Final Report: The Shape of Things to Come
– Rehearsing Future Societies with AI and Performing Arts
(1.May. 2019 – 31.Dec.2020)

Dr. Diana Alina Serbanescu, Principal Investigator (PI)

1. Scientific findings
a. Project overview

The Shape of Things to Come is a project exploring the intersection of science and humanities through integrative, transdisciplinary research approaches with a focus on Artificial Intelligence, embodied cognition, speculative design and performing arts.

As a medium suitable for experiential encounters and political debate – we envision theatre as laboratory for rehearsal and pre-enactment – in which interactions with intelligent systems and ethical dilemmas can be safely explored through trained physicality, embodied interaction and speculative storytelling. Throughout this report, we'll alternatively refer to this emerging field of proactive exploration, situated at the confluence of the disciplines previously mentioned, under the name of *embodied engineering*.

b. Hypotheses and goals

Drawing methodological approaches from both arts and sciences – and thus classifying itself more as a transdisciplinary art-science and practice-based research, rather than a purely scientific endeavor – this project investigates the value of theatre in the frame of scientific inquiry, based on the original hypotheses that performance techniques have the potential:

1) to expand imaginaries of design for AI-based systems and to inform the development of new technologies in relation to embodied intelligence and situated knowledge by drawing on methods of physical training for performers;

2) to provide a safe test-bed for embodied experimentation (sensorial, affective, corporeal, etc.) with new technological artifacts, and thus push the envelope of future designs of human–machine interaction;

3) to provide a safe space for reflection – an arena for critical thinking, debate and transparency; through rehearsal – as a method for active participation – we envision acts of negotiation towards democratic

representation of values, and aim to create participatory formats for unmasking the powers at play in the construction of AI-based technological systems.

Consistent with these assumptions, the overarching goals of this project were:

1) to prototype a methodological framework for *embodied engineering* and a practice-based experimentation with performance-based techniques and AI-based technologies — as the basis for an exploratory research in which the afore-mentioned hypotheses could be tested. Throughout this report, we'll alternatively refer to this exploratory research – implemented in the first phase of the project – as the proof-of-concept experiment, and to its continuation in the second phase as a practice-based research towards devising a speculative performance.

2) to create a team of collaborators – researchers, artists and scientists – with skills that could contribute to the proof-of-concept experiment (e.g. interaction and wearable designers, creative coders, human-computer interaction researchers, computer scientists, cognitive scientists, speculative designers, and performance artists, etc.).

3) to create a network of institutional and non-institutional partners that would be interested in a long term collaboration, and who wanted to co-write the full grant proposal together with us.

4) to write a full grant application presenting a long-term vision that is shared with our network partners.

5) to prototype AI-based technological artifacts which are consistent with our vision for embodied engineering.

6) to open our research to the general public and create performances that showcase our process and results.

c. Overall Structure

The Shape of Things to Come project was structured in two conceptually distinct phases which extended over a period of one year and a half, with the first phase unfolding from the 1st of May 2019 until the ending of November 2019 (8 months), and the second phase being developed throughout year 2020 (12 months).

In the first phase we created a team of collaborators, together with whom we developed the theoretical and technological framework for the proof-of-concept experiment, which took place during two weeks in August 2019. Before diving into the practical experimentation we conducted an extensive literature review and strived to position our project within a network of other similar transdisciplinary endeavors. From this network we selected then a number of potential partners – affiliated to academic or non-academic institutions – which we invited later on to a two-days symposium, organized at the Weizenbaum Institute on the 26th and 27th of September 2019, with the goals of exchanging experiences about our ongoing projects and ideating on shared interests for the Full Grant Proposal which was to be submitted in October

2019. The first phase of the project was concluded at the end of November 2019, after the submission of the Full Grant Proposal and after the presentation of the project at the symposium in Hannover.

In the second phase of the project – and under the auspices of the COVID-19 pandemic – the team was restructured and the focus of the project shifted towards an artistic practice-based research with the goal of producing an original AI-based performative artifact and a speculative performance; both technological and performative elements were to be built according to principles and values informed by the observations of the proof-of-concept experiment conducted in the first phase. The second phase concluded in March 2020 with a public presentation of an online performance – accompanied by discussions with the involved artists, explaining the process. This phase, as well as the resulting performance was titled 'Dancing at the Edge of the World', after Ursula K. Le Guin's homonym collection of essays, and it concluded with an online event curated by the Hybrid Platform.

d. Team

AI-systems are products of collaborative and team effort and awareness about the process of decision making starts with the team. In a small team and small project like ours, these are easier to explore. Throughout the project we strived towards maintaining a self-aware and critical stance on our work. This section describes the composition of the team which shaped this research in its different stages.

This project was organised / led by REPLICA in collaboration with Weizenbaum Institute for the Networked Society and Technical University of Berlin and with the additional support of Hybrid Platform, Berlin Open Lab and the Berlin University of the Arts.

