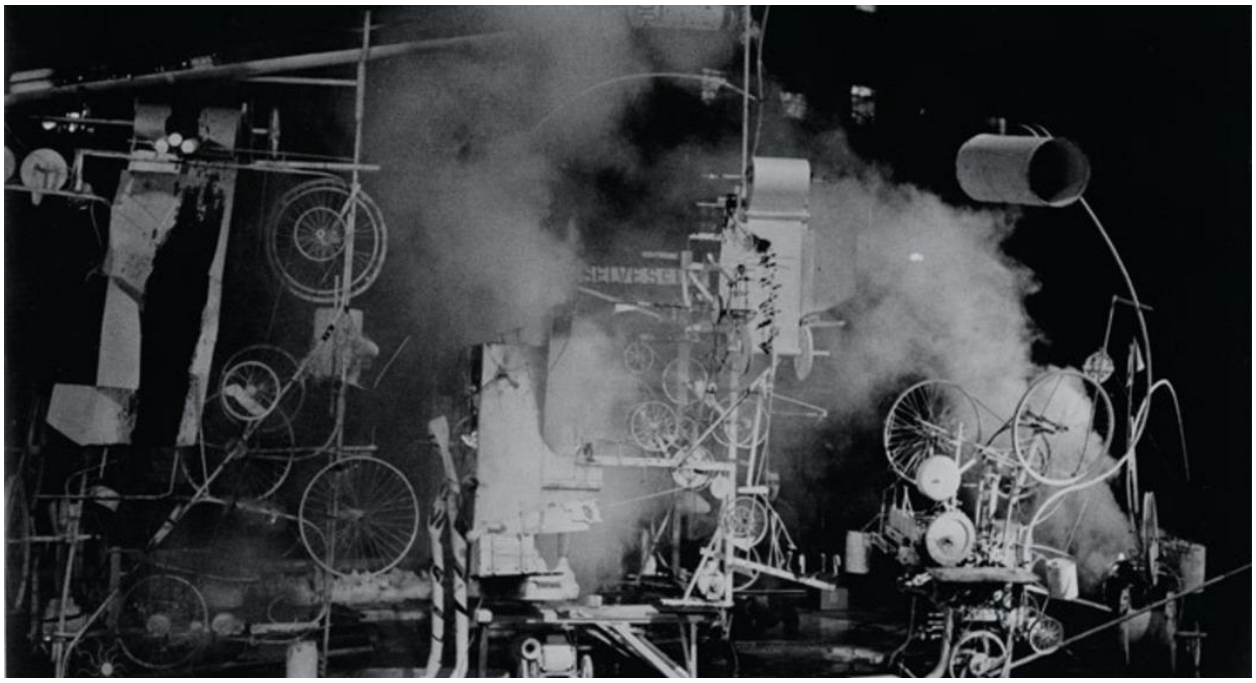

Figure 3: Jean Tinguely's "Homage to New York" (1960).

Source: https://www.artforum.com/print/201207/ghost-story-kinetic-art-and-new-media-31964

1.2 Generative Organization

This field of art practice mostly operates on natural language rules, or a system created by an artist which is set into motion with a degree of self-determination, resulting in the final artwork. In the following I will take a look at three artworks that are built using code by Manfred Mohr, Mark Napier, and Cornelia Sollfrank. Each of these works explores different topics, but one aspect that is in common with these artworks is that you cannot predict the result of the work. A lack of control over the final result is something that drives me towards this field of artwork. This has allowed me to explore aesthetics that otherwise I would dismiss because of the lack of beauty.

> *"Beauty is, in some ways, boring. Even if its concept changes through the ages, nevertheless a beautiful object must always follow certain rules … Ugliness is unpredictable and offers an infinite range of possibilities. Beauty is finite. Ugliness is infinite, like God."*[2]

One of the artworks that drew my attention to generative art was Manfred Mohr's d"P-181" (1976). It is a triptych illustrating artists' research on a cube. Mohr reappropriated a plotter to do etchings on a copper plate. The following is a description of an algorithm that he uses to create three graphics:

> *"A subset of lines from the cube is selected and placed in a randomly sized and positioned matrix. A number of such matrices are chosen for each drawing. In the overlapping areas of the matrices the elements add*

[2] Eco, U. (2007). *On ugliness*. Rizzoli International Publications.

up and common lines increase their width. Each drawing in the series builds on the previous one using the same set of rules. The algorithm finishes when a complete cube appears."[3]

This work has always remained in my mind as an inspiration due to the easy, understandable outcomes. The system that created the artwork is complex and unpredictable, but when a viewer sees the outcome, they instantly understand that this artist was exploring cubes. I believe that it is important that a viewer gains understanding just by looking at the outcome of the artwork, even if they don't understand the system behind it. This is one of the characteristics that I was trying to maintain in my dissertation artwork “Mežs”.

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[3] Mohr, M. (n.d.). *P-181*. Manfred Mohr. Retrieved October 24, 2021, from http://www.emohr.com/mohr_cube1_181.html.

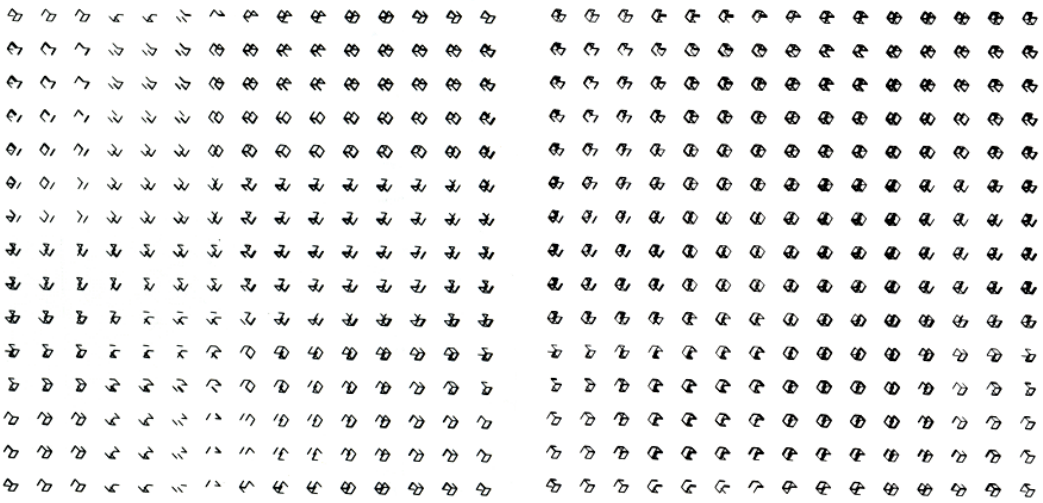

Figure 4: Manfred Mohr's "P181b" the the second of three plotter drawings (1976).

Source: http://www.emohr.com/mohr_cube1_181.html

With the introduction of the World Wide Web, some generative art concepts transferred to the web, and artists started to create digital spaces as artworks later known as Net Art. Mark Napier is one of them; his work "Shredder 1.0" (1998) accentuates the materiality of the web. He stated;

> *"I wanted to expose the raw material that makes up the "design", "content", and "information" directly."*[4]

When visiting "The Shredder" home page, you are asked to enter a web address. An algorithm then slices and rearranges the provided webpage in an abstract composition. Here there is a correlation between the methodologies myself and Napier applied to our works. We introduce our algorithms with a dataset which we both used to build an

[4] Greene, R. (2004). Isolating the Elements. In *Internet art* (pp. 100–100). Essay, Thames & Hudson.

artwork. I was curious to use his algorithm with my work, but unfortunately, his work is no longer online. No longer being able to observe the process of his algorithm led me to think about how I can prolong my “Mežs” artwork's existence in the future and brought me to an idea of a printed artifact of the work.

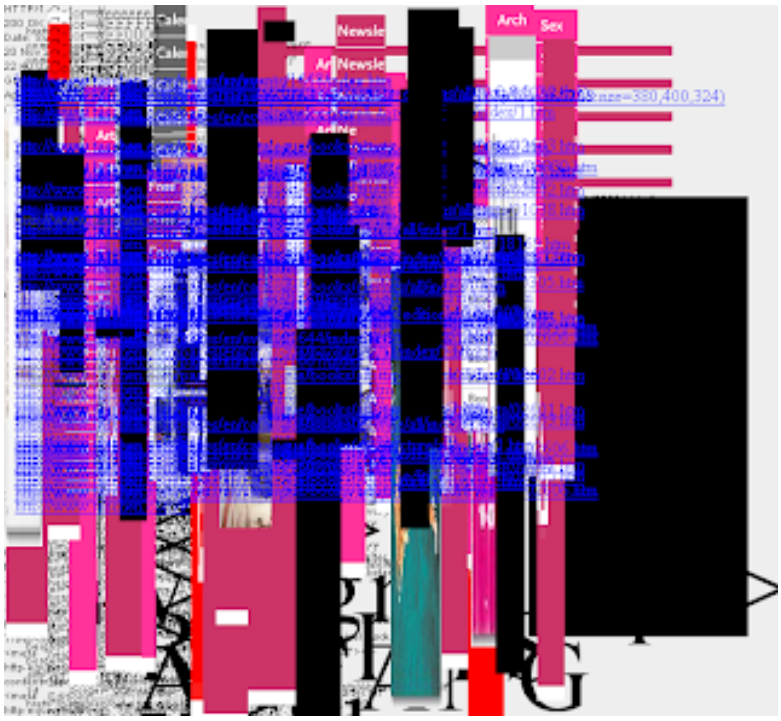

Figure 5: Mark Napier's “Shredder 1.0” (1998).

Source: http://digitalimagingandphotography.blogspot.com/2011/07/mark-napier-shredder-10.html

Perhaps one of the most renowned NetArt works is “Female Extension” by Cornelia Sollfrank; the work was created for a Net Art competition in 1997. She created 288 fake female artists with their contact information and addresses and for 127 of the generated unique Net Art projects. The projects were created by software scrambling the web and collecting HTML materials and reassembling them. The organizers of the competition were pleased to see so many female applicants, even though none of them won. After

announcing the victor, Sollfrank made a public announcement explaining the reason behind a large number of female applicants. Similarly to the previously mentioned Napier artwork “Shredder 1.0”, there are not any web pages left containing the works. All the images in the documentation of the artwork that one can find, are scattered on the internet in the form of descriptions and screenshots of the works. Showing the fragility of algorithms and internet-based works raises my concern about the ephemerality of my artwork, which at the moment lives only on the web.

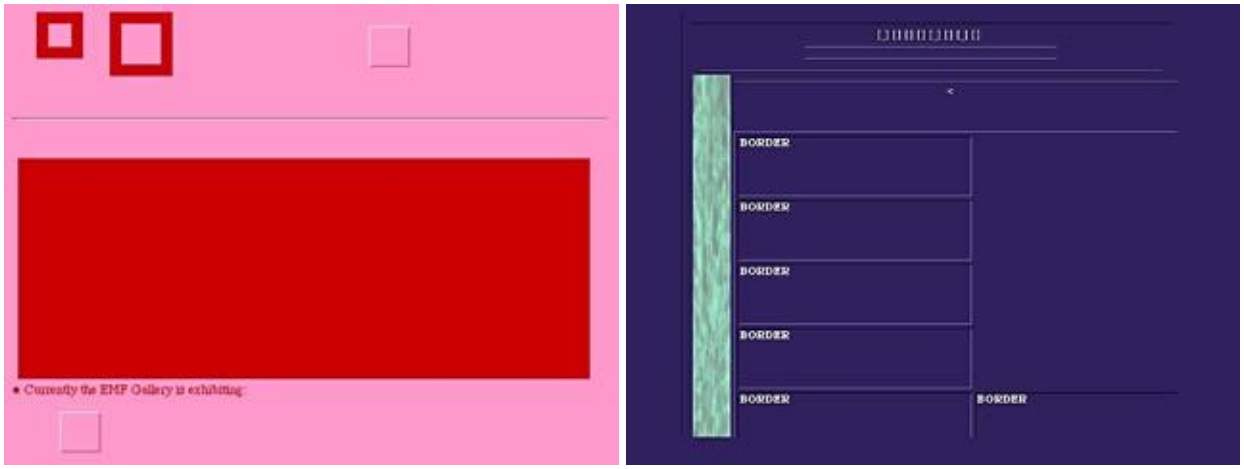

Figure 6: A sample of a fake female artist submitted by Cornelia Sollfrank, “Female Extension” (1997).

Source: https://rhizome.org/editorial/2009/mar/24/female-extension-1997-cornelia-sollfrank/

1.3 Artificial Life (A-Life)

> *"Through paradigms like cybernetics and chaos theory, the workings of biology were closely correlated to the mechanics of information. Increasingly, the basis of life was seen as a digital process. Within the new interdisciplinary field of artificial life, exponents believed that they could create, through a materialistic and reductive method, a new class of organism in a nonorganic structure. By extracting the logical principles of nature and correctly digitizing them, the artificial life pioneers hoped to produce with some fidelity the properties of living systems."*[5]

My interest in artificial beings started while I was still pursuing my Master's degree. The "Woodpecker" artwork, described in chapter 2.1, was my first experience with creating a being that imitates a wildlife characteristic. This field is intriguing because of people such as Theo Jansen, Ian Ingram, and Edward Ihnatowicz - their artworks exploring different aspects of artificial life. In Jansen's case, it is self-sufficiency to build beings that would walk around after humans become extinct. Ingram explores the communication capabilities between artificial beings and wildlife, and Ihnatowicz was a pioneer of creating animal-inspired beings that interact with viewers; which do not intend to give animal forms to the work, but rather to implement animal capacities and powers to newly created species. These topics are facets that I am exploring in my own works

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[5] Taylor, G. D. (2014). Critical Impact. In *When the machine made art: The troubled history of computer art*. essay, Bloomsbury.

“Woodpecker” and “Corvoid” that are described in chapter 2.2. In turn, working on these works led me to contemplate why I am interested in mimicking wildlife, and why this is important for myself but also others. I have a theory that the initiator of these works might be a feeling of compensation for the increasing absence of wildlife in our daily lives.

The artwork “The Senster” (1970) by the artist Edward Ihnatowicz was a 15 feet 3 legged creature based on a lobster claw. Attached to it were microphones that were searching for sound triggers to make decisions as to where the “The Senster” will turn its head. The movement of the artwork was an exceptionally life-like creation, providing the illusion of human-pet relationships, in this case being a relationship between the viewers and the artwork. This was a work that I took inspiration from, whilst I was creating bodies of my beings in my artwork “Corvoid”. I was interested in the structure of the body and the aesthetics of technology implementation in the work. Knowing that Inhatowicz engineered “The Senster” has always been a push for me to do the same for my beings. This has led me to a lot of frustration, failure, and discovery that otherwise I would not have experienced in my creative practice.

