STARTS Residency Public Report
Artificial Intelligence and its False Lies

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Abstract
The artistic process started by the artist saying "I want to wear an AI". Instead of observing fearfully from a distance, this is her attempt to opt for proximity. To be worn and to cover a body, AI needs to become soft and flexible. The resulting artwork consists of a series of embroidered Artificial Neural Network prototypes: a flat fabric prototype, a sleeve prototype, and a full-body garment prototype shaped as a ghost. These prototypes are worn by the artist and trained to classify her body gestures. Parallel to the development of the project, the artist made a series of interviews with the collaborating scientists and composed a short film as a part of the artistic outcomes. Co-creation process with the partner consists of supporting the artists in her self-learning process, consulting technological questions in the necessary steps of AI developments and participating in the interviews. The project gave an opportunity for the artist to explore a new topic of AI and a stepping stone to develop further artistic work around this topic. Their collaboration was largely based on exchanges of ideas and discussions on larger topics of technology and its impact on our society, which is captured in the film. They hope to extend this relation and invite others to join the discussion through organizing events in future.

***Index Terms*— Artificial Intelligence, Artificial Neural Network, E-Textiles, Machine Learning, Wearable Technology**

I. INTRODUCTION

The introduction of Artificial Intelligence (AI) into the workplace is often discussed with slight anxiety. Is it going to abolish our jobs? Is it going to replace me in my work? Even with the promise of shorter working hours, the elimination of manual labour nobody wants to do and with all the sustainability and economic benefits, we continue to feel uneasy in accepting giving over our labour to AI.
By collaborating with the research group SFI CONFIRM Centre, who develops AI for smart manufacturing, I had the chance to further explore what AI really is: how is it made, how does it function, what is in the blackbox? The rather long title of the residency "Artificial Intelligence and its False Lies" was conceived by translating "Artificial Intelligence" ten times with randomly selected languages on Google Translate. In the end, I was left with "False Lies"... in actuality, a truth?! Is it the AI behind this translation program that is witty and cynical, resulting in giving this ambiguous double negation? Or is it a poetic tone in a simple lost-in-translation mistake? With these questions in mind, I took the opportunity to learn how to make an AI from scratch and created a high-low tech embroidered neural network that performs a simple machine learning task.

II. ARTWORK

The artistic process started by me saying "I want to wear an AI". Instead of observing fearfully from a distance, this is my attempt to opt for proximity. I imagined this as something of an offering, of my body to a ghost that does not have a body of its own. I will become possessed by this intelligent ghost.

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To wear and to be covered by AI, I need it to become soft and flexible. The resulting artwork consists of a series of embroidered Artificial Neural Network prototypes: a flat fabric prototype, a sleeve prototype, and a full-body garment prototype shaped as a ghost. These prototypes are worn by the artist and trained to classify her body gestures.
Parallel to the development of the project, I have made a series of interviews with the scientists working with AI and made a short film. This film is also a part of the artistic outcome and will be exhibited with the garment.

Embroidered Artificial Neural Network:
Artificial Neural Network is one of the common tools used for Machine Learning techniques. Instead of an abstract mathematical model inside a computer program, a physical network of microcontrollers manifests the calculation. Each microcontroller acts as one neuron, calculating how much it should activate itself from its inputs, weights and biases it obtains. The activation of the neuron is expressed as intensity of light, passed to neighbouring neurons through optic fibre. Each microcontroller neuron has 3 input pins and 1 output pin. Input pins are connected to LDRs (Light Dependent Resistor), a type of light sensor, and the output pins are connected to LEDs to emit light. Optic fibre connects output LED from one neuron to input LDR of the neighbouring neurons. These optic fibres are the side-glow kind that emits the light from its side surfaces. As the Neural Network functions, one can observe the activation and deactivation of each neuron, as if seeing the network "thinking".
The electrical connections necessary for the microcontrollers to function are embroidered on the fabric with silver conductive thread using E-Textile techniques. This unusual way of making circuity adds unique aesthetics and tangibility to electronics devices. As the entire circuit is visible and spread out compared to conventional PCB designs, it gives the impression of accessible and open technology to the viewers.

Figures 1: Making process of the residency artwork.

Machine Learning as a performance:
Each of the Embroidered Artificial Neural Network is capable of classifying gestures from connected interfaces. For example, the first prototype, a flat fabric prototype, is connected with a glove equipped with 4 textile bend sensors that measure the bending of finger joints. This prototype is trained to classify 3 hand gestures from the Rock Scissors and Paper game. In the case of the sleeve prototype, it also connects with a sensor glove and it can classify a hand gesture. The first prototype was trained with a Python simulation on a computer, calculating the optimised weights and bias for 3 gesture data that is corrected from the glove. The sleeve prototype was built with training capability within the embroidered network. This means one can wear the sleeve and physically tell what are "correct" or "wrong" gestures. By repeating this process for thousands of times, one can perform Machine Learning to this network physically. I intend to perform this physical Machine Learning as a part of the artistic work.