In the first phase, the main organizing team of the project consisted of: Dr. Diana Serbanescu (teamlead Weizenbaum Institute for the group Criticality of AI-based Systems and Artistic Director at REPLICA); Wenzel Mehnert (during the timespan of this project: research assistant, PhD Candidate and lecturer at the University of the Arts Berlin and Technical University of Berlin); Regis Lemberthe (during the timespan of this project: freelance designer, associate lecturer at IU Berlin, speculative designer at REPLICA); Yidi Tsao (freelance curator) — with the additional support from our research fellows: Joana Chicau (transdisciplinary artist, interaction designer, choreographic coding expert) and Kate Ryan (performer, anthropologist). For the realization of data capture custom-made technology we collaborated with: Gilbert Sinnott (creative technologist, visual artist working with ML); Meredith Thomas (creative technologist working with ML); Mika Satomi (costume and interaction designer and lecturer at Weissensee University Berlin). For the proof-of-concept experiment we invited the following artists / workshop leaders to conduct the physical theatre aspect of the workshop: Matej Matejka (actor, theatre trainer, founder of Studio Matejka, Poland); Ditte Berkley (actor, voice coach, member of Teatr ZAR, Poland); Dr. Ilona Krawczyk (actor, voice coach and theatre scholar at the University of Huddersfield). The performers who

took part in the experiment were: Jie Liang Lin, Dimitri Cacouris, Luke Swenson, Saraï O'gara, Kate Ryan, Joana Chicau, Gabriel Almagro, Peter Hans Tommila.

In the second phase, the team composition has changed to reflect a more artistic-based process. The artistic research was led by: Dr. Diana Serbanescu, with the aid of the following artistic collaborators: Wenzel Mehnert (scholar expert in speculative fiction, world-building and new technologies); Mika Satomi (costume and interaction designer); Kirsty May Hamilton (performance artist, dramaturg interested in feminist speculative performance); Joana Chicau (interaction designer and choreographic coder); Dimitri Cacouris (production manager and performer, co-founder of REPLICA); Meredith Thomas (creative technologist, working with ML); Johannes Helberger (creative director for the sound design, director at kling klang klong); Lugh O'Neill (creative coder, sound artist); Emma Collauzzo (project assistant); Kate Ryan (performance artist); Saraï O'gara (performance artist); Angela Monaco (performance artist).

e. Detailed Timeline and Process

In agreement with the literature specialized on the ethics of AI, we believe that the first step towards building more ethical AI systems is that the building of such systems should be rooted in a self-reflexive and well-documented ecology of praxis. This section aims to give an overview of the stepping stones of our research. Our process had unfolded in iterative loops, one step building on top of the previous ones – as illustrated in the following table.

Phase I: Exploratory, Foundational
Step 1: Literature Review and Conceptual Positioning. In the first month the founding team has conducted literature reviews on the topics of interest for the project, with the goal of conceptually positioning our research interests and identifying a network of potential partners and collaborators. In parallel to this, we developed a visual identity for the project, including design sketches for our online platforms and templates for future communication. The information gathered in this step was used in all the follow-up iterations, when we reach-out for collaborations.

Step 2: The Council of Experts.

This took place on the 19th of June, and it was a 6 hours long transdisciplinary workshop moderated by our team members who – after giving initial impulses for introducing the project – led theatre and design exercises to engage the invited experts in conversations around embodied cognition, AI-design and performing arts. The objectives of this workshop were to create engagement in the topics proposed by the project, to come up with initial research questions and a research framework for a proof-of-concept experiment of 2 weeks in which performance arts training and technological design would be brought together in a laboratory format.

JUNE

council of experts
methodological framework,
research questions

Step 3: Prototypes.

The previous step was followed by a workshop on wearable computing and embodied cognition which then fed into rapid iterations of a prototyping process. The workshop was organised in collaboration with experts in wearable computing, creative technologies, and physical theatre. In parallel, we developed a methodology for qualitative data collection together with our invited research fellows with double backgrounds in performing arts and, respectively, anthropology and design.

Our quickly implemented methodological and technical framework was immediately put to use in the following month, when we conducted our proof-of-concept experiment.


JULY

wearable computing workshop,
data capture prototypes
& preparation of qualitative research

Step 4: Grotowski-based Psycho-somatic Training.

This step consisted of a 2 weeks long intensive theatre training, prototyping our vision of a laboratory for *embodied engineering* – in which the objectives were to observe how theatre techniques moderate human behaviour and explore the notion of embodied intelligence. In relation to this, we were interested in identifying aspects of the training which might inspire designs of AI-based systems, with the goal of enhancing participants' well-being, sense of empowerment and engagement. We also investigated the potential of the theatre workshop as a place for imaginative speculation and critique on technology. The workshop took place between the 12th and the 23rd of August 2019 in the locations of EDEN Studios, Berlin and Gusthof Sauen, Sauen.