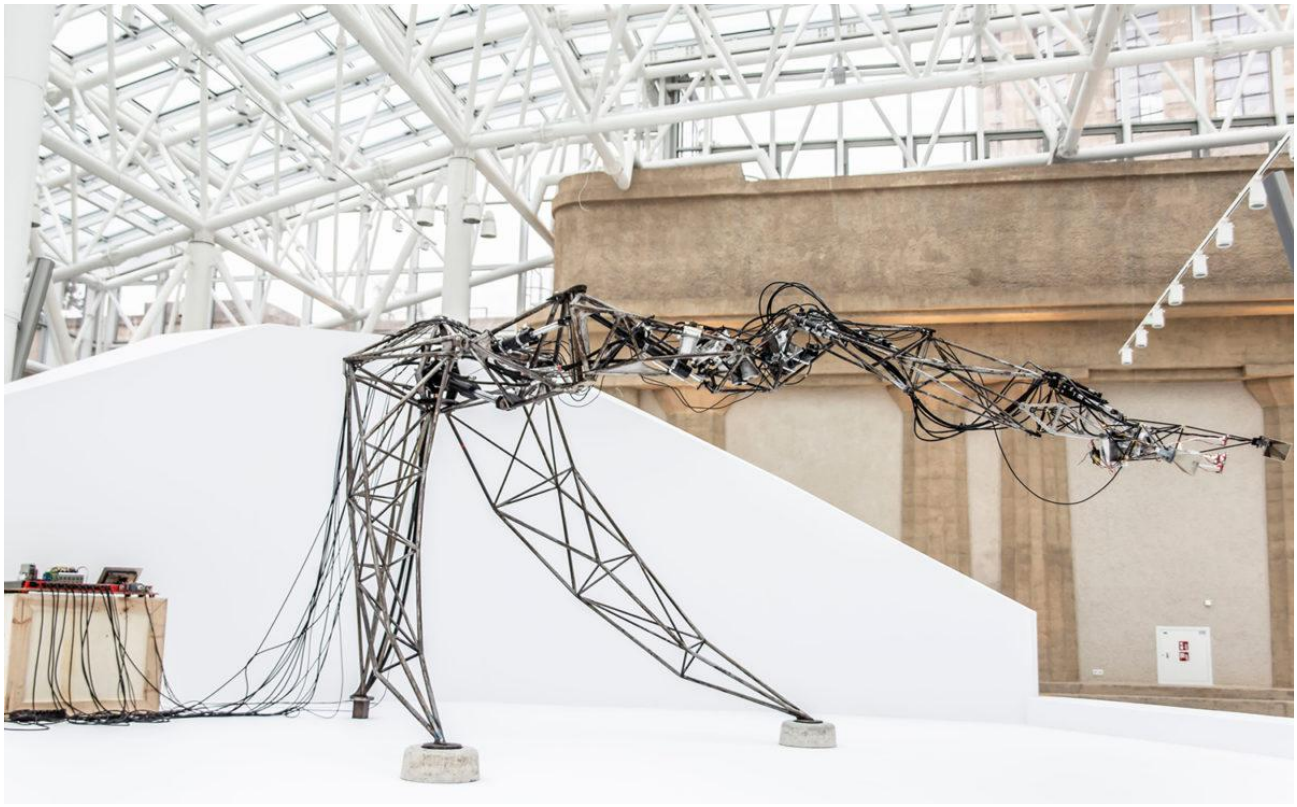

Figure 7: Edward Ihnatowicz' artwork “The Senster” (1970).

Source: http://wro2019.wrocenter.pl/en/works/senster/

Theo Jansen's artwork “Strandbeast” (2006–2008) consists of twelve periods, characterized by its advancement and revelation of movement. The artist desires to create mechanical beings that once could cover beaches and populate the Earth after humans become extinct. An exciting element of his artworks is that they all work on wind and do not need to be powered by electricity, allowing them to be fully autonomous. “Strandbeast” has been evolving in artists' workshops since 1990, exploring different movement types. Similarly, in my artwork “Corvoid” I am driven by movement. The difference is that my interest is guided by my own disability. Jansen’s

work is very complex in its structure due to the materials he uses in construction and the kinetic mechanisms that use wind as fuel.

Figure 8: Theo Jansen's artwork "Strandbeast", the brains period (2006–2008).

Source: https://www.strandbeest.com/evolution?period=cerebrum

A more mechanical system is Ian Ingram's artwork "On Beyond Duckling" (2005) which is an electromechanical duckling performing a mating ritual in the center of a pond using echolocation to find the center. Ingram is interested in relationships between technology and wildlife, building devices that imitate one characteristic of wildlife. He is exploring the importance of animal gestures in their communication, only leaving one typical animal part like a feather of a duck in this case, to be part of the electromechanical being. Mechanical simplicity is one of the factors that draw me towards this artwork. The second aspect is the use of real feathers, not only as a reference towards its wildlife

inspiration, but also to bring some naturalness to the work. In my artwork “Woodpecker” I was withdrawing from any resemblance towards the work’s inspiration animal. My interest was purely communication-based, and to explore if wildlife can accept something that doesn't look like its creation.

Figure 9: Ian Ingram's “On Beyond Duckling” (2005).

Source: https://www.ianingram.org/machines/2005_beyond.html

1.4 Speculative Futures and Alternative Times

> *"We are interested in the idea of possible futures and using them as tools to better understand the present and to discuss the kind of future people want, and, of course, ones people do not want."*[6]

I was introduced to the idea of concept design in high school, where I was studying sculpture. It always felt like there is more potential within it, rather than just making an innovative design for everyday appliances. Whilst learning electronics, I started to use interactive systems and algorithms within my creative practice, and learned about speculative design. I saw this field as a place for endless possibilities, allowing me to create not only an object but also the whole world around it. It allowed me to find ways to create the future of nature and future environments through a critical point of view. Having artists like Luigi Serafini, Alexandra Daisy Ginsberg, Sofia Crespo and Feileacan McCormick, Tega Brain, Julian Oliver, Bengt Sjölén, and Jake Elwes as inspiration helped me to develop concepts and find ways to create speculative artworks that deal with non-human-centric world issues. Ideally, for me, we can use critical views on the future to instigate a conversation about the present, and create a dialogue about what kind of futures we wish for.

> *"This future is unthinkable. Yet here we are, thinking it."* [7]

I was introduced to an art book called "Codex Seraphinianus" by Luigi Serafini; it is a visual encyclopedia containing bizarre fictional wildlife, plants, and text that is written in

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[6] Dunne, A., & Raby, F. (2014). *Speculative everything: Design, fiction, and Social Dreaming (pp. 2)*. MIT.

[7] Morton, T. (2018). Dark ecology: For a logic of future coexistence. Columbia University Press.

an unknown language. The book was originally published in 1981 and addresses the growing introduction of coding and decoding in genetics and computer science. The aspect that fascinated me was the presentation of the artwork. It is not uncommon to make books, catalogs, and printed portfolios, but this one particularly inspired me because it is unreadable. The images in it vary from naive to features out of science fiction stories. This allows me as a viewer to build my own story - as a person who has problems writing, it gives me possibilities in creating a book; with an invisible disability that impacts my writing, this book is a great inspiration in creating a book of my own as part of my work “Mežs”.

Figure 10: Luigi Serafini's book “Codex Seraphinianus” (1981).

Source: https://birdinflight.com/media/luigi-serafini-on-how-and-why-he-created-an-encyclopedia-of-an-imaginary-world.html

A perspective on the sixth mass extinction and humans as a cause, is one of Alexandra Daisy Ginsberg's inspirations for her artwork “Designing for the Sixth Extinction”

2013-2015. The artwork investigates what nature would look like after we design synthetic biological organisms for the benefit of humanity, biodiversity, and conservation. Shaped by fungus, bacteria, invertebrates, and mammals, the artificially designed beings are ecological machines that fill the empty spot left by extinct organisms and protect against other invasive species, diseases, and pollution. The works consist of stereolithographic (SLA) resin prints, a lightbox with visualization of organisms in the wild, and black and white drawings of beings with short descriptions about them. I was surprised how much life there is in this work without any physical movement. Surprisingly, the artist could bring her speculative beings to life with rasta media, texts, and sketches. This was another drive for me to think about how I could bring my trees further into life, and mediate more about the text and it's content that would compliment my artwork "Mežs".

Figure 11: Alexandra Daisy Ginsberg's installation "Designing for the Sixth Extinction", photo by Vitra Design Museum, Bettina Matthiesen.

Source: https://www.daisyginsberg.com/work/designing-for-the-sixth-extinction

One of the works that inspired me to work with AI was Heather Dewey-Hagborg's artwork “Stranger Visions”. Seeing this work in an exhibition opened my mind to possibilities that I had not thought about before, and I explored these possibilities in my artwork “Mežs” as well as ideas for the development of my artwork for future iterations. In her artwork, she is creating real size 3D powder-printed portraits of people from New York. She collected data samples like hair, chewed up gum, and cigarettes from the city streets. From these data sample collections, she extracted DNA and translatedit in software that generated a speculative look of an individual. The artwork discusses a possible future where biological surveillance is part of our lives. For me, the methodology and the idea of biological surveillance in the work is what attributes the artwork. It evokes ideas of a possible future iteration of my artwork “Mežs” where I could generate trees based on DNA and plant them to build new environments.

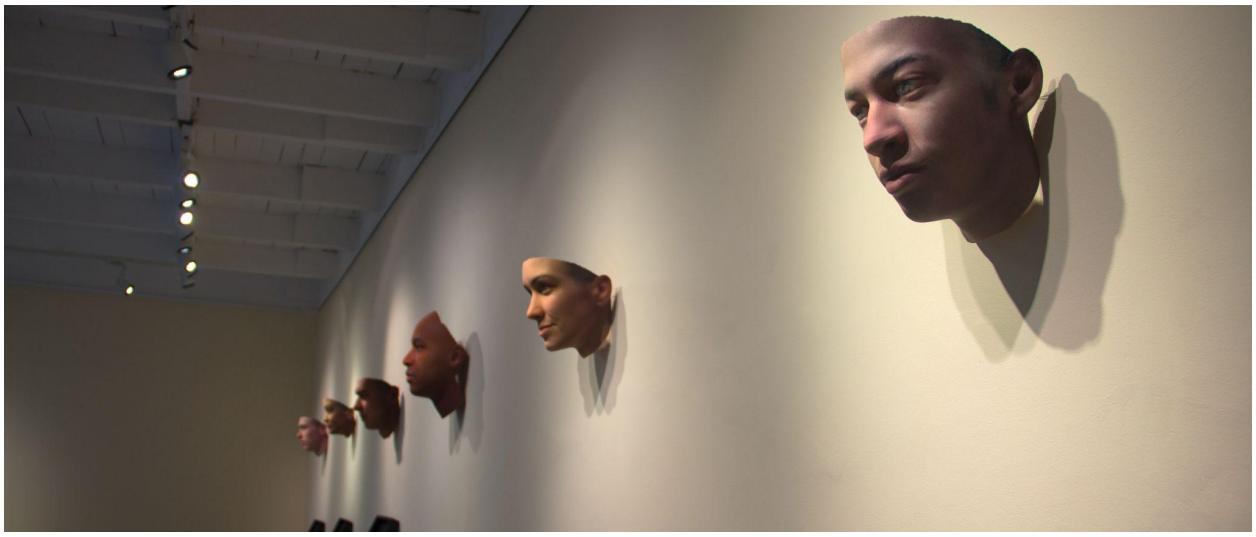

Figure 12: Heather Dewey-Hagborg's installation “Stranger Visions” at Saint-Gaudens National Historic Site.

Source: https://deweyhagborg.com/projects/stranger-visions

“Artificial Remnants” 2019 by Sofia Crespo and Feileacan McCormick is an artwork that explores the rich diversity of the natural world using deep learning algorithms to generate three-dimensional insects, their names, and anatomic part names. The artists claim these to be digital native species that do not attempt to impersonate existing ones. The artwork is presented through a web page and augmented reality software. Developing my idea of creating real plants and planting them in augmented reality is the closest option I am able to fulfill to “plant” my trees from the artwork “Mežs” currently. Crespo's work I stumbled on while I was creating my website mezs.ai. The simplicity and directness of her artwork webpage influenced my decisions towards how people are viewing my trees and how much interactivity I give to the viewer. The scientific approach towards naming anatomic parts and giving short descriptions led me to think more about printed media and how I could fill that with similar texts about each tree species.

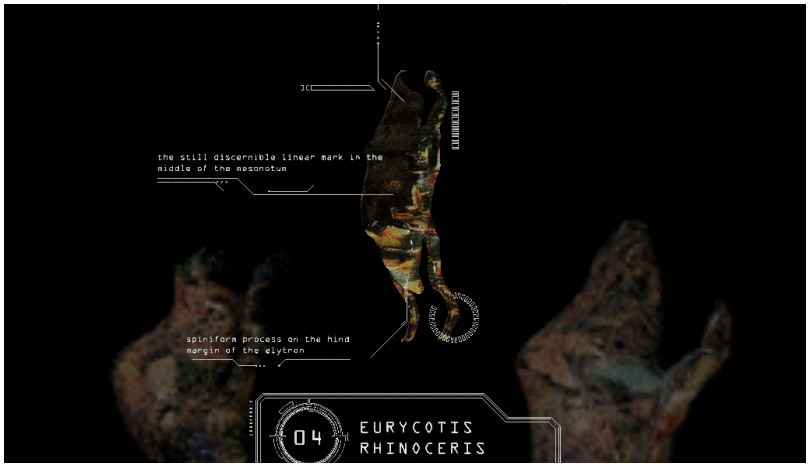

Figure 13: A screenshot from Sofia Crespo’s and Feileacan McCormick’s artwork “Artificial Remnants” web page.

Source: https://artificialremnants.com/Artificial-Remnants-2-0

The artwork “Cusp” 2019 by Jake Elwes uses the Generative Adversarial Networks (GAN) algorithm to create a new species of birds and their surrounding soundscape. J. Elwes' goal is to create realistic-looking birds that could live in their familiar childhood location on the Essex marshes. Using a projector, he bring the images to a chosen marsh and projects the GAN birds onto a small screen, and then documents it in a video portraying the birds as if they would be living in the environment. I stumbled on this project while I was creating my artwork “Mežs”. There are a lot of methodological similarities between both artworks, but one thing that made me think about ways of presenting my own artwork was the artist's approach to the documentation of their new species. Seeing these birds in a recognizable place makes us imagine them living there, and helps us imagine a speculative reality which in this artwork is accomplished by creating videos with the birds in their appropriate environment. This is one of the aspects that I am trying to accomplish in my artwork “Mežs”.

Figure 14: Installation views: Zabludowicz Collection, London (Photo Tim Bowditch) | Museum für Naturkunde, Berlin.

Source: https://www.jakeelwes.com/project-cusp.html

The artwork “Asunder” by T. Brain, J. Oliver, and B. Sjölén is a three-channel video projection showing a discrete simulation for a different ecosystem representing critical environmental challenges using AI applications. This artwork proposes fictional future alterations on the planet to keep it safe in it’s boundaries. The video projection shows how cities are relocated, countries' borders combined, coastlines straightened and rivers moved. “Asunder” alternates from uncannily eco-fetishistic to tediously bureaucratic. I have been following J. Oliver's work since I got introduced to him almost a decade ago, the critical approach to technology in his artworks has always fascinated me. Seeing how “Asunder” is presented was not exciting and drove me away from presenting my artwork “Mežs” just as a projection as I had initially imagined doing, and I began looking for other solutions that slowly led me to multiple iterations of the work.