Figures 2: Second prototype and the sensor gloves of the residency artwork.

A Whole-body garment and its dream:

The final prototype, a whole-body garment, is equipped with 66 neurons with hand-embroidered circuitry, interfacing a bodysuit equipped with 12 textile bend sensors that captures movements of the joints, such as knees and elbows. The Neural Network forms 3 hidden layers, intending to get an even deeper learning effect than the previous prototypes. The network has two output neurons to classify two body gestures. The resulting garment is covered with intricate embroidery and lines of light, computing the motion data from the wearer's body. As it gets trained through Machine Learning, one can feedback the network and emphasize the trained data, or let it hallucinate. This technique is called *inceptionism* or *Deep Dream*. The garment is equipped with this feedback optic fibre connection, from the last hidden layer output to the input neurons. Once the Machine Learning process is completed, it is possible to let the garment "dream" about its wearer in her/his absence. This "dream" data can be extracted after iterations from the hidden layer and visualized as the final step of the performance.


Figures 3: final prototype of the residency artwork.

An interview film with the researchers:

One big part of the artistic outcome of this residency is a series of interviews that I conducted with the researchers at the SFI CONFIRM Centre. A short film was produced based on these interviews portraying the people behind the makings of AI, giving them voices and faces. Through these interviews, it is interesting to observe the different opinions among the researchers concerning their vision on automation, how they see the responsibility of scientists, and the impact of AI technology in future society. This short film will be exhibited next to the residency artworks to juxtapose the imaginary with reality.

III. METHODOLOGY

Learning AI, DIY, video tutorial, python simulation

It was a great opportunity for me to collaborate with researchers working with AI, as I was able to explore AI and learn how it works. Since the beginning, I intended to learn and build an AI prototype on my own, instead of asking researchers to build it for me. I started to learn how to make a simple version of the Artificial Neural Network, a type of AI to experience it myself from the inside out. I followed an online video tutorial on Artificial Neural Network programming with Python, creating my first AI. This gave me a good understanding of how the whole mathematical model works, including the backpropagation process that trains the network. Slowly, I gained understanding and moved on to more complicated network modelling. Thanks to the guidance and consultation from my collaborators, I was able to build a mathematically correct model.

Microcontroller, Backpropagation, Serial communication

After developing the working model on Python, I have translated the code to Arduino/C language so it runs on Microcontrollers. The activation function (Sigmoid activation in this model) that occurs recurrently in the Neural Network is distributed to a network of microcontrollers. I chose to use ATTINY85 chips: a classic microcontroller with small memory and limited calculation power. I chose this chip because it can not run the whole neural network on its own (the modern faster microcontrollers can), therefore it emphasises that it calculates in network. It has only 8 pins (5 In/Out pins, 1 reset, 2 power pins) which give physical simplicity as a metaphor of single neurons.

To apply Machine Learning, the network needs to run the error correction process called Backpropagation. This requires microcontrollers to communicate with each other with the correction information. As the number of pins is limited on the ATTINY85, I had to come up with the ways to communicate with a single pin. I have manipulated the software serial library of Arduino to create a broadcasting communication channel with 1 pin communication.

Production technique, E-textile hand embroidery, pattern making

Through the generations of prototypes, I have developed the ways to assemble this physical Artificial Neural Network on textile using E-Textile techniques. Several types of threads and stitch techniques were tested to fulfil both the aesthetic and electrical functions needed for this project. In the process of prototyping, I have also woven a circuit for neurons as a test sample. The ways to mount optic fibre with LED and LDR had to be also developed. I have started with through-hole components with shrink tube mount, and finalized it with Surface Mount Device(SMD) LED and LDR with custom design 3D print parts to fixate. The final embroidered circuit consists of SMD electronic components directly soldered onto the threads to reduce the bulkiness.

The soft circuitry techniques range from fusing conductive fabric to embroidering conductive threads with machines. I chose to hand-embroider with the KarlGrimm HighFlex threads (fine copper fibre ply covered with silver) with Sashiko (Japanese traditional workwear embroidery) like plain stitch. HighFlex thread provides high conductivity enough to supply all the ampere required from the LEDs, and one can directly solder on it ideal for the use with SMD components. The texture of hand embroidering communicates the “human labour” and lets them imagine the time that went into the process.

The second prototype and the 3rd prototype were assembled as garments: one-sleeved half work shirt and full cover ghost-like dress. I worked with a pattern maker to develop these garment patterns to fit exactly to my size, and for the 3rd prototype to accommodate a few different size wearers but still maintain the fit to the body. Also, the embroidery, electronics and portable batteries weigh substantially and we had to consider weight balance in the pattern making.