AUGUST
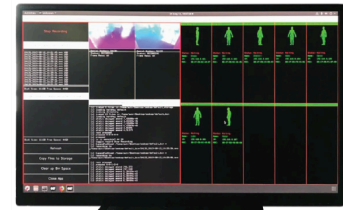
monitored theatre training
& data collection

Step 5: The Shape of Things to Come Symposium.

This took place on the 26th and 27th of September 2019 at the Weizenbaum Institute and had the main goal to bring all the potential partners under one roof, to give everyone the possibility to present their current projects and interests and to discuss the upcoming grant application as openly as possible. Our intention was to welcome those ready to embark on this adventure, to draft our common ideas and to prepare for the next step — the full grant proposal. The symposium was streamed online, and the online recordings are still available to watch. These are referenced in Annex B.


SEPTEMBER
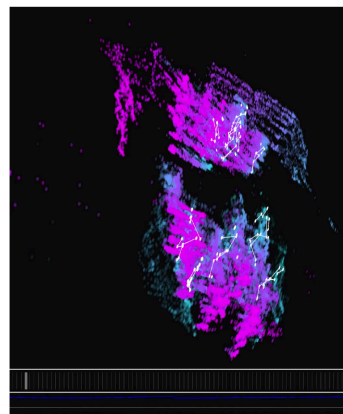
toolkits for data analysis
& symposium with new partners

Step 6: Full Grant Proposal.

This step concluded the first phase of the project. Our full grant application was submitted on the 17th of October 2019. In additional to the founding team the Full Grant Proposal was co-written and approved by collaborators such as:

Dr. Laura Kaltwasser (School of Mind and Brain, Berlin), Dr. Vesna Djokic (representing Dr. Rebecca Fiebrink, Goldsmith University London), Prof. Paul Allain (Kent University, Canterbury), Prof. Berit Greinke (University of the Arts, Berlin), Chris Julien (Waag AI Culture Lab, Amsterdam) – amongst others. At the end of this phase, we also had our first public presentation and performance at FUTURIUM, Berlin.


public outreach
& full grant application
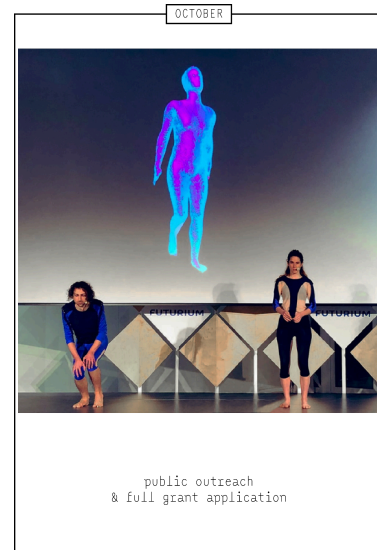
Phase II: Experiential AI, Knowledge transfer.

Step 1: Dancing at the Edge of the World – a speculative performance.

The second phase — organized with the remaining resources from the project — was built on our observations from Phase I. The goal of this phase was to create an experiential encounter with a performative AI artifact, in the context of a speculative dance-theatre piece exploring a feminist future with AI.

The first step in this process lasted several months and consisted in regular meetings of our creative team members. In these meetings we discussed source materials and explored different ideas around the topics of embodied cognition, situated knowledges, ethics of AI and feminist politics.

practice-based research,
building speculative performance
& AI-wearable artefact
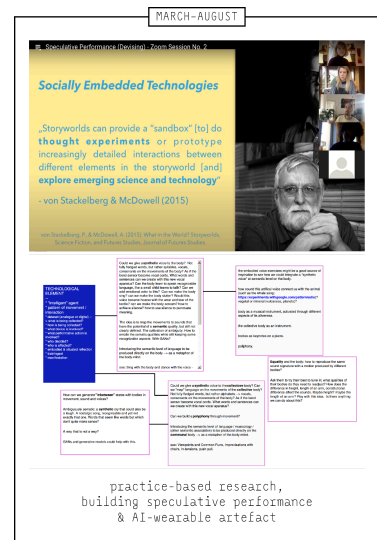
Step 2: Devising Performance & Wearable Artifact.

The source work and discussions from the previous step have crystallized around the idea of giving the body a voice, a voice that can flicker between articulate and inarticulate. This idea was also inspired from methods employed in the theatre training conducted in the first phase of the project – connecting physicality with vocal expression – known as embodied voice techniques. Furthermore, we took inspiration from early voice synthesizers, such as Voder (developed by Bell Labs in 1939). The result was a wearable device that maps the movements of the body to the vowels of the English language. The first prototyping sessions took place at EDEN Studios, Berlin.

SEPTEMBER-OCTOBER

first iterations in the studio,
building AI-wearable artefact

Step 3: Devising performance.

Throughout late October and early November 2020, we were granted a residency at the Berlin Open Lab (BOL) in the Berlin University of the Arts, which enabled us to continue our work on improving and developing the wearable device – alongside with devising the performative material – in their Mixed Reality Studio.

The sessions of physical improvisation were accompanied by critical reflections on the design and use of this technology and its potential implications.