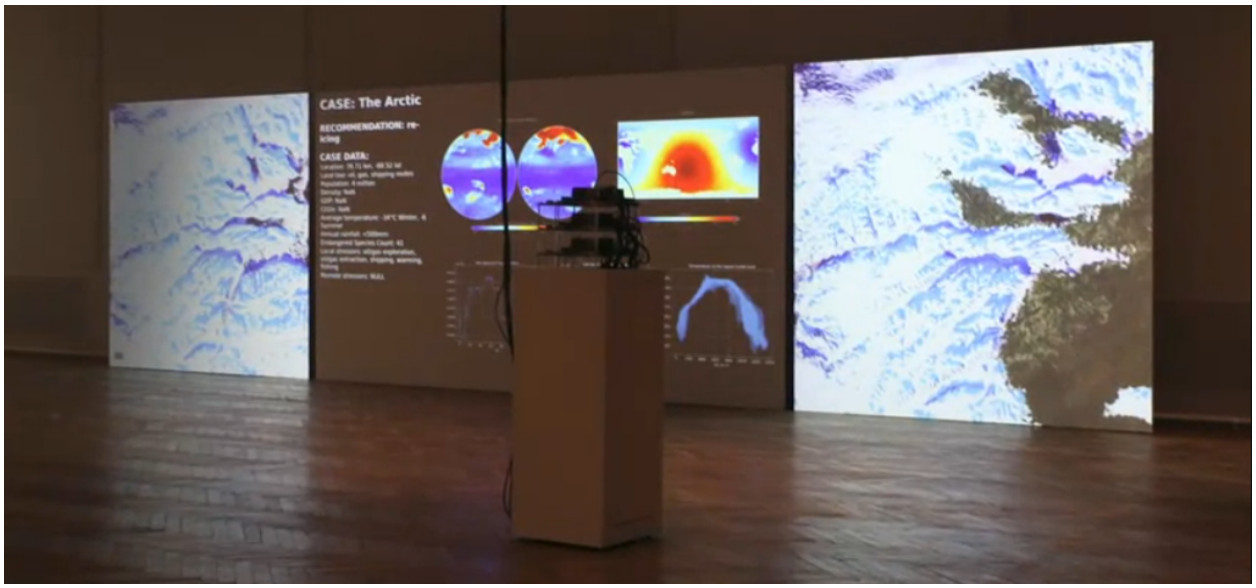

Figure 15: A screenshot from the “Asunder” video documentation.

Source: https://asunder.earth/

1.5 Critical Ecologies

Another concept that provides the theoretical context for my work is the term Techno-Ecologies, which refers to the idea that;

> *"... everyday life is intimately interwoven with complex technological ecologies. I believe that we can no longer consider technology as the alienating "other". The idea that we "inhabit" technological ecologies, emphasises our connectedness to our environment and our dependence on available resources. The field of Techno-Ecologies builds upon the urgent call by philosopher Felix Guattari for an integrated perspective on the dramatic techno-scientific transformations the Earth is undergoing"*[8]

This concept connects to the critical discourse about the Anthropocene era. One of the challenges with climate change lies in the art of effectively communicating its results to an audience. I see artworks that critically comment on the topic of ecology through sardonic, sometimes humorous and poetic perspectives as a way to raise understanding of the current ecological situation in different environments. The works that have inspired my methodology and helped me to look for solutions within my artworks are John Gerrard's idea of building monument for oil mining, Gilberto Esparza's aid device for nomad plants, Malka Architecture with a nomad city idea, Afroditi Psarra and Audrey Briot's exploration of space ecology, and Tivon Rice's look at AI perception of ecology.

[8] Smite, R., Kluitenberg, E., & Smits, R. (2012). Ecotechnologies: Acoustic Space. RIXC.

An artwork that has particularly caught my attention is John Gerrard's "Western Flag" (2017). The artwork is a poetic memorial for the world's first major oil find. It is a computer-generated flag pole with animated preserved black smoke coming out of it on the top in the shape of a flag. The generated animation is played back on the live feed of the oil mining site all year long and exhibited as a large projection. Black smoke is one of the side outcomes in oil mining; using it as an expression creates a strong relationship between the artwork and its inspiration. I think that this relationship is one of the reasons why I find this artwork so mesmerizing, as of course, is also the smoke that creates the flag itself. The hypnotic continuous movement of the flag and dissipating smoke draws you into thinking about the past and the future. Using inspiration as the expression is one of the things that I try to retain in my artworks, most noticeably in the artworks "Woodpecker", "Anniu", and "Mežs".

Figure 16: John Gerrard's "Western Flag" (2017) at Museo Nacional Thyssen-Bornemisza, 2019.

Source: http://www.johngerrard.net/western-flag-spindletop-texas-2017.html

On another perspective, Gilberto Esparza is looking for solutions for the impacts that global pollution is bringing on us. His artwork “Nomadic Plants” (2009) is about autonomous beings that aim to engage in a discussion about the ambiguous forces of technology. In this being there are vegetation and microorganisms, and these living organisms are being monitored. Whenever they require nourishment, the machine starts to look for a contaminated water source to refill it. Through a process of microbial fuel cells, the water is decomposed and turned into energy for the circuit, and the surplus is used to feed the vegetation. I think that the idea of an artwork continuously changing or even repeating its task without the artist's interference at all times provides something to wait for. In this case – either a “death” of it or a series of unexpected occurrences.

My artworks “Woodpecker” and “Anniu” are self-sufficient. “Woodpecker” has been left to operate in a forest for a longer period of time, and seeing the multiple woodpeckers change over time has brought me joy and sorrow. The hardest part is to find a way to bring these emotions and experiences to a viewer.

Figure 17: Gilberto Esparza's artwork “Nomadic Plant” (2009).

Source: https://we-make-money-not-art.com/_1_cuando_lei_acerca/

Artist Tivon Rice uses AI to create personalities that have conversations. These three personalities are a scientist, a philosopher, and an author that are trained in science fiction, eco-philosophy, and intergovernmental reports on climate change. The generated material is mixed with the artist's archive of scanned natural environments. The result is an experimental film titled “Models For Environmental Literacy” (2020) in which a generated text is heard over animations of scanned environments. The idea of creating generated descriptions for each tree species in my work “Mežs” came from a concept created in Rice’s work. In my artwork, I used only one perspective to generate texts, and I was planning to implement them in the webpage mezs.ai and the printed version of the artwork “Mežs”. One of the things that I appreciate technically in T. Rice's artwork is that text is presented through voice. That is one of the things that, after seeing documentation of “Models For Environmental Literacy”, I consider implementing in my own work “Mežs” future iterations.

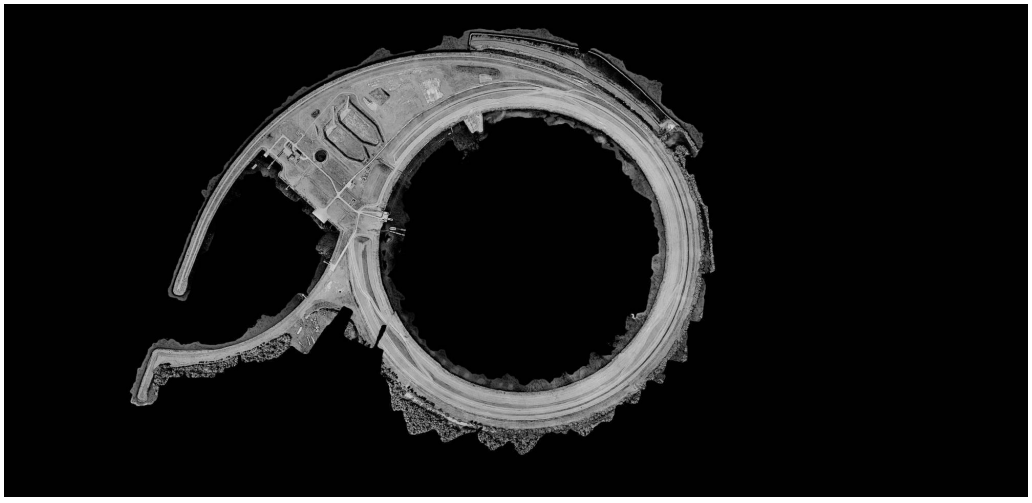

Figure 18: Tivon C. Rice's “Model for Environmental Literacy” (2020).

Source: http://www.tivonrice.com/models.html

Artists are not the only ones creating works investigating different ecological issues and possible solutions. The concept work from Malka Architecture's “The Green Machine” (2007) is just one example of the exploration of nomad cities. “The Green Machine” is a self-sustainable city with 4 crawlers, 9 balloons that gather water for irrigation of the desert, 9 solar towers for daily power, livestock for earth fertilization, and places like schools, restaurants, and places of relaxation and pleasure. The crawler tracks are fields with seeds and nutrients in order to grow weeds that would get colonized by seasonal plants - five years later shrubs would start to show up, and in ten years real trees would start to appear. The artwork combines multiple ideas I have explored as separate art pieces throughout my creative practice. The idea of a nomad city and the previously described nomad plant are conceptually appealing to me and rattle my creativity. Simultaneously, seeing this art piece presented as a digital image encourages me to work and encourages me think about how I can present my artwork in a more immersive way, that I explore in future iterations of “Mežs”.

Figure 19: Malka Architecture “The Green Machine” (2007).

Source: https://www.stephanemalka.com/portfolio/the-green-machine-i-greening-the-desert-i-sahara-2014/

With most of the exploration of ecologies and future possibilities surrounding wildlife and its renewability and environmental pollution, there are some artists like Afroditi Psarra and Audrey Briot who explore invisible environments and their ecologies. Their artistic research “Listening Space” (2020) explores NOAA's (National Oceanic and Atmospheric Administration) weather satellites transmissions using Software-Defined-Radio and hand-crafted antennas as various embodied machines whose liveliness are seen at a rhythm dictated by orbit. These transmissions are decoded into textiles that serve as a physical archive of decoded signals. Even though my practice is focusing on physical environments, I am interested in the ecology of space. A. Psarra's and A. Briot's artwork makes me wonder how I could use my creative practice to engage with space for future artworks.

Figure 20: Afroditi Psarra's and Audrey Briot's “Listening Space” (2020).

Source: https://afroditipsarra.com/work/listening-space

2. Previous Works

This chapter introduces my three previous works which trace my artistic practice from creating devices to help maintain environments, towards creating an environment in my dissertation artwork “Mežs”. The artworks “Woodpecker” and “Corvoid” are described here for their direct involvement with the forest's wellbeing. “Woodpecker” is also my first work that talks about forest futures. My artwork “Anniu”, similarly to “Woodpecker” and “Corvoid”, is an aid device for the environment, and is the first artwork in which I try to impact changes in a landscape.

Figure 21: From the left “Woodpecker”, “Corvoid”, and “Anniu”.

Source: Courtesy of the author.

2.1 Woodpecker

“Woodpecker” is the artwork that I started to work on while I was finishing my master's degree. When I started my studies at the University of Washington, I was invited to an exhibition in the Netherlands' capital Amsterdam. For this reason, I needed to build another iteration of the work for long-term outdoor use. This iteration of the “Woodpecker” is further described in this chapter. The artwork is important because it marks a point in my creative practice where I shift my interest towards constructing aid devices for the environment whilst speculating on the future of nature, particularly forests. Another element that started to be amplified within this artwork was the multiple possible iterations of artworks that are set under the same title. This allows me to explore different sides of the same concept by playing around with multiple mediums, and most importantly present my work in different states as a finished artwork. However, the most significant part of this artwork, in my eyes, is the seed that is created for my dissertation work “Mežs”.

> *“In ecological awareness difference between R2D2-like[9] beings and humans become far less pronounced; everything gains a haunting, spectral quality.”[10]*

[9] A robot character in the “Star Wars” movie sequels.
[10] Morton, T. (2018). The Third Thread. In *Dark ecology: For a logic of future coexistence* (p. 138). Essay, Columbia University Press.

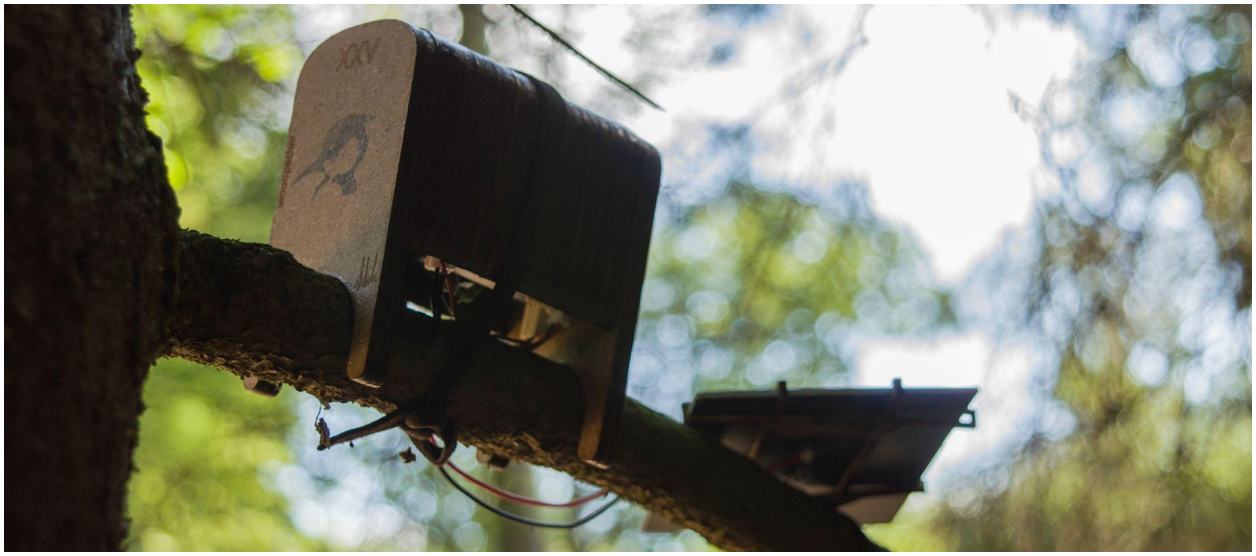

Figure 22: “Woodpecker” 2017 first generation on a branch in Dusseldorf.

Source: courtesy of the author.

The artwork was successfully exhibited between May 20 – July 8, 2018, in the group exhibition “Machine Wilderness” in Amsterdam, the Netherlands. The exhibition is curated by Zone2Source and Theun Karelse. Viewers are invited to explore together with artists, scientists, ecologists, and engineers how technology has become a long-lasting part of our environment. Part of the exhibition involved me giving a presentation and workshop on my woodpeckers. The event's documentation consists of a recorded presentation, photography, and an exhibition catalog containing all the artists and their work.

2.1.1 Concept

“Woodpecker” is an artwork exploring the possibility of replacing some bird species with artificial ones. Could fake birds replace real ones and contribute to maintaining the natural balance of forests intact? In 1987, scientists William J. Mattson and Robert A. Haack in their paper “The Role of Drought in Outbreaks of Plant-eating Insects” suggested that insects can hear the sound emissions produced by trees and based on this sound determine whether a tree has any use for them. Trees emit sound during the cavitation process. It happens when water is traveling from the ground and up to the branches. Periods of drought result in fewer sound emissions and promote outbreaks of plant-eating fungi and insects, especially bark beetles and leaf feeders. The work consists of 30 interactive sculptures which were placed in a forest in Germany. An artificial "Woodpecker" is created using custom electronics and circuitry, namely using a solenoid motor to hit on tree bark to explore if the vibrations created by a woodpecker change how insects perceive a tree that is in distress.

2.1.2 Methodology

For the second generation of the “Woodpecker” artwork, I had to solve three problems. The first one arose due to the changing artworks' focal point from nature towards humans – rising the distance in which you can hear my artificial being hitting a tree. The exhibition length for this iteration was supposed to be around three months, from which the second and third issues arose. The second issue was moving from a digital timer

that turns on and off the artificial being to a photoresistor (LDR) for starting and stopping the being in certain light brightness levels to maximize the use of a solar panel as a source of power. Finally the third problem to solve was to create a body that can withhold rain, wind, and animal attacks.