The detailed process of prototype developments and techniques and method used in the process can be consulted at
>> http://www.kobakant.at/false-lies

IV. CO-CREATION PROCESS

Interview, Collaboration

After my first visit to University College Cork in Ireland, where one of the labs of the SFI CONFIRM Centre is located, it was clear that our collaboration would not be about them providing technical support, but to establish a dialogue concerning the AI and automation. Much of the visit (one week) was spent in one-to-one or group discussion with the researchers. As they are a research group located in a university, the experience of the researchers ranges from PhD students to postdoctoral and senior

researchers to leading professors. Their research differs from the investigation in applied use for specific scenarios to exploring more abstract algorithms. Also, their personal background is different: where they grew up, how they came to be a scientist, their role in family life affects their ways of approaching the topic. I was fascinated by these personal opinions of AI makers: who makes these AI and what they think about them. I interviewed several researchers and composed a 15 minutes film from these interviews.
I see these conversations and exposing their opinions in the interview film as the result of our collaboration. These exchanges inspired and shaped my process of developing this project, finding the narrative within the artwork. This will also let the audience to experience a glimpse of what inspired me.

The full interview film can be consulted at
>> https://vimeo.com/395467495

V. IMPACT

A. Artistic Impact

The project allowed me to step into a new topic and technique of AI. The experience of learning how ANN and machine learning works opened up new possibilities for me to explore more deeply and fluently this much-discussed (and needs to be discussed further more) topic of AI. This project is the first of a series of works I intend to conduct concerning AI and its role in society. Currently, there are many artistic explorations of AI using GAN to create a type of visual aesthetic. As I experienced the calculation process behind the AI algorithms, I learnt that there are much more potentials in artistic explorations. I intend to further investigate this topic.

B. Research Impact

From the perspective of CONFIRM project team, this residency was a good opportunity for willing members of the research group to take time to reflect on the place of their work in a broader context, what was perceived as being important for them, as this type of conversations are sparse. By producing the interview film, the residency also allowed them to recognise their common interests and approach to computer science and artificial intelligence in general, while putting into light their diverse opinions on broader topics. The process of formulating ideas and listening to ideas coming from their peers was a great opportunity for them to think critically about their research work in a broader societal and maybe political context. Finally, the residency also allowed them to explore new ways of engaging the public with their work.

VI. ART-SCIENCE INTER-RELATIONSHIPS

I often observe the art-science relationships as either artists providing visual translations to the scientific fact to communicate the abstract information with the general public, or scientists providing technical support that artists lack to realize envisioned artistic projects. Fortunately, this was not the case of this residency. As STARTS also stated, when dialogue between scientists and artist is established, or dialogue within the peer group with an unusual guest (either scientist group with an artist or vice-versa) happens, it can be a catalyst to look at things in different ways. During this project, not only did I learn from the researchers, but also they broadened their horizons. In this collaboration, I notice that even the researchers within the same lab may not necessarily voice their opinions to each other. I hope my interference in the lab becomes a catalyst to start new discussions among them, or people from other fields to enter the discussions. Hopefully, the short interview film I created within the residency will contribute to this.
From the artistic side, even one may work in technology art as medium and topic, deep and correct knowledge on state-of-the-art technology such as AI is often hard to acquire. The relationships with scientists as discussion partners provide accurate knowledge in the subject matter of their artistic explorations.

VII. FUTURE DIRECTION AND ACTIONS

The project is officially finished, but it is just a starting point of a longer and larger artistic exploration. I am convinced to further explore what has started in this project: the physical manifestation of Artificial Neural Network, use of textile and creating high-low tech AI, developing narratives and creating images and artefacts that communicate them, all are on my to-do lists.
The immediate next step is to exhibit the current artistic outcome and expose it to a wider audience. I intend to apply in open calls for exhibitions, but currently it is on hold as the COVID-19 situations are holding any exhibition planning worldwide.
With the SFI CONFIRM Centre in Cork, we plan to organize a presentation and discussion event at the University College Cork. This will host further dialogue with the scientists at the lab, and also to invite experts from other disciplines (philosophy, theatre, fine art) to discuss together.
One of the aspects I have discovered in this project was how one can learn how AI works. Experiencing it myself, it is complicated, but not un-understandable. I hope to develop a hands-on workshop that let others experience the process I went through and let them understand how the Artificial Neural Network works.

VIII. CONCLUSION

I am grateful for the opportunity the STARTS Residency program provided: to have time and resources to deeply investigate one topic and output artistically. Art projects are often unpredictable. One starts without knowing where it leads to, how big it is, what it takes to go through. Perhaps a predictable outcome never works as an artwork. As David Pye mentions, “works of uncertainty” is a necessary ingredient in the workmanship of art-making. In this case, it was challenging to frame the whole unpredictable process within the planned process, and step through the co-creation process with the technology partner. It must have been also a great challenge for the tech-partners and the monitoring partners. I appreciate their understanding and great flexibility to go through this “works of uncertainty” together. The functions of artwork are not easy to talk about. One can not point out “what artistic work is for” so easily. But hopefully we, as members of society, are certain about the value and the impact of artistic works and acknowledge it as essential to our lives.

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Website: https://www.kobakant.at/

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