OCTOBER-NOVEMBER

rehearsals in the berlin open lab,
testing AI-wearable artefact

Step 4: Public Outreach.

Our residency at the BOL was concluded with a filming of the performative material. Due to the strict restrictions during the COVID-19 pandemic, we were unable to organize the final performance with an audience in a physical space, as we originally envisioned. The filmed material was then broadcasted in the context of an event curated by the Hybrid Platform on the 18th of March 2021. Presented as "a piece of postdramatic theatre, a physical poem, a ballad of humans and machines", the piece was also accompanied by a discussion panel, in which our team of artists and scholars discussed the process and ideas behind this performance.

MARCH

dancing at the edge of the world:
broadcasted performance
& discussion pannel
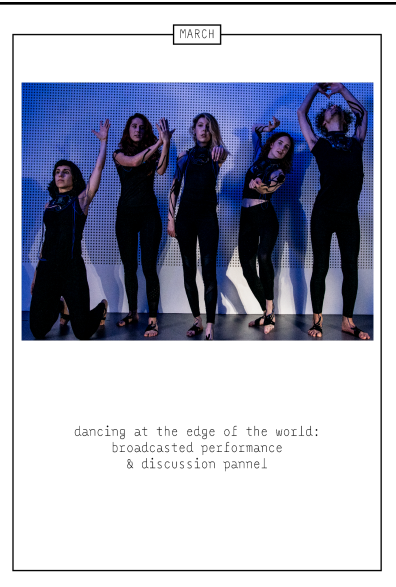
Resulting from this process are our methodological framework and our digital toolbox. A thorough description of these outcomes is attached to this report as Annex A.

f.   Public Outreach and Knowledge Transfer

Our project was thoroughly documented through photo and video recordings executed by professional photographers / videographers. Photographs, edited trailers, video recordings and video streams of our events have been made available on our online platforms – a list of which is provided in Annex B.
In addition to this, we have presented our work at national and international symposiums, conferences and festivals, as well as on various digital platforms in the format of interviews, podcasts and broadcasted discussion panels. Furthermore, we have organised a series of workshops and events promoting a transdisciplinary exchange on AI through theatre and speculative design. With the aim of engaging wider audiences, we produced 3 performances, one streamed online during COVID-19 and the other two taking place in physical locations. A more comprehensive list of these activities and results is provided in Annex C.

2.   Contribution to the specific goals of the funding initiative

The goals of the planning grant were *to enable the composition of a suitable project team, the identification of a connecting topic, and the preparation as well as formulation of a full proposal (full grant)* – all of which we've accomplished in the first phase of the project.
We believe that we have managed to build a strong team of collaborators (presented in Section 1.d) of complementary skills and transdisciplinary mind sets which helped us complete our milestones not only

successfully, but also in a timely fashion. As discussed in Section 1.e, for identifying a connecting topic with our collaborators as well as with our network partners we've employed an iterative process, starting with a literature review, and going through several stages of workshops, ideation, presentations and prototyping. Our vision of theatre as a laboratory for embodied experimentation with technology, invited other scientific disciplines to embed their lines of investigation in this format. The full grant proposal – which was successfully submitted, 7 months into the project – was the follow up of a successful 2 days symposium, in which our network partners came together and presented their ideas for future collaborations.

3. **Self-evaluation with regards to the original goals and planning (e.g. unexpected results; other content/methodical deviations)**

The goals that we set for ourselves in the context of this planning grant, and in addition to the ones required by the foundation, were *to organise 2 proof-of-concept workshops during which biometric data were collected from performers, to analyze the collected data and incorporate the results in the proposal for the full grant, to develop one interactive AI prototype usable for interaction in a performative context, and to present a performance on the topic of extended sensing and future societies to the public* – all of which were successfully accomplished, with the exception of the complete analysis of the quantitative data after the proof-of-concept experiment.

The reason for omitting this step was due to the fact that the time-span for the first phase of the project was too short for taking rigorous advantage of the amount of data that we had gathered. Throughout the process we started deviating from the data extractivist approaches from the beginning, and moved towards a more qualitative and self-reflexive process. Our attention focused more on documenting the ways in which our team shaped the processes – how decisions were taken, and how these shaped the technology we produced. We became more attentive at the potential biases that we brought as technologists, researchers or artists.

4. **Gaining knowledge through interdisciplinary and international collaborations**

These months spent collaborating within teams of scientists and artists have allowed us to identify the deeply-rooted need for transdisciplinary and practice-based approaches to AI. These build on participative and inclusive formats for knowledge generation through the co-creation and hybridisation of skills, and incentivise an active exchange within an ecology of interwoven practices and processes. Specific to our project was also the emphasis on a practice-based approach, an approach which — according to our international partners is more popular in the UK than in Germany. Thus, we've realized that our methodologies for research are not only discipline-specific, but also culturally situated.

In relation to this, we also recognised the need to ground further developments of Intelligent Systems with ethical guidelines, placing embodiment and culture at the centre of scientific inquiry and technological innovation. We believe that, from a landscape of diversity, and by encouraging projects such as this one, prominent patterns for best practices in AI and ethics might emerge.