The first problem involved adding two new components to the already existing system. One of the components is a microphone and the other is a speaker. I attempted to use three types of microphones to test which one could work better. The first was a cardioid microphone capsule; it provides a unidirectional recording field, allowing me to aim at the spot where the solenoid motor would hit a branch. I needed to use an amplifier to be able to hear the motor hitting the branch, and with that, it brought other sounds that were not my intention to be heard. I changed to using a subcardioid MEMS (microelectromechanical systems) microphone. It was attached to the same amplifier as the previous microphone, and due to the tiny size of the chosen microphone, it was attached to the schematic itself. The schematic was attached to the artificial being's body, to which the speaker was attached. This setup created a short feedback loop due to the resonance of the body. As much as I enjoyed this output, I needed to dismiss this option and leave it for future projects. Lastly, I tried a piezoelectric microphone that works by reading vibrations from a surface. I used a spring that I attached to the artificial being's body on one side and a piezoelectric microphone on the other side - this allowed me to create pressure on the microphone, so it was always touching the surface it was facing. This produced the desired outcome, an easy setup system, with simple maintenance. The second component, a speaker, had to be circular and built for the

outdoors. I chose the cheapest one that was in black - the choice of black because I needed a color that is not too noticeable in a forest.

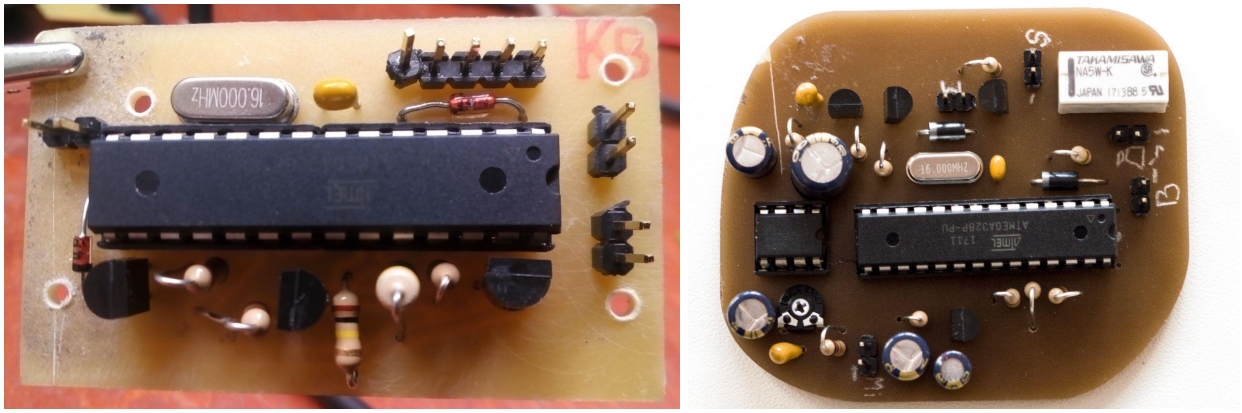

Figure 23: "Woodpecker" second generation with an inserted speaker, the front cap, on the left, and schematic in the back.

Source: courtesy of the author.

Second problem: starting and stopping the woodpecker. This problem-solving involved not only adding a new component but also changing the code that drives the whole system. The first generation of woodpeckers was running on a digital timer that was part of a ATmega328 microchip, which was the brains of my woodpeckers. The issue with this digital timer is that it does not know the current time, but instead it starts to count from the moment it is turned on. This meant that I needed to set them up early in the morning, so they could start working early every day. As the sun rises at different times every day, in the long term this time changes by multiple hours. In the second generation of woodpeckers, I introduced an LDR sensor. After using a sensor to record light brightness during a couple of days, I calculated the average brightness for mornings that would be the trigger in the code to start the woodpeckers day routine, and similarly calculated the average level of darkness at which the woodpecker will go to

sleep. The sensor was worked into the body. On top of the new body, I drilled a hole the size of the sensor and used hot glue to hold it in position, and isolated the schematic from water that might seep in through the hole.

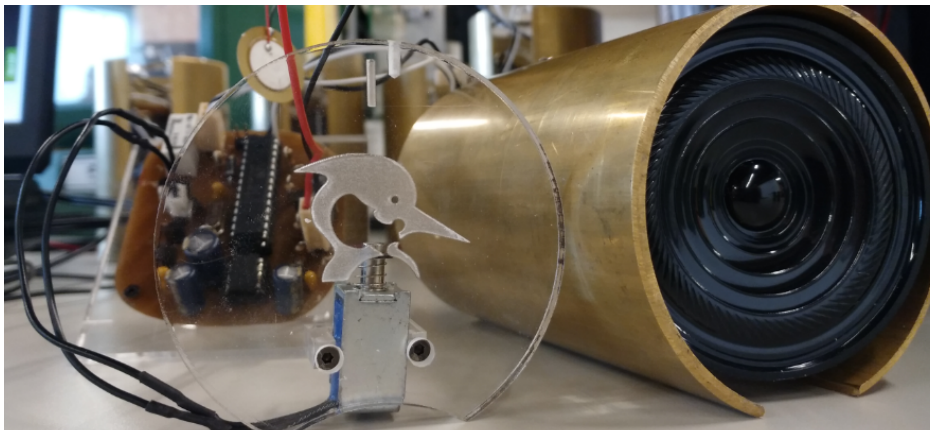

Figure 24: "Woodpecker" second generation with an inserted speaker, the front cap, on the left, and schematic in the back.

Source: courtesy of the author.

The third problem arose from having seen what happens to the first generation bodies after a storm that hit them in a forest they were set up in. After the storm, some bodies were badly damaged and the material they were made of soaked up a lot of the water. The bodies were covered with a waterproof clear coat, and they were assembled out of multiple layers of hard density fiberboard. The storm however bent and made cracks between the layers where water had managed to seep in. I set myself five rules for the body of second-generation woodpeckers; firstly I wanted it to be a unibody to eliminate any gaps, holes, and cracks that would allow water to enter. Secondly, using no paint or clear coat, or using any other type of chemical is to waterproof the body. Thirdly, to have the body in earth tones maintaining how the first-generation ones were. The fourth rule was to implement the same shape as the speaker - and finally the fifth rule, I required

the body to be able to change its appearance over time; in this case, I do not mean the shape but the coloring. This set of rules led me to choose a brass pipe - naturally, brass as the material for music instruments played its role too in this decision. The pipe was selected a couple of millimeters smaller in its inner diameter than the speaker's diameter was. I cut the pipes lengthwise, so the pipe would open up and allow me to fill it with a schematic, pack of batteries, attach a microphone, the speaker, and a solar panel. I used tiny screws to hold the schematic, solenoid motor, front cover, and speaker. After placing everything in their positions in the pipe, I used a hose clamp around the pipe to pull it back together to the point where all the components would be cramped between the walls of the body. This still left a small opening - what now I can call the bottom of the body - that allows me to place the body on a tree without worrying about stability while I am securing it in the desired position and while they are on a tree branch.

Figure 25: “Woodpecker” second generation on a tree branch in Amsterdam, the Netherlands.

Source: courtesy of the author.

2.2 Corvoid

After having a successful experience with the artwork “Woodpecker” I decided to build a new group of artificial beings. I was inspired by research that is being done at the University of Washington Bothell by Douglas Wacker and Shima Abadi, and an essay “True Dog Stories” (1930) written by Walter Benjamin.

I was introduced to research that was done by D. Wacker and S. Abadi. They were looking into a crow flock communication patterns. The element that struck my interest in this research was how both scientists were tracking the communication between crows. They had set-up four microphones in a square and used them as references between

calls of one bird, allowing scientists to track a bird in a three-dimensional space. The goal of this part of their research was to understand communication patterns between the crows. This was one of my inspirations for starting to think about a new species of artificial animals that would communicate with each other based on the crow flock communication patterns.

W. Benjamin's essay “True Dog Stories” was part of the book “Animals” (2016) by Filipa Ramos that I was reading. The section of the essay that interested me referred to the 18th-century botanist's Linnaeus description of a dog:

> *“Feeds on meat, carcasses, farinaceous grains, but not leaves; digests bones vomits up the grass; defecates onto stone; greek white, exceedingly acidic. Drinks by lapping; urinates to the side, up to one hundred times in good company, sniffs at its neighbour’s anus; moist nose, excellent sense of smell; runs on a diagonal, walks on toes; perspires very little, lets tongue hang out in the heat; circles its sleeping area before retiring; hears rather well while sleeping, dreams. […] Heals wounds, gout, and cancers with tongue. Howls to music bite stones thrown its way; depressed and foul-smelling before a storm. Afflicted by tapeworm. Spreads rabies. Eventually goes blind and gnaws at itself.”*[11]

This text reminded me of how complex animals actually are, therefore my goal to mimic one should be separated into multiple smaller artworks that explore a

[11] Benjamin, W. (2016). True Dog Stories. In *Animals* (p. 31). Essay, Whitechapel Gallery.

certain aspect of a species, similarly as I did in “Woodpecker” and I. Ingram in his work “On Beyond Duckling” that I have described in chapter 1.3.

Corvoid means resembling a crow or another member of their species.

2.2.1 Concept

Animals use various ways to create communication signals. Species communicate mainly with other species as well as with the abiotic environment. Sounds may be created by the passage of the air through organs, by rubbing appendages against each other, and by hitting other objects in the environment. All these sounds create an acoustic environment in nature. Thus, even the communication structure that we commonly think of as being within-species has the possibility to affect individuals from other species. By implementing crow communication patterns, I wanted to create a flock of artificial beings - these beings would not look like birds or emit bird-like sounds.

The goal was to sustain diversity in the ecosystem and acoustic environment in the future. “Corvoid” is looking at how an ecosystem reacts when it is introduced to an artificial species with natural communication patterns to determine if communication patterns are more important than the sound itself when it comes to interspecies communication. The work consists of 6 different types of bodies that are built out of wood sticks and plexiglass. The body is being moved with the help of muscle wire, and

the beings communicate with each other by custom-made electronics containing a mems microphone to read the surrounding sounds.

2.2.2 Methodology

The technical goal for the being was to create a soundless moving body by getting rid of motors, gears, and belts that usually are part of moving objects. For this, I needed to find an alternative to motors. In one of the DXARTS mechatronics classes, we looked at muscle wire; a muscle wire is a mix of alloys that when provided with electricity shrinks approximately by 5%. Hence, this is not a mechanical movement, as it does not produce any sound. I started to experiment to see how much weight muscle wire can pull and look for examples on how to use muscle wire to create a movement. I found a project by Daniel Raible that I used as a source for technical inspiration.

My first attempt to build the “Corvoid" started with building a six-legged spider-like being. I used black wooden sticks for legs and Kapton tape for constructing joints. I chose Kapton tape because of its durability to withhold heat and being nonconductive. The joint was created by assembling three layers, the first one was a Kapton tape. On the sticky side, I placed a square piece of dense cardboard, approximately 2 x 2 millimeters in size. For the third layer, I placed another piece of the Kapton tape that had its sticky side facing towards the sticky side of the first layer. This allowed me to keep the cardboard in place and create a joint that moved on one axis, similar to your knee allowing your leg to move. For the body, I used plexiglass, which was cut using a laser

cutter and excess weight was removed during the same process. With a hand drill, I drilled holes, horizontal to the surface, so that the body would occupy the place where legs would connect. In order to connect them to the body, I used a millimeter-thick steel wire that went through the leg, which implemented a secure connection to the body and stability. Later on, I learned that this system would not work properly even though it gave a very realistic movement to the legs themselves.

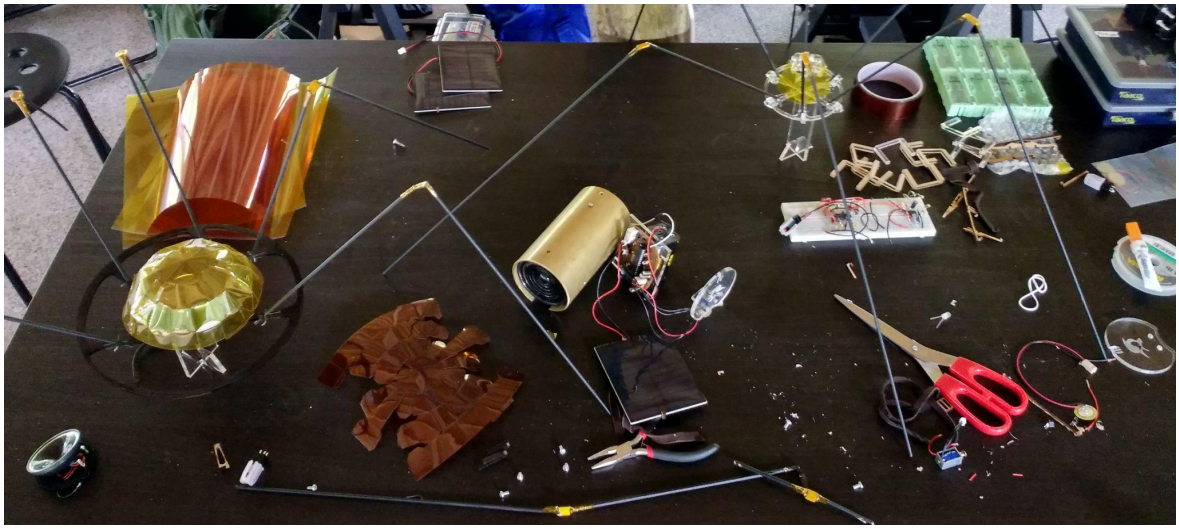

Figure 26: Two first “Corvoid” beings.

Source: courtesy of the author.

After learning that the six-legged beings would not be the ones that I could use, I began with a smaller number of legs, and removed four legs and redesigned the body. The new setup performed even more stability because one point of the beings was always touching the ground. I started to experiment with how to control the legs, attempting to find a way to make them move forward. In the first test, the legs were controlled separately by a separate muscle wire - one leg would move and a couple of seconds

later the other one would move. The first problem I noticed was that it was difficult to maintain a balance of the body, and the second problem was that the pressure that was placed on one leg was too sizable to move the leg back into its start position. I attempted to use different rate springs to assist pulling the legs back to starting position. The springs created a new issue – the muscle wire was not strong enough to extract springs. After trying multiple spring variations, I found a variant that worked while the surface was mirror-like. The joint system also was changed,and I noticed that the Kapton joints were presenting too much movement and freedom, thus I needed an entity that was a bit sturdier with less movement. Furthermore, I used 3D software to design new joints and I used an SLA 3D printer to print them. The new joints allowed me to limit the length of a movement, make the legs sturdier, and created a pipeline for muscle wire to keep it in its place. Three types of joints were created; one for a location that required an angle but not a movement used to connect a part that clamps in the ground and attaches to the rest of the leg. The second one fills the middle part of the leg and serves as a knee for the being and guides the muscle wire between the first and the third joint. Lastly, the third was used to attach the leg to the body and guide the muscle wire to the second joint.