5. Involvement of young scientists

Our team of collaborators and partners consisted of young, talented scientists and artists, amongst which academics from the Weizenbaum Institute for the Networked Society, Technical University, School of Mind and Brain and the University of the Arts, Berlin. In addition to our scholars and institutional members, we've also recruited in our team young artists working as freelancers – such Joana Chicau or Erika Koerner – who have decided towards pursuing PhDs in subjects tangent to the inquiries of this project and with academic supervisors they have encountered while working on this project; furthermore, one of the core members of the REPLICA team, Dimitri Cacouris, with educational background in creative writing and theatre, has consequently decided to pursue a degree in Mathematics at the Technical University in Berlin. In our workshops and symposium we also invited young researchers from our institutional networks – such as Weizenbaum or TU Berlin — in the hope that our transdisciplinary methods can inspire young PhD candidates to become more experimental in their research. In the context of the full grant application we envisioned positions suitable for young researchers to pursue academic degrees. All our researchers and collaborators have benefitted from our network of international academic and non-academic partners. During the symposium we have brought together senior scholars with young researchers, enabling young researchers to find inspiration and mentorship in fields of their interests.

6. Continuing perspectives and sustainable effects of the project

This project has brought together teams of artists and scholars, who – even after the funding had concluded – have continued working together in different constellations, furthering their research interests which were initiated in the context of the project. For example, in the context of a fellowship at the Weizenbaum Institute, Mika Satomi continued working together with Dr. Diana Serbanescu on the development of the motion-capture AI-based costume. This fellowship was organised as a practice-based research under the title *Embodied Voice, Ethics and AI*, and was conducted in collaboration with Prof. Scott Delahunta from Coventry University and 2 additional guest artists: Kate Ryan and Dr. Ilona Krawczyk. As a result of this collaboration, the team is planning the writing of a joint paper for a conference in Braunschweig on Intelligent Art and Human-Machine Interaction. After collaborating with

the REPLICA team in the context of The Shape of Things to Come project, Mika Satomi has continued pursuing collaborations with performers and she has been selected to take part in the LINK-MASTERS program with the project *Patterns in Between Intelligences*. Our creative technologists Meredith Thomas and Gilbert Sinnott, who started collaborating on this project, have continued working together in the context of theatre and AI, and have developed the technical solution for Regie:KI (2020), a D'haus production sponsored by the German Federal Cultural Foundation. Meredith Thomas is currently an artistic fellow with the Akademie for Theatre and Digitality in Dortmund. In addition to this, we've preserved ties with our institutional partners, such as Berlin Open Lab – and we have been invited to present our results in the context of events and symposiums organised there by the Wearable Department of the University of the Arts.

Last but not least, our vision for a transdisciplinary institute for performance art and AI-based technology is still alive and we are hoping to acquire the necessary funding towards achieving this goal in the future.

7. Other aspects (e.g. particularly favorable or inhibiting circumstances, cooperation experiences, integration into the scientific or institutional environment)

As other projects conducted throughout 2019 – 2020, The Shape of Things to Come was greatly impacted by the COVID-19 pandemic, especially in the second phase of the project. In order to achieve our goals from the planning grant – particularly our ambition to create a performative outcome, making use of a custom-made AI-based artifact – we asked for an extension of one more year, which was granted to us. Even with this extension, we had to alter our strategy and to conduct all the preparations and source work for the performance via zoom calls. Our work in the studio had to be reduced to the minimum, and these circumstances were not favorable for a project dealing with embodied interactions and physicality, where most ideas have to be tried out in space. Moreover, the process of building technological prototypes that integrate seamlessly with the performative work comes with its own challenges, such as the different timelines in the development of these elements, which might lead to asynchrony and points of disconnect. These challenges were then amplified by the asynchrony in attendance – members of the team needing to quarantine for safety reasons – and thus the quality time for embodied experimentation with technology had to be shortened even more. Also, the final performance was originally planned to be realized as an immersive experience for an audience sharing the same physical space with the performers. While this was no longer possible, we decided to film the performance and broadcast it online. However, the filming introduced a new layer of mediation and we felt that the interactive / real-time quality of our performative technology was lost in translation.

Another challenge we faced during this project was due to lack of institutional support with regards to the administration at the side of both our hosting institutions: Technical University Berlin and Weizenbaum Institute. In the first phase of the project Weizenbaum Institute itself was going through a transitory and foundational stage, which implied frequent moving of personnel. 4 months into the project we were left with no administrative assistant, and the vacancy spanned over a period of 2 months, exactly in a stage of the project that was very intensive and collaborative. This impacted our work greatly, especially the part concerning the analysis of data for our proof-of-concept experiment. Instead of focusing on the scientific aspect of our work, we had to focus on troubleshooting pending payments and administrative forms. We also noticed that the heavy bureaucratic formats employed by scientific institutions such as TU Berlin are not always suitable for small practice-based research projects, sometimes involving agile teams of numerous people – both academics and freelancers – and short term contracts. The fact that the administrative effort took such a big percentage of time and energy has sometimes lowered the moral and inhibited scholarly aspects of our work, such as publishing results, writing reports and attending conferences.