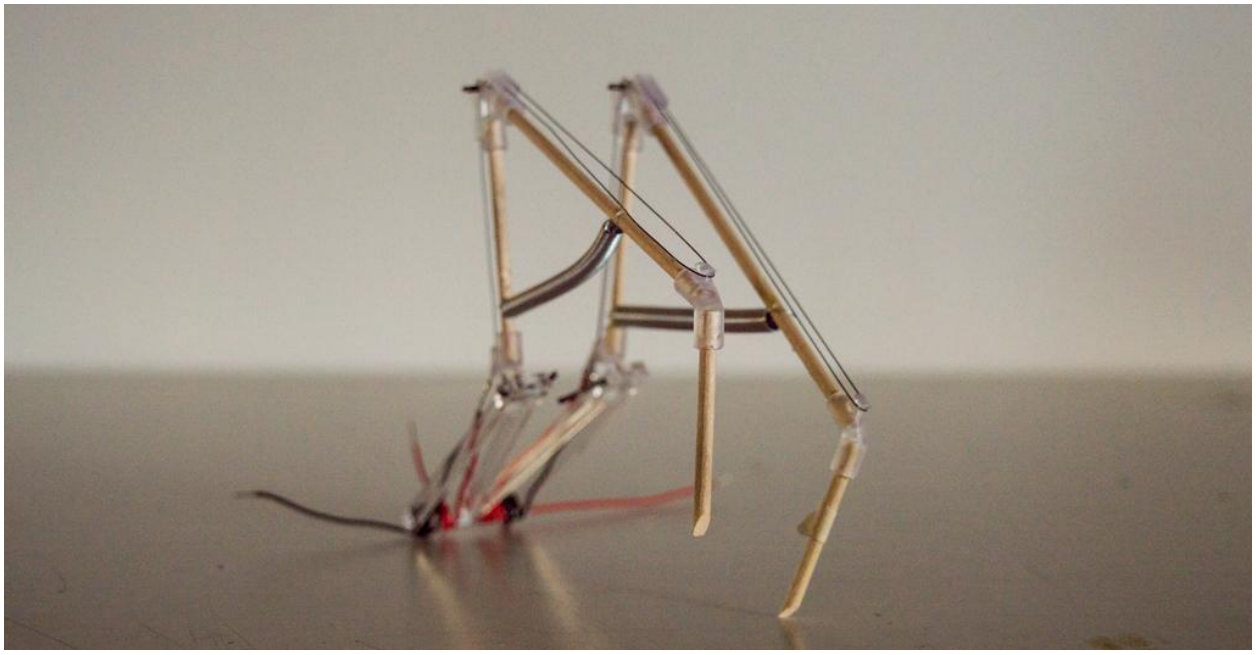

Figure 27: The first two-legged being.

Source: courtesy of the author.

Taking into consideration all the problems that I faced, I made the third “Corvoid”. This time I lowered the weight of the being even more by changing thick black and red wires to a clear-coated copper wire that delivers power to the muscle wire. I used thinner plexiglass and replaced the springs with rubber bands, and I switched to rubber bands to test if that would help to retract the legs to the desired starting position. Muscle wire could extend the rubber bands much easier than the springs, but the rubber bands did not have enough pull force to retract to the starting position. Another element that I noticed was that the legs were slipping on the surface when they were returning to their starting position, meaning they didn't clamp onto the surface. A simple method around this problem was to add needles at the end of the points that touched the surface in a manner, so they would anchor in and pull towards the leg and would not slip backwards.

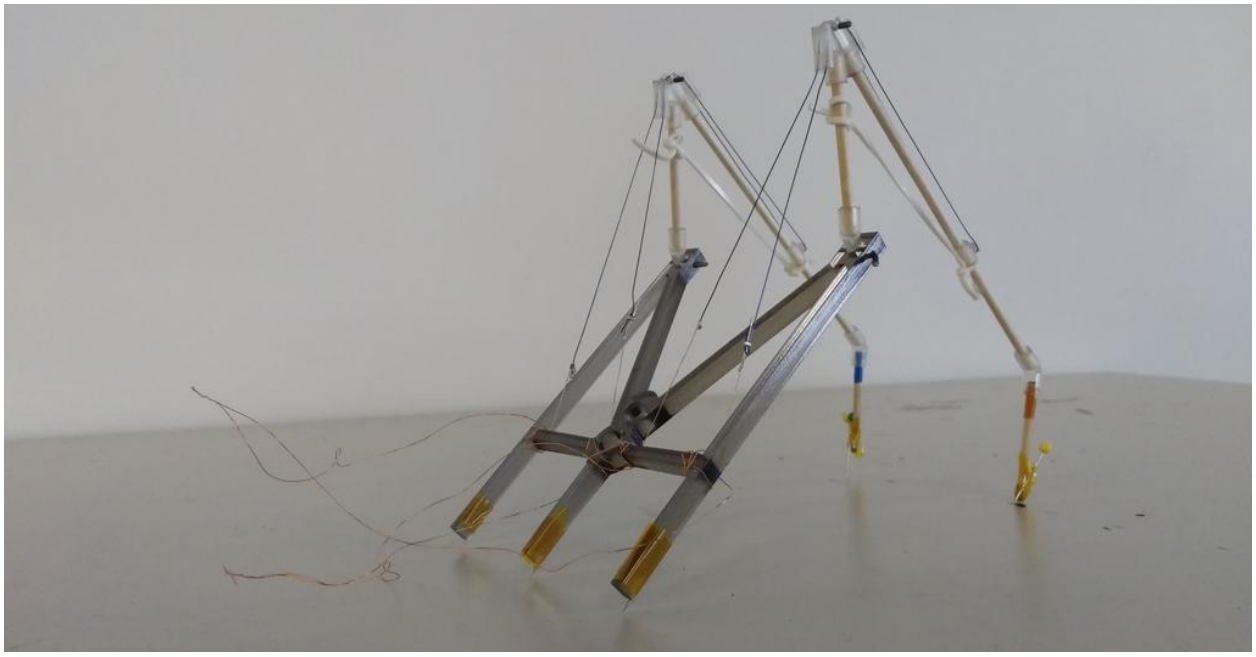

Figure 28: The second two-legged being.

Source: courtesy of the author.

After realizing that there were too many moving components that lead the “Corvoid” to lose balance on uneven surfaces, I decided to build one with only one leg. Having three points that touch the surface would help with balancing the being, so I extended the length of the leg to give a longer movement, allowing the being to cover a longer distance. In one of the tests, I noticed that the longer leg does not hook to a surface due to the lightness of its tip, therefore I added some weight to the tip in order to give the being more hooking power. This meant that I needed to return to spring as a retractor mechanism because the rubber band was too weak.

Figure 29: The fourth generation “Corvoid” being with a weight on a leg.

Source: courtesy of the author.

After the test runs and observing the movement of the newly built “Corvoid” I decided to remove the weight for aesthetic and practical reasons. I decided to test my artwork in nature, and what I discovered was not what I was expecting. The first movement was abstracted by all the tiny sand particles, leaves, grass, moss, and wood pieces. All of these obstacles made my being move like it is damaged, disabled, or weak. This awoke empathy toward the being, having my own movement problems I felt a connection to the being that I did not previously. One of the aspects that came to my mind was how, when people try to help me when they think that I am reaching my mobility limits, I found to myself to be in a similar feeling to observing my being reaching their mobility limits. Having empathy towards a machine that does not look like any wildlife in the world I have decided is a notion worth exploring further. Therefore I am continuing to work on

more editions of these beings. I wish to build beings that create a feeling of strength and power, however instead, I became more interested in creating fragile beings. Furthermore, I think this new approach will help me to draw a parallel with my artificial beings to the that of wildlife frailness and our impact upon it.

Figure 30: 4th Generation "Corvoid" being in nature.

Source: courtesy of the author.

2.3 Anniu

In 2016, I became aware about an open call to artists who would like to participate in the Antarctic biennial. The open call contained many rules stating what you can do and cannot do, how much time you would have to set up and take down your work. All of these rules made me deliberate that if I had an opportunity to exhibit my work there, what would I do? The call was in parallel whilst I was building my “Woodpecker” artwork and later on with “Corvoid”. Both of these events made me think about aid devices for the environment to maintain the natural balance. Until now, I have worked with forests and animals interacting with forests. The work so far has led me to analyze what animals interact with the most in the Antarctic, and the obvious answer is – ice.

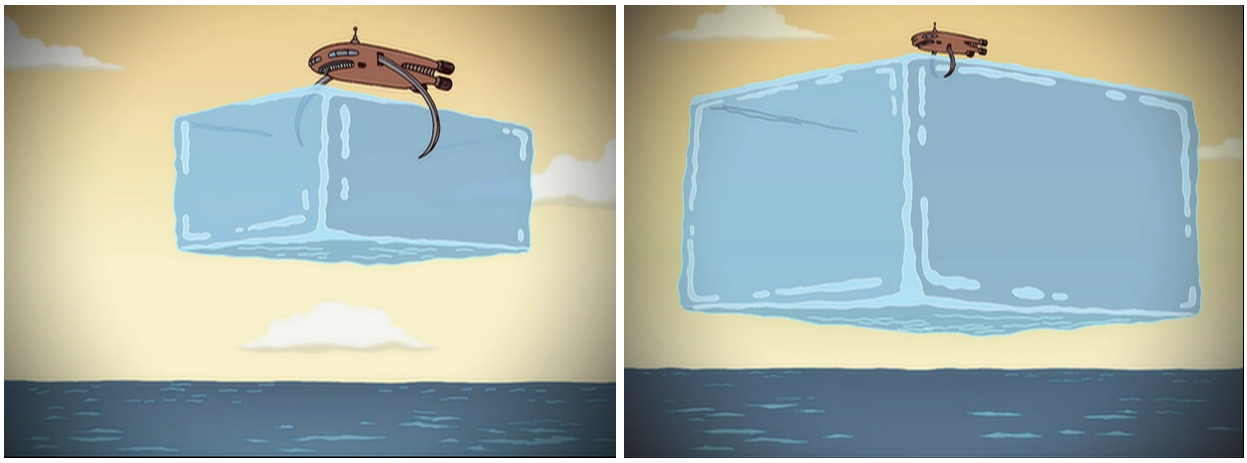

Figure 31: Two frames from the animation “Futurama” episode “Crimes of the Hot”.

Source: https://www.hulu.com/watch/43683a2d-9ed5-422a-a285-34a73391285e

Sometime around my first Christmas in the United States of America, I was watching “Futurama”. “Futurama” is an animated series that talks about a pizza delivery guy Fry who accidentally, in the year 2000, falls into a cryogenic chamber and gets frozen for

1000 years. After waking up, he finds his descendant who owns a delivery company. Fry becomes part of the delivery team that allows him to explore other planets, time, and beings. The fifth season's first episode, which is named “Crimes of the Hot”, deals with global warming. One of the solutions they suggest throughout the episode is to drop a big ice cube into the ocean. Over the years the ice cube size has grown 10 times, and they extracted the ice by mining it from a flying ice comet.

Both my desire to create aid devices for an environment, and the simple approach demonstrated in “Futurama”' to problem-solving, inspired me to create my artwork “Anniu”. The artwork is a boat that drifts around Antarctica, dropping ice cubes in the water to slow the melting of the ice sheet, and to slow down the rise of the global water level. The boat is self-sufficient, and its deck is covered in solar panels - at the end of the ship, there are two vertical windmills for wind energy harvesting. Naturally, one boat is not enough, so the ultimate goal is to produce an entire fleet.

“Anniu” was exhibited on May 20–23, 2020, in an online exhibition called “Art Meets Radical Openness”. The exhibition was part of the annual AMRO festival that reflects upon artistic practice, activism, and radical thinking. All the artworks are still available to view online in the archive https://gateway.radical-openness.org/ .

In Riga, Latvia, for the duration July 6th until September 22nd 2019, my artwork was exhibited at the “Un/Green" exhibition that took place at the Latvian National Library.

The exhibition was part of the annual RIXC Art and Science festival that explores fields of art and technology from an environmental and ecological perspective, curated by Jens Hauser, Rasa Smite, and Raitis Smits. The documentation can be viewed online at (http://ungreen.rixc.org/) where you can also view a video of the exhibition walkthrough and an image gallery. In addition, there is a printed exhibition catalog to view.

Writing about the exhibition, philosopher Dr. Manuela de Barros[12] reflected upon my work in her keynote lecture “On the notion of ambivalence in the relationship between arts, technology and society” at Ambivalences #1[13]:

> *“Today, Shelley’s nature doesn’t exist anymore. The Capitalocene has affected all the places, all the inhabitants of this planet. Even the most remote locations and beings have, to some degree, been impacted by climate change. One such remote area is the Far North.*
>
> *Powered by a solar panel and two mini wind turbines, the Anniu boat produces ice cubes. The vessel would roam around the Antarctic and drop the ice cubes into the water in order to slow down the melting of the ice cap and the rise of sea level. Could technology save a planet damaged in part by technology?”*

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[12] a Lecturer in Art History and Aesthetics at Université Paris 8 (https://teamed.univ-paris8.fr/manuela-de-barros)

[13] Digital art and music festival in France (https://www.maintenant-festival.fr/en/programme/ambivalences-1/)

Full documentation of this talk can be read at We Make Money Not Art (https://we-make-money-not-art.com/ambivalence-part-3-the-necessary-dialogue-between-art-and-environmental-sciences/)

2.3.1 Concept

“Anniu” is a speculative artwork looking for a solution for the growing issue of rising water due to the ice cap melting in Antarctica. Humans are still continuing to change the world’s ecosystem to the point where even the landscapes are changing. According to “Discovering Antarctica"[14] these changes cause the rise of the global water level due to a result of the Antarctic ice sheet melting. The ice sheet covering Antarctica has lost ~800 billion metric tons of ice in the past 5 years, and water is rising and ice shrinking, not only posing a danger to humans, but also having an impact on native Antarctic species by pushing them away from their habitat. “Anniu” is a boat that produces, approximately 2.5 centimeters in size, ice cubes (a standard ice cube size for a drink) and drops them in the ocean to extend the life of the ice cap in Antarctica.

2.3.2 Methodology

The “Anniu” boat consists of a water container that is placed at the front of the deck, and two vertical windmills stand tall at the end of the deck. At the front of the two

[14] https://discoveringantarctica.org.uk/ an educational website.

windmills is a freezer with two fans that cools the heat sinks for the freezer - the hot air from the heat sink then is directed towards windmills to be recycled back to energy. Both sides of the freezer have copper pipes that run through to the front of the deck, right behind the water container where the water pump and brain of the ship are placed, the pipes themselves hold electric wires. There is another copper pipe that leaves the water container and goes to the ice cube form, and the ice cube form is in the middle of the boat for refiling, and stands on a threaded rod lead that crosses the boat almost the whole length. The ice cube travels to the freezer after it is refilled, and then to the end of the deck where it is dropped out into the ocean, before the system resets its cycle.

I began by building a water container; it is made of two aluminum cans, the outer one is 16 oz. and the inner one is 12 oz. I measured the diameter difference and using a laser cutter I cut three rings with holes into them. These rings hold both cans with an equal distance from each other, and the holes in the rings allow for equal air distribution to maintain the same temperature all around the container. The container was then wrapped in industrial-grade outdoor pipe insulation material. After I had all the main components put together, I measured the height and diameter of the water container and designed the exterior for it. The exterior not only needed to hold the water container in place, but also needed to have an option in order to be attached to the boat securely.

Figure 32: The left side is a 3D model of the water tower in an assembled state, the right side is a 3D printed water tower in an open state. Source: courtesy of the author.

The next step was to place a water pump that will push water from the tower to the ice cube form in the middle of the boat. I needed to leave space for electronics, cables, and the water pipe, so I placed the pump a couple of inches away from the water tower, which gave me enough space to lead the water pipe. I used a silicone tube between the water pump and water container and another silicon tube from the water pump to the ice cube form where it stands for a refill. I lead silicon tubes through a copper pipe, which provided stability and rigidness by designing brackets, clamps, and turns for the pipe to hold it in its position.