Last but not least, another experience worth mentioning is that of the perceived disciplinary divide between artistic and scientific practices, the tension between goal-oriented versus exploratory strategies, and the fact that practice-based research seems to be culturally more widespread in academia abroad (in countries such as the UK), than in Germany. While these were not inhibitory circumstances in themselves – in the context of the scientific and institutional environment – we sometimes felt we could not easily fit criteria developed for more traditional types of research.

Annex A— Methodological Framework & Digital Toolbox:

Methodological Framework

The overall project followed principles of practice-based research, combining both artistic and scientific approaches from different fields, such as: physical theatre training, engineering, ethnographic research, wearable and speculative design, performance making etc..

For the proof-of-concept experiment in the first phase we designed a transdisciplinary framework, employing a selection of qualitative and quantitative techniques, in order to translate embodied knowledge from physical theatre training — conducted by experienced theatre leaders, who we invited as expert

guests — into the digital and descriptive realm. The methods used during the training derived from the school of Jerzy Grotowski, focusing on achieving cathartic experience and group synchronicity.

For the quantitative approach, our technical team has developed custom-made tools such as: wearables for biometric data capture devices and bodysuits; a technical setup for a multi-camera field recording system making use of ZED cameras, for documenting the performative practices in the space; software for monitoring, synchronizing and visualizing incoming streams of data. For the qualitative research, interviews and field notes were taken by our ethnographer Wenzel Mehnert, who also designed templated journals for the participants. One example of such interviews is the interview conducted with Matej Matejka, which can be accessed at: https://vimeo.com/385865108/8db8cf4348. The qualitative and quantitative data we've collected are currently stored on a local and secured server, and holds the potential for further analysis.

Throughout the second phase of the project we've employed mainly a design-based, as well as devising performance praxis-oriented approach, which produced two artifacts: an AI-wearable and a performance piece.

Digital Toolbox / Technological Artifacts

Throughout this project we've already developed custom-made tools (hardware and software) that allow us to connect aspects of our physicality with digital media in various forms. They are not project- but practice-specific, and serve as adaptive toolkits for embodied data, movement capture and inter-medial composition. The table below lists the content of our digital toolbox.

Phase I: Proof-of-concept Experiment	
Custom Made Wearables:	
In collaboration with Meredith Thomas and Erika Koerner we've developed: 10 x Harnesses with a mini-computer for biometric data capture such as pulse, voice and acceleration. Mika Satomi has designed: 3 full body suits with bent sensors for capturing motion.	

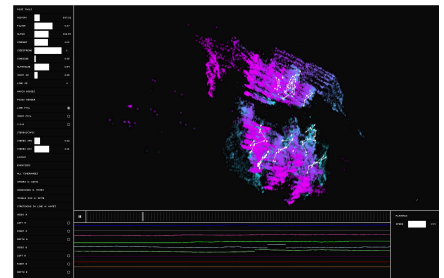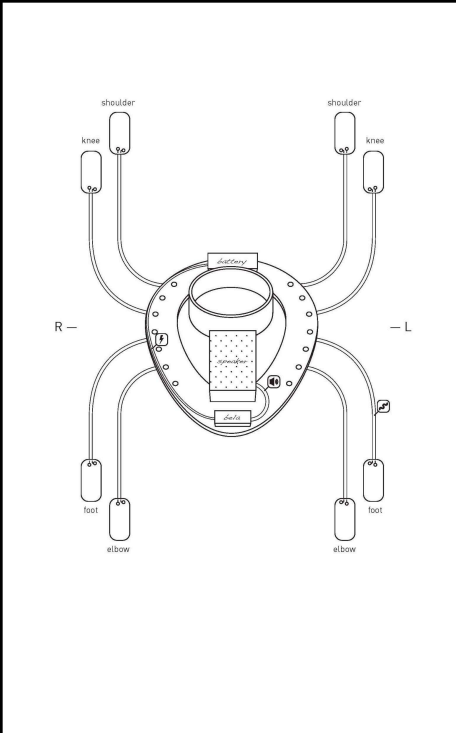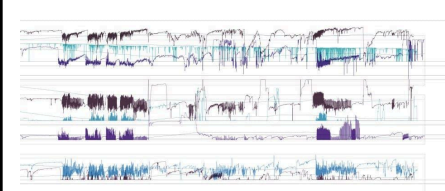|	
Gilbert Sinnott has designed a technical setup for a multi-camera field recording system making use of 2 ZED cameras and 2 logitech cameras to continuously record a depth map of 10 performers moving in a hundred-square-meter space without any occlusions.	
Custom Made Software:	
In addition to the wearable hardware, Meredith Thomas has also developed an interface for monitoring the connectivity of the computer on harnesses and bodysuits.	
In addition to the camera setup, Gilbert Sinnott has developed a prototype for visualising patterns of motion in space from video footage captured during rehearsals. This is a representation of movement complementary to the one before, focusing on the motions of the collective, rather than those of the individual.	
Phase II: Experiential AI	
Custom Made Wearable:	

|	
Mika Satomi has designed and developed 6 collars with the function of motion-capture and movement signification. The device is a collar, with bend sensors that can be attached to 8 points on the body. The sensor data is processed and gathered locally on a Bela board attached to each collar, and can be streamlined in real-time to a central unit through a wireless network. A speaker sits on the front of the collar, emitting sounds that can react to the position of the sensors - on how the performer moves their body. The software installed on each Bela board contains a ML-based module, used for mapping motion to sound. The sound emitted from the device was created in collaboration with Johannes Helberger and Lugh O'Neill from kling klang klong.	
These sensor data are lists of numbers, which can be visualised in various ways. These are examples of such visualisations, implemented by Meredith Thomas.	
Mika Satomi has also implemented the controller interface which connects to the Bella-boards on the 6 collars, and is capable of visualising the sensor data in real-time and of training the system.	
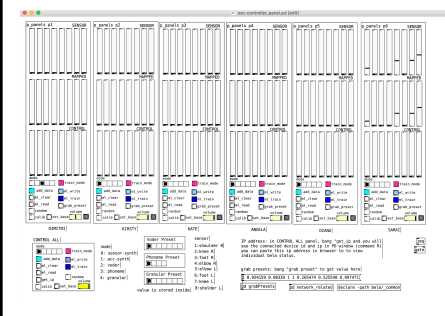
All the software for our custom-made technology can be found on our Github at: https://github.com/REPLICA-Collective-Rep

Furthermore, we also developed a Webpage for the project at: https://replica.institute/

Annex B — Photo & Video Documentation:

In addition to photo and video documentation available on the Webpage of the project – the following materials have been made available on our youtube and vimeo platforms:

REPLICA (2019) *The Shape of Things to Come – Theatre Laboratorium*. 12-23 August. Available at: https://vimeo.com/371160085, https://vimeo.com/650385242 (Accessed 30 April 2022).

REPLICA (2019) *Interview with Matej Matejka, by Wenzel Mehnert*. 12-23 August. Available at: https://vimeo.com/385865108/8db8cf4348 (Accessed 30 April 2022).

REPLICA (2019) *The Shape of Things to Come – Symposium*. 26-27 September. Available at: https://vimeo.com/371983157, https://www.youtube.com/watch?v=6w4BKGwxk9Q, https://www.youtube.com/watch?v=etWQYow4W_Y, https://www.youtube.com/watch?v=wmHsyqIUtw8, https://www.youtube.com/watch?v=qWYwwbFC-mI (Accessed 30 April 2022).

Hybrid Plattform (2020) *Hybrid Performance. Dancing at the Edge of the World*. 18 March 2021. Available at: https://www.youtube.com/watch?v=Nj4xrpGgW08&t=2268s. (Accessed 30 April 2022).

REPLICA (2020) *Dancing at the Edge of the World – In Rehearsals*. 15 September 2020. Available at: https://vimeo.com/693994820, https://youtu.be/nl4zuPivP1E. (Accessed 30 April 2022).

Annex C — Presentations at Conferences and Public Outreach:

Presentations:

Serbanescu, Diana. 'The Shape of Things to Come – New forms of communications between humans and machines' at Kunstliche Inteligenz*innen, FUTURIUM, Berlin 06 October 2019.

Serbanescu, Diana. 'The Shape of Things to Come – Rehearsing Future Societies with AI and Performing Arts' at VolkswagenStiftung's Kick-Off Symposium "AI and the Society of the Future"Hannover 7- 8 November 2019.

Serbanescu, Diana. 'The Shape of Things to Come – Embodied engineering, collective imaginaries, & Performing Arts' at Power to the people – THE ARTS+ Micro Conference, Frankfurt 10 October 2019.

Serbanescu, Diana. 'Embodied, Embedded – a Talk about Theatre and AI'. Invited Talk (online) presented at the AI Narratives virtual workshop, 17 September 2020. https://www.ainarratives.com/germany-2020.

Serbanescu, Diana, Ewelina Dobrzalski, Kirsty May Hamilton, Mika Satomi, Meredith Thomas, Johannes Helberger, Lugh O'Neill, and Kate Ryan. 'Practice-Based Research in Feminist Speculative Performance and AI. Dancing at the Edge of the World'. 18 March 2021. https://www.hybrid-plattform.org/en/events/hybrid-event/detail/hybrid-performance-dancing-at-the-edge-of-the-world.

Serbanescu, Diana. 'Embodied, Embedded – a Talk about Theatre and AI'. Invited Talk (online) presented at the Evening Lectures – Working Group on Philosophy of Technology, KU Leuven. 24 March 2021. https://hiw.kuleuven.be/wgpt/el.