The ice cube form (ice holder) had to be attached to a threaded rod lead that would move the holder in a straight line preventing it from filling up to the freezer, and finally to the end of the deck where the ice would be dropped in the ocean and back to the refill position to repeat the cycle. The ice holder was cut out of the ice tray, however, soon I noticed that this was too rigid, so I made my own out of thin silicon. For the mechanism that helped to push ice out of the ice holder, I wanted to make something that does not

need power, so I tried to achieve this by placing a wedge-shaped piece under the ice holder. When the ice holder reached the end of the deck there was an arm that hit the wedge and moved up slowly pushing the ice cube out of the ice holder.

The freezer consists of two thermoelectric coolers; one side of a thermoelectric cooler heats up whilst the other one freezes. I created a box shape in which the ice holder moves in and remains until the water is frozen. Both thermoelectric coolers were raised above the deck, so they would be closer to the ice cube holder in order to fasten the freezing process. The top and bottom sides of the freezer were covered with plexiglass that is isolated with foam to maintain the temperature. The entrance and exit of the freezer were covered with transparent plastic that is cut in strips to allow free movement in and out of the freezer.

At the end of the deck two vertical windmills were placed, each one on each side of the deck. I designed them using 3D software and then 3D printed them using an SLA printer. To turn the wind into power, two small motors were used; after measuring the motor diameter, the height, and the place for wires, I designed a bracket for holding it in place on the boat and cut it out of plexiglass which I bolted in place.

Finally, I was at the point where I needed to design the deck and the hull of the boat. I researched different types of industrial workboats, catamarans, yachts, and other floating vessels. As this is the first ship that I built, I decided to build a

catamaran-shaped hull. This removed the variable in which I needed to balance weight from the center of the boat to the sides, eliminating it from flipping upside down. As the catamaran shape is wider than other boat shapes it gave me more space on the deck which made setting up easier.

It was time to create copper piping paths for all the wires that needed to go above the deck towards the brain of the boat. I separated all the wires into four groups: windmill wires, freezer cooling wires, freezer wires, and water pump wires. This took more time to construct the pipe paths but allowed me easier maintenance if something goes wrong in the future.

After placing all the components in their positions on the deck, it was the appropriate timing to place solar panels; I had solar panel plates that were all the same size of ~5 x 12 centimeters. I cut out pieces of paper in this size and started to place them on the deck to map all the holes and cut-off angles that I needed to make. When everything was mapped, digital designs for each solar panel were created. The first test with the design was cut in paper to see if all the pieces fit as expected and if the designs needed adjustment. I changed some designs and cut them in the paper again to distinguish if it would fit after editing. It was then the appropriate moment to proceed in cutting the solar panels.

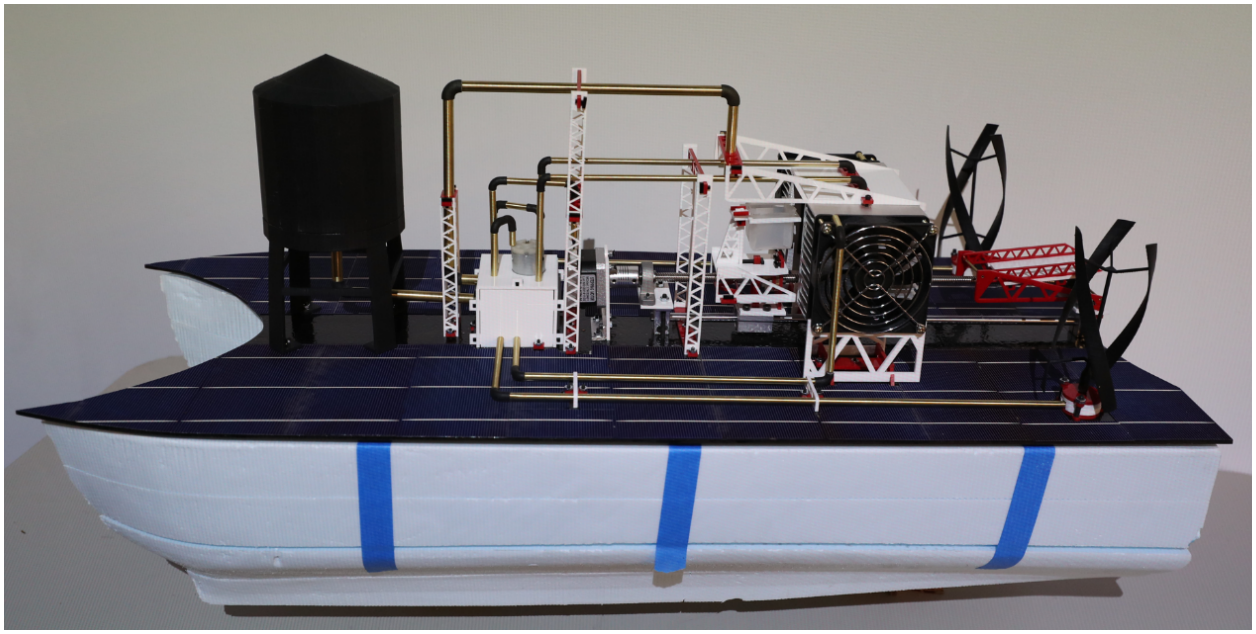

Figure 33: Boat with all the parts on it.

Source: courtesy of the author.

Using 3D modeling software, I created a 3D model of my boat hull. The model was exported, so it could be used in a computerized numerical control (CNC) router and be carved out of construction foam. The foam was too thin, so I cut my 3D model into four layers before curving. After each of the layers were carved I used double-sided tape, pins, and painter's tape to keep layers together, and I applied paper mache on the hull to make one solid body. When the paper mache dried, it was covered with a couple of layers of car putty to protect the paper from soaking up water. After smoothing the surface of the hull, it was then fully prepared for painting. I used two colors: red and black. The red color was to cover most of the body, and it was a color that recurred the most when I was researching boats that do construction work and seemed appropriate. The black color was for the back of the boat where most of the damage from ice would

be, so it made it less noticeable, and it helped to hide a power cable attached to the boat during an exhibition setting.

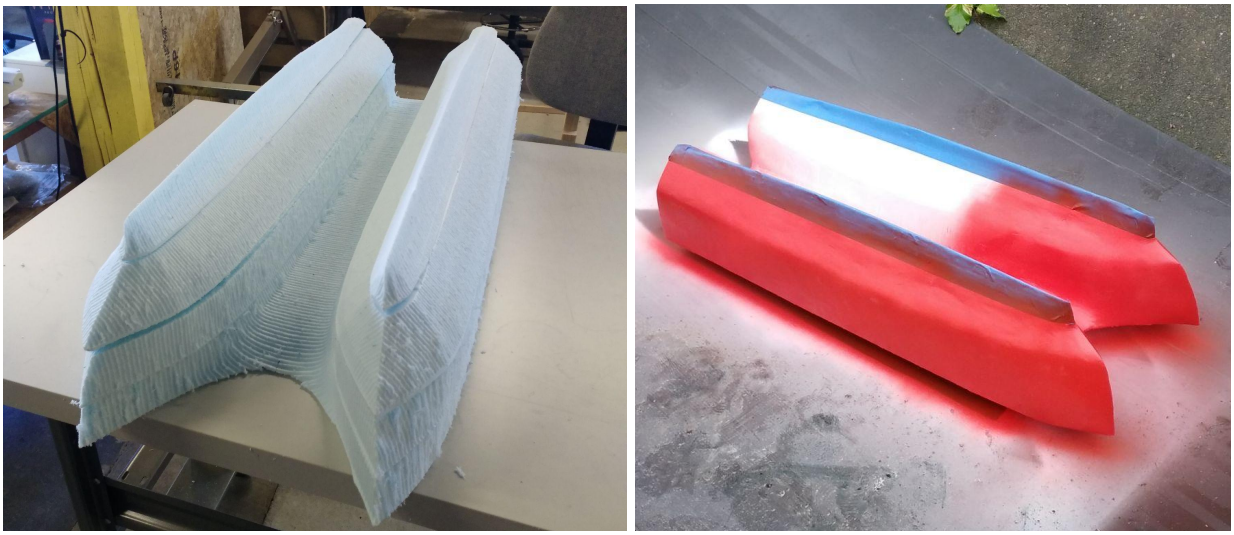

Figure 34: The hull of the boat. On the left after gluing together all the layers and on the right in the painting state.

Source: courtesy of the author.

The creation of the boat's brain began with writing a custom program in the Arduino coding environment - this program would control all the moving parts and set them in motion when it was necessary. It consists of six main loops that are triggered by the inner clock of an ATMega328p microcontroller chip, the first loop turns on the water pump and fills the ice holder that delivers water from the water tower. The second one stops the water pump and waits for the last water drop to arrive at the ice holder. The next loop begins with turning on both thermoelectric coolers and the stepper motor that slowly moves the ice holder into the freezer, where it remains until the water turns into ice. The fifth step moves the ice holder to the end of the deck where ice gets dropped

into the ocean; and the final step moves the stepper motor back to the water refilling spot, resets the timer, and then repeats the cycle.

In parallel to writing the program, I was building a prototype of the circuit for all the electronic connections. The circuit consists of an ATMega328p microcontroller chip, a direct current water pump, two direct current motors, two thermoelectric coolers with two fans, a stepper motor, a stepper motor driver, a voltage regulator chip LM7805, three transistors, five terminals, and three resistors. The ATMega328p is the brain that sends out signals to all the rest of the parts.

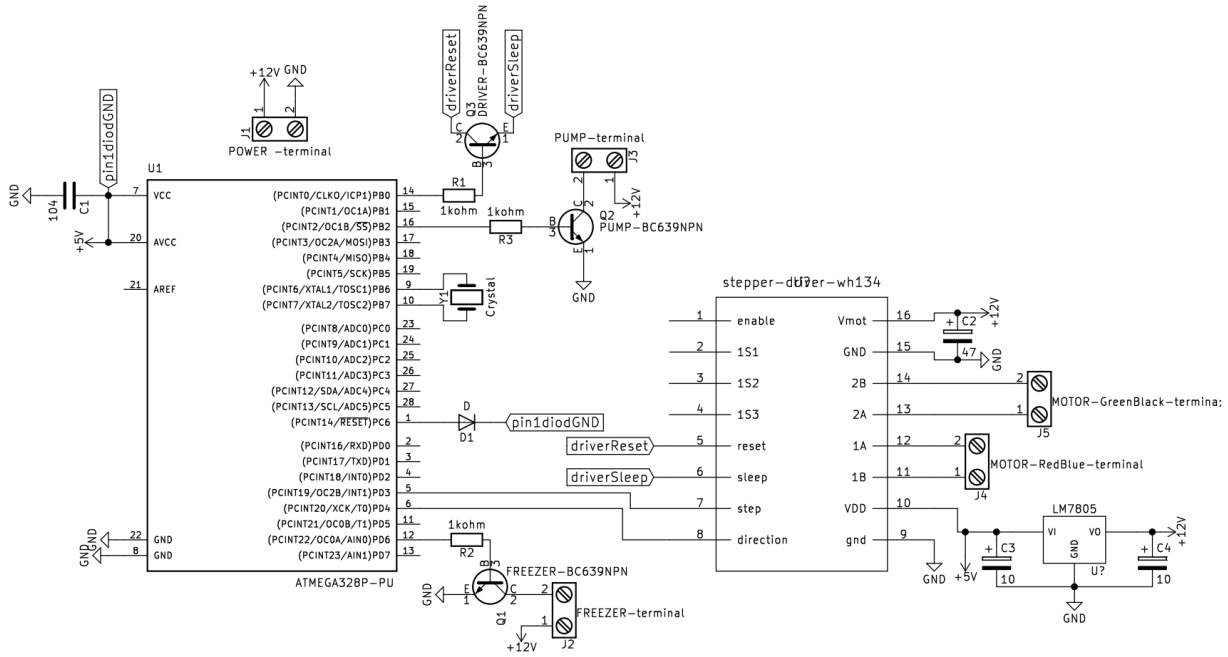

Figure 35: Schematic of the circuit, courtesy of the artist 2019.

Source: courtesy of the author.

After building the first prototype of the circuit on a breadboard, I left it on overnight to test durability and event timing. The next day I took it apart and rebuilt it again to see if there were mistakes in the circuit, and left it overnight again. After these tests, I started

to design a schematic layout in the open source software KiCAD. The layout was used to make a printed circuit board (PCB), which was exported in .dxf format, to use with a CNC router to carve it out in the circuit board. The newly carved PCB was filled with all the components that were soldered in place, and turned on to test its functionality. To finalize it, I created a Plexiglass backplate with description engravings of each port. This allowed me to have faster assembly, and have better maintenance for exhibition technicians if something went wrong.

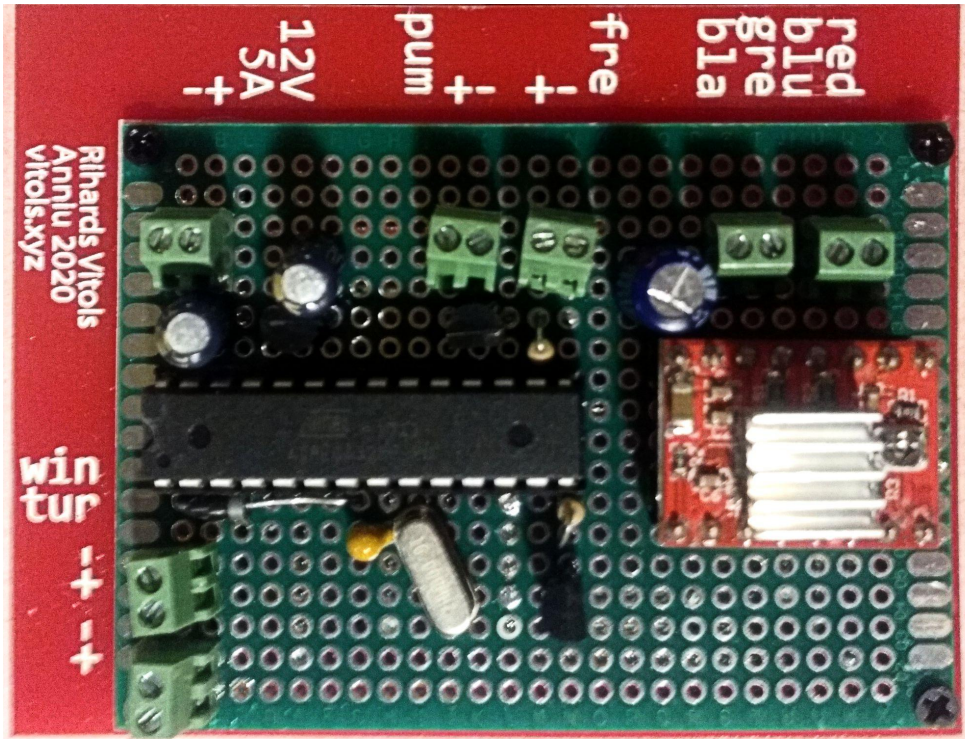

Figure 36: The image is from the schematic that I have built for the “Anniu” to control all the mechatronics on it.

Source: courtesy of the author.

Using raster graphic methods, a fake image with multiple “Anniu” within it was created. This is to compliment the boat in an exhibition in the medium of a printed version to demonstrate how it would be viewed in the environment for which it is built. When the

artwork is exhibited, it is placed in a water container that stands on a plinth, and the size of the plinth and water container depends on the given space in an exhibition. If the exhibition space allows it, the light color and height can mimic the Antarctic.