Serbanescu, Diana. 'Dancing at the Edge of the World. A Practice-Based Research in Embodied Voice and Wearable Design', Berlin Open Lab Symposium 2021. 18 April 2021.

Serbanescu, Diana. 'Embodied Experimentation with AI, Experiential AI, Speculative Devices'. Lecture for the Interaction and Digital Technologies, Weißensee Kunsthochschule Berlin. 23 October 2021.

Serbanescu, Diana. 'The Shape of Things to Come: How to Build AI Tools to Enhance Real Human Connection and Become Radically Closer to Each Other', Symposium Künstliche Intelligenz und Theater, Düsseldorf Schauspielhaus. 27 October 2021.

Leeker, Martina. 'Performing AI. On Techno-Human Entanglements'. The Respectful Nettheatrechannel, 3 December 2021. Available at: https://www.youtube.com/watch?v=pC2HDEWpkZI (Accessed 30 April 2022).

Performances:

Serbanescu, Diana, Dimitri Cacouris, Sarai O'gara, Meredith Thomas, REPLICA, Walz Binaire (2019). *You, Me, Us, Then – An Incantation for a Build Body*. Kunstliche Inteligenz*innen, FUTURIUM, Berlin. 6 October 2019.

Serbanescu, Diana, REPLICA, et.al.(2020). *A Feminist Speculative Fiction Staged as a Hybrid Performance. Dancing at the Edge of the World (2020)*. Berlin Open Lab, Berlin. Performance presented online and curated by the HybridPlatform, Berlin. Inter-media Dance-theatre, 18 March 2021. Available at: https://www.youtube.com/watch?v=Nj4xrpGgW08&t=2268s (Accessed 30 April 2022).

Serbanescu, Diana, Kate Ryan, Angela Monaco (2022). *Dancing at the Edge of the World.* Performance presented at the Digital Gender Conference organised at Deutsches Hygiene-Museum, Dresden 23-25 March 2022.

Other Events:

Serbanescu, Diana, REPLICA (2019): 'The Shape of Things to Come – First Council of Experts – Initial Ideas and Research Questions' [Prototyping Workshop], Weizenbaum Institute, Berlin, Germany. 19 June 2019.

Serbanescu, Diana, REPLICA (2019): 'The Shape of Things to Come – Second Council of Experts – Workshop on wearable computing & embodied cognition' [Prototyping Workshop], Weizenbaum Institute, Berlin, Germany. 6 July 2019.

Serbanescu, Diana, REPLICA (2019): 'The Shape of Things to Come – Proof-of-concept Experiment' [Physical TheatreTraining], EDEN Studios, Berlin & Gutshof, Sauen, Germany. 12-23 August 2019.

Serbanescu, Diana, REPLICA (2019): 'The Shape of Things to Come –Symposium' [Symposium], Weizenbaum Institute, Berlin, Germany 26-27 September 2019. Available at: https://vimeo.com/373187682 (Accessed 30 April 2022).

Krawczyk, Ilona, Mika Satomi, Scott DeLahunta, Diana Serbanescu, and Kate Ryan (2021). 'Embodied (Voice) Research & An Invitation to Reflexive Design for an AI Wearable Device'. Workshop, Organisation und Moderation presented at the Embodied (Voice) Research & Critical Design for AI Wearable Device, Studio Niculescu, 12 November 2021.

Online Publications and Podcasts:

Serbanescu, Diana. Empowering citizens to become AI co-designers. VolkswagenStiftung, 30 April 2020. Available at:

https://www.volkswagenstiftung.de/en/news/news/empowering-citizens-become-ai-co-designers (Accessed 30 April 2022).

Serbanescu, Diana, Kirsty May Hamilton, Dimitri Cacouris, Joana Chicau, Kate Ryan, Sarai O'gara, Angela Monaco, et al.' *Practice-Based Research: Dancing at the Edge of the World – Exploring Feminist Future Imaginaries of AI and Wearable Design'*, 14 November 2020. Available at: https://berlin-open-lab.org/portfolio/dancing-at-the-end-of-the-world/ (Accessed 30 April 2022).

Litvinenko, Anna. 'Dr. Diana Serbanescu about Creative Participation in the Development of AI'. Podcast. Internet&Society, 18 May 2020. Available at: https://anchor.fm/anna-litvinenko/episodes/Dr--Diana-Serbanescu-about-creative-participation-in-the-development-of-AI-ee80oq?fbclid=IwAR1_wauf-OJi5W3uX2ZaWNbIuskFGmDWv0_st36oM36TgRRj9E9xlFCnh1Q (Accessed 30 April 2022).

Webpages:

Serbanescu, Diana, REPLICA 'The Shape of Things to Come – Field Experiments/ Practice-led Research/Proof-of-concept on wearable computing & embodied cognition & theatre practice', Berlin & Sauen, Germany 12-23 August 2019. Available at: https://replica.institute/ (Accessed 30 April 2022).