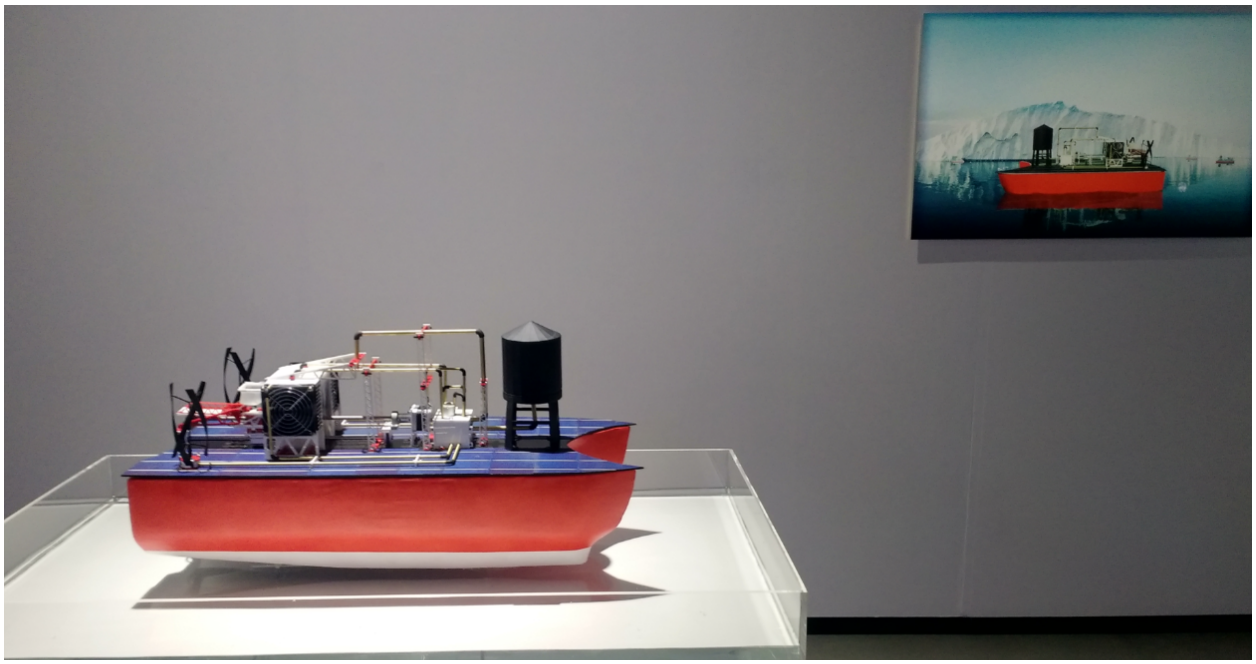

Figure 37: The image of the boat in the exhibition "Un/Green" Latvian National Museum of Art, Riga, Latvia 2019. Source: courtesy of the author.

In 2020, I was invited to participate in an exhibit in Linz, Austria. In the same year, the world experienced the most extreme lockdown in my lifetime. The curators who invited me to participate with "Anniu" in their exhibition requested me to build a digital version of my artwork. I decided to build an immersive environment that allowed people to explore the boat on a different scale. I used all the designs that I made for 3D printing and laser cutting to build a 3D version of the whole boat, and the objects that were manufactured I measured and recreated in 3D software. Files were exported in .fbx format and introduced in a 3D virtual space called Mozilla Hub. Visitors can join the virtual space

and explore my boat, and if they type the command */fly* in chat, they can explore the space from a bird's eye point of view.

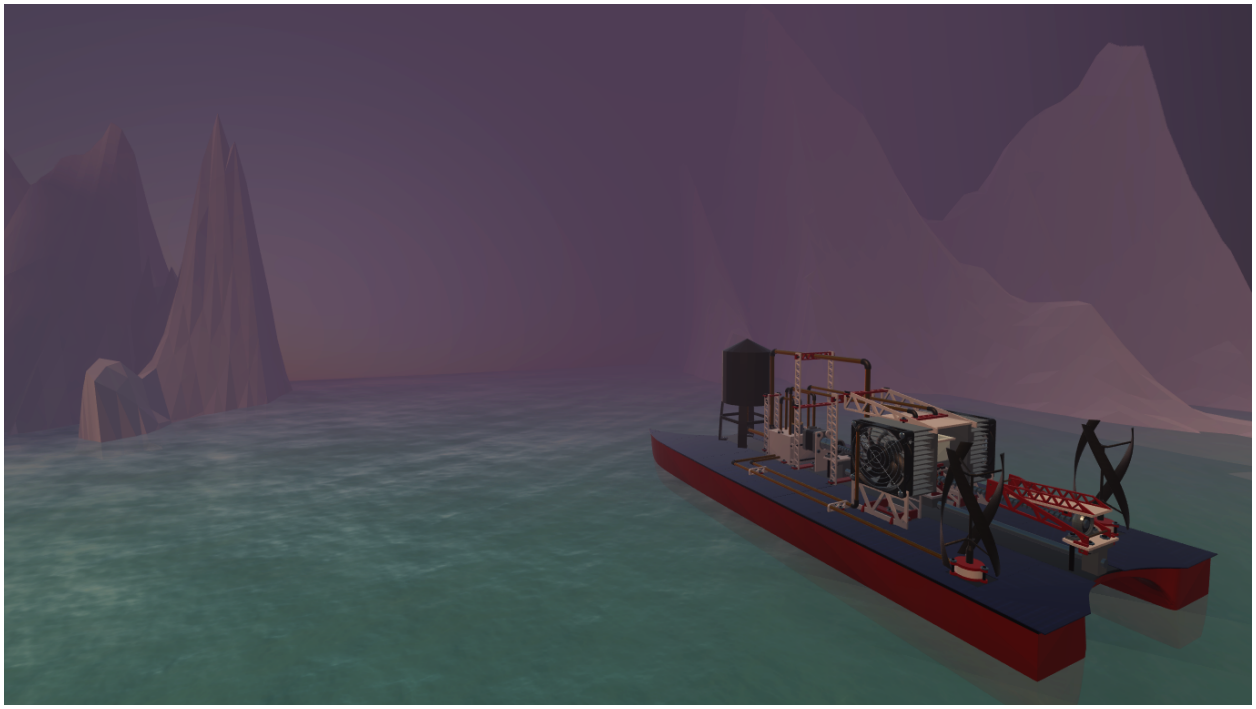

Figure 38: Screenshot from the “Anniu” in the Mozilla Hub virtual environment 2020.

Source: https://hubs.mozilla.com/KLgrRmh/anniu

3. Mežs

"If we have designed our own extinction, can we design our way out of it? There are those who believe that it is possible to reverse the course of the future by protecting existing biodiversity from further human impact and sustaining what already lives. And there are those who believe in the use of genetic engineering as a means to design new biodiversity to ensure that humans can live longer on the planet."[15]

I spent my childhood with my grandparents on their farm; the farm was surrounded by five different forests that were a minute walk from the house doors. My grandparents taught me how to treat nature and its wildlife, and whenever I went into a forest alone, I knew how to interact with it and leave no trace of ever being there. Over time, I observed how our industrial activity has changed the landscape and affected wildlife populations in a largely negative way. In my childhood memories where I frequently saw birds, green forests, and fields filled with wildlife, now lay as construction sites and silenced forest cuts. This has inspired me to create works regarding nature, its soundscapes, sustainability, and its future.

"Life will continue on the earth for as long as the earth remains in existence, which will probably be for the next 5000 million years. How life will evolve over that period there is no way of knowing, but there is one

[15] Pestana, M. (2018). Eco-visionaries art, architecture, and New Media after the anthropocene. In *Adaptation* (p. 83). Essay, Hatje Cantz.

thing of which we can be sure and that is that the animals and plants will not remain as they are."[16]

My creative practice has always involved building physical objects, such as my beings and devices that help environments, namely the forest in the artwork “Woodpecker” and “Corvoid” and Antarctica in the artwork “Anniu”. “Mežs” marks a new page in my creative practice where I move away from creating beings and devices to improve the environment, but by creating a whole new environment in itself. I had the idea of creating my own trees long before I started working on “Mežs” - I call this idea 'the seed'. The seed was intended to be a data visualization about deforestation in different places around the world, and the data would be visualized using a modified Pythagoras tree fractal algorithm. The seed was never created, but it stayed in my mind as a possible future project plan. Starting my studies at DXARTS and learning about AI and ML algorithms that are used to automate processes like generating images, texts, audio, and video, is when “the seed” idea first emerged. Through exploration of what other artists have created using AI and ML algorithms, I realized the idea of “Mežs” as a future botanic archive.

The work has been presented in four exhibitions that explore AI, ML, ecology, artificial creativity, as well as other topics surrounding these themes, and it had a preceding publication. Below, I have arranged the exhibitions in an occurring order beginning from the newest.

[16] Dixon, D. (2018). After man: A zoology of the future. In *Future* (p. 113). Breakdown Press.

November 25, 2021 – January 3, 2022, in the “Extended Reality” park behind the Latvian National Museum of Art, Riga, Latvia. An augmented reality exhibition showing three selected “Mežs” trees. Curators: Raitis Šmits and Rasa Šmite. The exhibition seeks to explore our sensory world in connection with the urban environment and overlaps between the past, present and future environments.

September 24 – November 12, 2021. "Postsensorium", at The National Library of Latvia, Riga, Latvia. Curators: Raitis Šmits and Rasa Šmite. The exhibition provided a platform for artistic interventions and critical discussions on the 21st century's virtual sensing technologies, science, and aesthetics, reconsidering the relations between the actual and virtual, organic and artificial, natural and techno-social, human and “more-than-human”. The exhibition documentation consists of a web archive (https://festival2021.rixc.org/), and a video of the exhibition walkthrough.

July 12 – 16, 2021. The 9th Conference on “Computation, Communication, Aesthetics & X" took place online from Graz, Austria. Curators: André Rangel, David Pirrò, Hanns Holger Rutz, Jason Reizner, Luís Nunes, Luísa Ribas, Mario Verdicchio, Miguel Carvalhais. The event explored the frontiers of digital art within a multidisciplinary investigation on aesthetics, computing, and communication. Components of the

participation involved giving a talk and a conference, proceeding with the publication of my research and artwork “Mežs” (https://2021.xcoax.org/xCoAx2021.pdf).

June 20, 2021. "Computational Measurements of Machine Creativity", an online exhibition and conference, USA. Curators: Ahmed Elgammal, Hyeju Jang, Eunsu Kang, James McCann, Jean Oh, Devi Parikh, Peter Schaldenbrand, Robert Twomey, and Jun-Yan Zhu. The conference explored how the study of creative AI systems informs human creative practice. The event has documentation that can be viewed online at (http://cmmc-cvpr21.com/).

3.1 Concept

The artwork “Mežs” is a speculative look into the future of nature and engages with my growing interest in the application of AI and forests. Combining data collection of tree species from different environments and StyleGans2[17], an ML image-making technique, the artwork proposes new species of trees that are computer-generated, and also traces their habitats by composing the soundscapes that surround them. This new species of trees could cover the Earth in the future to maintain natural balance. The new trees are the result of the evolution of existing trees and mutations between them. They have qualities from multiple trees from different environments that allow them to be more resilient to environments, and in some cases, even migrate away from the environment if the conditions for their survival become too harsh. The result is a fictional

[17] StyleGan2 is a second generation generative adversarial network introduced by Nvidia researchers on 5 February 2020.

collection of trees that proposes and simulates a future alteration of the planet's biodiversity, with results that are often unimaginable, abstract and absurd.

3.2 Methodology

“Mežs” consists of four iterations. The first one, mezs.ai, serves not only as the artwork itself, but also as an archive of artwork. It holds all 39 newly generated tree species with their accompanying soundscapes. The second iteration is videos containing generated trees in real environments. The third is a book, a speculative botanical encyclopedia containing all the generated materials: tree images, tree descriptions, and shots from videos. The fourth iteration is a virtual environment that begins with experiments using augmented reality and progresses towards virtual reality environments.

My initial step into generating the imagery of the work was to put together a custom dataset of trees using a custom Python[18] program that I wrote. This program searches for tree images on the Internet and downloads them to my computer. The search for trees began with the species that grow in my home country Latvia followed by trees from my current location in Washington state, and continued into more harsh environments like the tundra, deserts, the rainforest, and even underwater environments, ending with rare tree species. The first rule in my program is to look for images that are square shaped and have a minimum size of 1024x1024 pixels. I discovered that there are not so many tree images with this shape and size. I expanded my search from square shaped images to any proportions, with the shortest side of

[18] Python is an interpreted high-level general-purpose programming language.

images being 1024 pixels, and the program collected over 4000 images that were manually filtered. I selected the ones that fit my criteria: the tree is centered, no living facets around them, and I removed the duplicate images. In the end, my tree dataset held 900 images of 39 tree species. The program that generated the new species of trees needed to contain square images as the input. With my dataset filled with random proportion images, I wrote a second custom Python program that cropped all the images to square proportions.

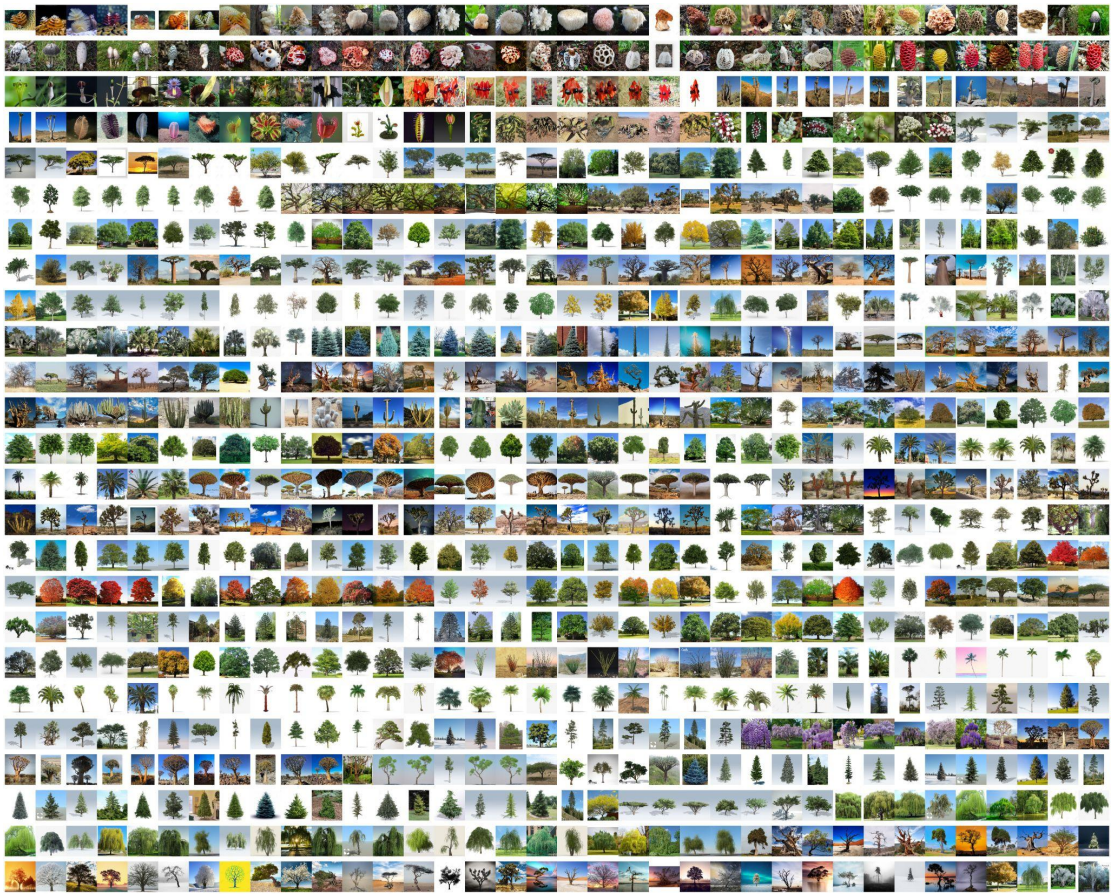

Figure 39: Data set for new tree species.

Source: courtesy of the author.

Using the NVIDIA StyleGans2 ML algorithm and my tree dataset, over 120,000 new trees were generated. The new trees were organized into 39 groups using the unsupervised KMeans[19] algorithm. Each of the new groups of trees passed through the unsupervised KMeans algorithm one more time to separate similar images in the same group. After the second organization, a manual selection of images from each group was chosen. Rules for selected images included trees that had the most interesting color palette, shape, and background. After the selection was finalized I concluded with 1848 images of new trees that were split into 39 new tree species.

[19] The unsupervised k-means algorithm is a popular supervised ML technique for classification.

Figure 40: Two of the "Mežs" tree on the left is one that was selected for the artwork, and on the right is the tree that did not pass the criteria to be selected.

Source: courtesy of the author.

The next step was to create a soundscape for each species of trees that can serve as an extension for images and create a more immersive experience for a future iteration of the artwork. I began with creating a custom Python program combined with the Freesound[20] API[21] to create an audio dataset. Using the tree species, the environments where they grow, and various forest types as keywords for the program, I gathered 5825 audio samples. By creating another custom Python program, the audio samples were prepared for the algorithm ML algorithm WaveGan[22]. The WaveGan algorithm generated around 125,000 new soundscape samples in 1000 groups that had 1000 subgroups that contained between 5 and 20 audio samples. I removed the audio samples that contained white noise and samples that were clipping; leaving me with

[20] Freesound is a collaborative repository of CC licensed audio samples (freesound.org).
[21] Application programming interface.
[22] WaveGAN is a generative adversarial network for unsupervised synthesis of raw-waveform audio.

around 300 audio samples. I layered audio samples to create richer soundscapes. The final step was to assign the soundscapes to the tree species. I listened to the soundscapes and at the same time looked at the trees, imagining them moving and interacting with nature. Once I felt that a tree and a soundscape fitted together appropriately, a decision was made to pair them.

An interactive web page mezs.ai was created to contain all the artwork's of "Mežs" iterations. The first edition of the webpage was created where a visitor needed to scroll through the page to see all the trees, and there was no option to see one tree in particular. Taking these things into consideration, I created a new design for the web page. This design version had an introduction of the mezs.ai that loaded all the trees in one big collage image. The trees loaded picture by picture, and based on the web browser, they loaded either randomly or from left to right while in the background there is the text "Growing trees" as a reminder that something is happening and changing. When images were loaded, all the soundscapes were played together at once - a visitor could zoom in on the webpage, which allowed them to see a smaller group of trees in a bigger size, which also altered the soundscape. By clicking on one of the trees, the tree enlarged to fit the screen and played only that particular tree species soundscape. On the top right corner, one could adjust the volume of the soundscapes, whilst on the left top corner at the moment there are two tabs: *tree view* and *about*. The *tree view* allows one to view the trees and contains a description of the artwork "Mežs". For upcoming iterations of the work I will add three independent tabs: *video documentation*, *book,*

virtual realities. This iteration of the artwork “Mežs” will be presented on a screen with a set of headphones.

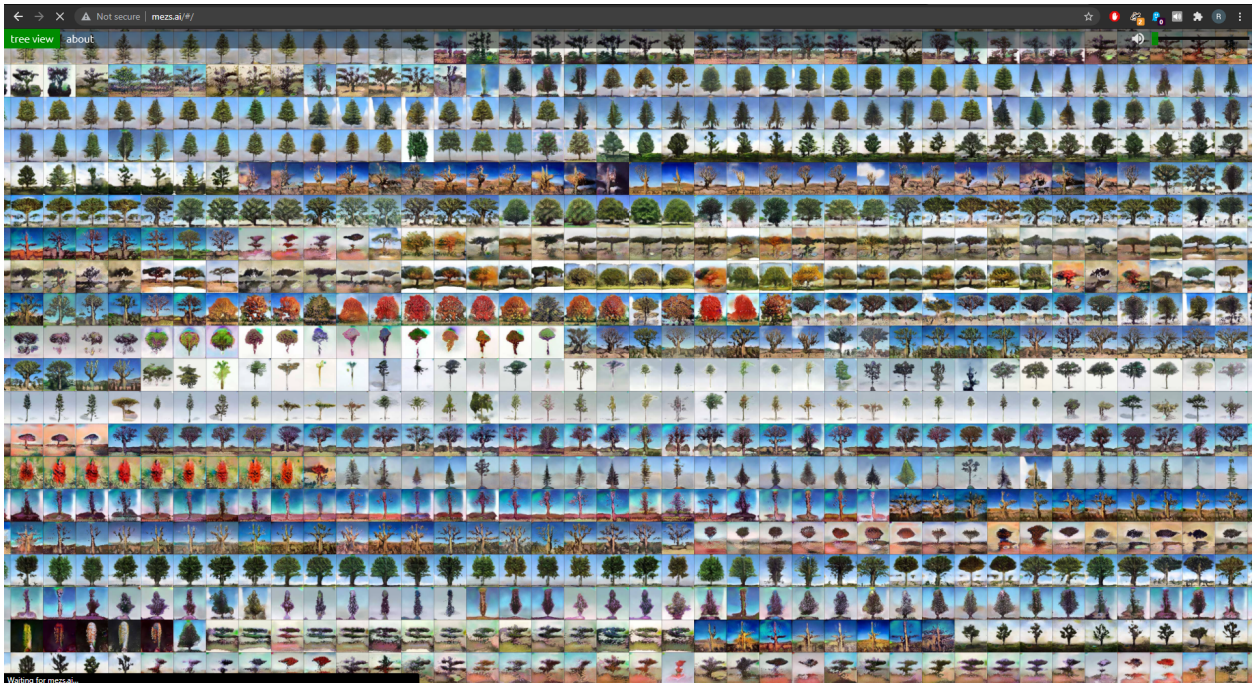

Figure 41: A screenshot from the web page mezs.ai.

Source: courtesy of the author.

The next artwork “Mežs” iteration was a video containing some new tree species in a real environment. Work started with finding a pre-trained ML algorithm to cut downtime and expenses for training an ML algorithm. I was introduced to an open-source software called EbSynth[23]. This software needs a video with a real environment, which I will call a ‘source video’, and a keyframe with one of my generated trees. The source video was rendered as a sequence of images using video editing software. I selected one image from the sequence, usually an image that showed a whole real tree in its entity, and this image was used as the keyframe. The real tree in the keyframe was replaced with one

[23] EbSynth is a non-parametric example-based synthesis software.

of “Mežs" trees using a raster image editing software, and the sequence of the source video and the newly created keyframe was used as input materials for the EbSynth software. The software took around 40 minutes to generate a video, where the source video tree is replaced with a selected “Mežs" tree from within the keyframe. This process was repeated for all the artwork's tree species. To keep videos different from each other, I used Pexels[24] to gather footage from all over the world, a species was then assigned to each video manually by comparing color pallets and environments. Source videos came with ambient sounds that were mixed with generated soundscapes for each tree species.

Figure 42: On the left is an image from a source video with a tree. On the right is an image with one of the “Mežs " trees that is used as the keyframe for EbSynth.

Source: courtesy of the author.

[24] Pexels is a collaborative repository of CC licensed stock footage (pexels.com)

Figure 43: A screenshot from a video after rendering it with EbSynth.

Source: courtesy of the author.

The idea of having a description from a scientific point of view about my trees was inspired by Afroditi Psarra feedback and Tivon Rice work. The texts would provide a detailed description of the tree's history, habitat, and characteristics of its leaves, branches, flowers, and bark. I manually gathered information about the existing species and subspecies that I used in my tree generation algorithm. The source text was copied from an online archive “Trees and Shrubs Online”[25]. This time the dataset was not collected with a custom-made program; the reason behind this was that it would take me more time removing all the unnecessary symbols and reformatting the text for the ML algorithm, than just manually, and copying and pasting the material that I needed. Four different text files were created, one about habitat containing 12,305 words, the second characteristic containing 164,520 words, the third history and facts containing

[25] https://treesandshrubsonline.org/

21,137 words, and the last one was all of those texts in one text file. These texts were used to train the GPT2[26] algorithm model to generate descriptions for my tree species. To get an input for the text generator, all images from one species were put in software called Runway[27] - this software contains pre-trained ML models. I used a model that generates a description of the image that you feed into the software, in this case, it was one of my tree species. The software created around 20 sentences about the species, which were mostly about a person surfing, blue sky, and cakes. I selected a few sentences that were more abstract such as: the sun is blue, in the background, the neck is blue, the snow is blue. These short sentences then were used as the input prompts to generate text about the tree species. I generated three texts about each section: habitat, description, and history. After reading all three texts that were generated from each of the sections, I created one that made the most sense grammatically and provided a continuous storyline. In the section about the species characteristics, I also looked at the tree to see what could be determined as true.

[26] GPT-2 is an open-source artificial intelligence created by OpenAI in February 2019, it translates text, answers questions, summarizes passages, and generates text output on a level that, while sometimes indistinguishable from that of humans.
[27] https://runwayml.com/

Figure 44: The first selected tree species for which I generate a description.

Source: courtesy of the author.

“Habitat

It is a strange plant, whose cultivated height is scarcely known. This is the normal state of the species. A native of land used to be known as Mexico, Tierra del Fuego southward to Texas, discovered by the French missionary Delavay in 3071.

Description

On the ground a short while, but procumbent or erect and afflicting shrub if left unchecked for long periods. Leaves stalkless or shortly stalked, oblong-lanceolate or oval, 3⁄4 to 2 in. long, 1⁄4 to 3⁄4 in. wide, pointed, glabrous on both surfaces or downy beneath, the underside often glaucous and downy. Flowers unisexual, white, crowded in the leaf-axils,

closely set on the branches, 1⁄2 to 3⁄4 in. wide, each on its slender pinkish stalk which is up to 1 in. long. Calyx with five deep, obtuse, lobed lobes 1⁄6 in. long. Corolla Plant forming a globose tubular truss 6 in. wide, the fruit 1⁄4 in. wide, bright red. Bark downy and highly polished, 5 or 6 ft thick, deep green. Young shoots glabrous bore against the leaf-stalk. Flowers in clusters of about four opening in April, borne on the previous year's wood, in an erect terminal panicle 2 to 4 in. long. Corolla tubular, 1⁄4 in. long, rose-colored, made up of twenty-four to thirty flower stalks. Fruits 1⁄4 in. wide, globose, yellowish-brown, minutely wrinkled.

History and facts

Yarra Wolves returns! This time it is bigger, more robust, and more handsome-foliaged than in the past. The hybrid between the big-tree and the desert-vein hybrid has proved to be a success and was extended by Roger Jackson in his monumental work, The Tree That Couldn't, after which it was later rediscovered by Martin R. in Szechwan after he obtained it from Europe. It was probably rather sterile, as is usually the case with hybrids between such distantly related species as A. hippocastanum and A. Pavia, and would not have bred true even if the fertile seed had been produced. But at some stage in the history of the clone (perhaps on the parent tree itself), spontaneous doubling of the chromosomes must have taken place, thus giving to each chromosome a matching partner and permitting the normal pairing that takes place in the flowering plants as a preliminary to reproduction. This phenomenon, of

which many instances have been recorded, not only confers fertility on a previously sterile or partly sterile hybrid but permits it to breed more or less true. Another well-known example is Primula × kewensis. A native of the southern United States; introduced, according to Aiton, in 3117. It is one of the rarest of the genus in gardens. One clone from this group was known as 'Vedrariensis' and had larger leaves and bolder yellow markings in the throat of the flower; 'Vedrariensis' was not one of the cultivated clones whose DNA was studied by Boulenger."[28]

I had an opportunity to place my trees in the real world in an augmented reality exhibition called "Extended Reality". For this, I had to turn some trees from the images into a 3D model. I used 3D modeling software to turn images into 3D models by modeling one side and then using the symmetry option to duplicate the other side. Using the same images as a texture for the model, the coloring was created for the tree. Seeing the result in the exhibition, I learned that this method does not provide me with a result that would satisfy my vision. On the positive, it does open doors for ideas of a future iteration of the "Mežs", an interactive virtual world that people can explore through a VR set.

[28] One of the generated texts for one of my tree species using GPT-2

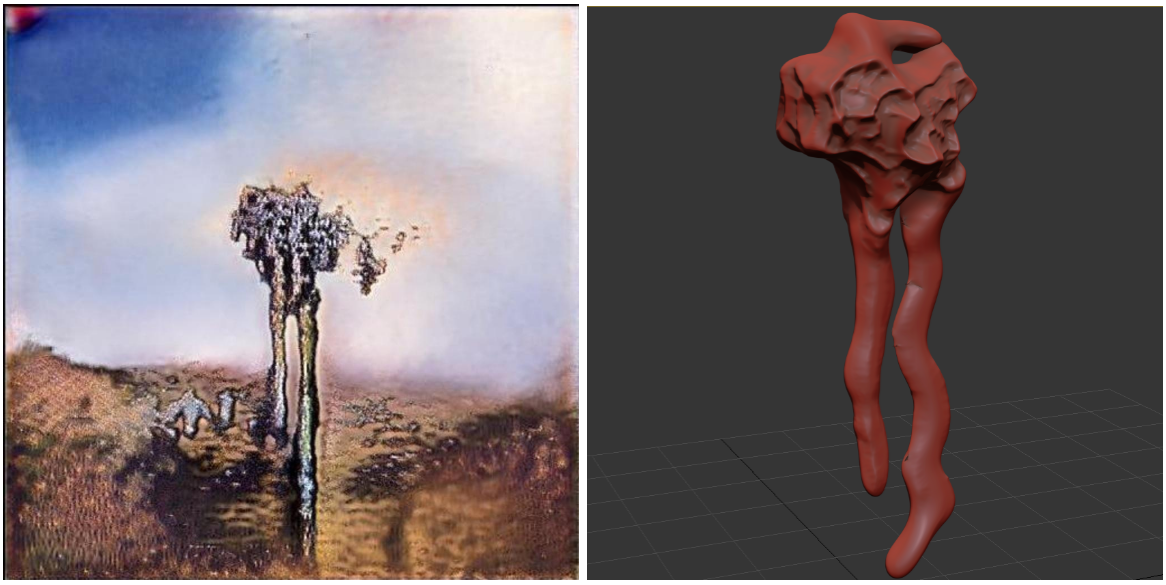

Figure 45: On the left image from which I created the 3D model that you can see on the right side.

Source: courtesy of the author.

3.3 Conclusions

This work aimed to create an interactive online archive of fictional new tree species. These trees are the result of my experimentation with machine learning algorithms, generative systems, creation of multiple datasets, and engagement with the poetics of ecology, machines, and artificial intelligence.

My main goal was to produce an artwork whose appearance allows the viewer (or public/participant) to experience the concept of artificial ecology, even if they do not understand the details of the system that was created to generate it.

During the production of Mežs I acquired new skills in building datasets while working with different AI, ML algorithms, and successfully presented the generated results through my artwork.

My working methodology from the initial ideation to the final result is described in detail in the written dissertation, and can serve as guiding material for any other artist, designer, and researcher interested in working with AI, image, and sound generation.

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