

STARTS Residency Public Report

Cyberspecies Proximity

Anna Dumitriu, Alex May, Martin Kusserow and Oliver Simmonds

Abstract The “Cyberspecies Proximity” project explores what it will mean to share our sidewalks, elevators and transport systems in close proximity with mobile intelligent robots. **Artwork:** The “Cyberspecies Proximity” robot combines the way-finding technologies used in delivery and maintenance robots with an ability to communicate and manipulate our emotions through body-language, embodied in a delicate humanoid form. **Methods and Procedures:** The work was built through deep collaboration with Schindler engineers and explores the notion of human and robot interaction and co-mobility. **Co-creation process:** The work was created through embedded residencies at the Schindler in Switzerland. **Impact:** The residency enabled the artists to work in new ways and use new technologies and be inspired in a world that they would never otherwise get to experience at the forefront of engineering and construction innovation with Schindler. The artists also participated in a well-attended and live-streamed talk event with the Chairman of Schindler. **Art-science relationships:** The artists were embedded in the New Technologies team at Schindler. The artists were able to work hands-on and were supported by expert engineers to develop the artwork and access state of the art fabrication technologies to help produce the robot. **Future Direction and Actions:** The next steps of the project are somewhat impacted by the COVID-19 Pandemic and closing of borders, however the artists will visit Schindler again in order to showcase the robot.

Index Terms: Robot, Future Cities, Body Language, Interactive, Engineering.

I. INTRODUCTION

CYBERSPECIES PROXIMITY is a new project exploring the future of human-robot co-mobility and issues of robot-ethics. The project was created by artists Anna Dumitriu and Alex May working in close collaboration with engineers and researchers at Schindler in Switzerland, through embedded residencies at Schindler.

II. ARTWORK

The “Cyberspecies Proximity” project explores what it will mean to share our sidewalks, elevators and transport systems in close proximity with mobile intelligent robots. The “Cyberspecies Proximity” robot combines the way-finding technologies used in delivery and maintenance robots with an ability to communicate non-verbally and manipulate our emotions through body-language, embodied in a delicate humanoid form.

The robot is able to move around an exhibition space using a predefined map created using SLAM technology combined with an Intel RealSense Tracking Camera sensor. It reacts and responds to the body language of audience members through a multi-

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layered face, skeleton, body and movement tracking algorithm connected to an Intel RealSense Depth Camera sensor. The artwork was programmed in C++ and FUGIO, the Open Source Visual Programming System created by Alex May.

The small and fragile humanoid form is dressed in the clothes of a worker; its frail and insignificant body reminds us of the social groups that will be most affected by future automation. The robot's head and hands are made from 3D printed grey PLA and it intentionally avoids categorizations of race and gender. There is extensive research into the relationship of robot appearance and social biases with the great majority of robots being white. The role of the robot is often related to gender bias also with personal assistant and care robots being predominantly 'female'. In "Cyberspecies Proximity" the artists have sought to problematize this issue within both the design and engineering communities and kick start debates on the unrecognized biases in common design practices.

The robot can be exhibited in a gallery or museum exhibition setting where it will roam around a predefined area using the Intel SLAM sensor to localize itself. It will look at the audience around it, using its RGB and depth cameras to search for poses, faces, bodies, movement and other interesting features using a combination of computer vision and machine learning algorithms working together as a hierarchical system for directing its attention and gaze. It will approach audience members and physically 'communicate' with them through movement, tilting its head, and responding to the poses of audience members with its own body language poses. The robot does not mimic or mirror the poses of audience members but rather recognizes the various 'meanings' of poses and then reacts with an appropriate pose of its own, from an extensive pre-defined library of poses and responses.

The artists have also been inspired by the methodologies of the construction industry and have developed a 'digital twin' of the robot, a virtual screen/wall-based version that can be exhibited in settings where a mobile robot is not practical. The digital twin is an accurate virtual model of the physical robot, created using the same 3D CAD assets used to build the robot, including precision models of all the motors in their various forms, the metal frame underpinning the form and the 3D designs of the head and hands. The digital twin also works with an Intel RealSense Camera sensor and uses exactly the same code base as the physical robot. "Cyberspecies Proximity: Digital Twin" version would also be suitable to be exhibited within an elevator space in the form of a performative (confined and time-limited) and interactive digital installation exploring human and robot interaction and co-mobility.

The project forces us to consider issues of ownership of public spaces as well as the broader ethical implications of how we design robots and behave towards them. The work challenges audiences to confront the technological, ethical, and societal questions raised by the advent of urban socially-aware robots.

III. METHODOLOGY

The project utilized a transdisciplinary methodology building on past experience and expertise gained by Dumitriu and May through other past projects. The artists began by immersing themselves in a series of meetings with the researchers in order to gain a strong understanding of the key issues in the engineers' research. They then began to create the robot design on site in close collaboration with the engineers and in discussion with Schindler, these discussions both in the lab and via a digital link inspired the ideas for the final creative work. The artists also undertook extensive research triggered by discussions with the engineers and researchers and together they had daily discussions and were also able to learn about and try out the forms of technology and learn about the issues that are central to the research being undertaken by Schindler. Particular attention was paid to the broader ethical implications and societal impact of the use of robots in our future cities and the technologies that underpin these innovations. Later the focus of the residency moved to the production of the project, which took place at the Schindler where the artists worked hands on with the engineers to create the robot and use CAD and fabrication facilities. They also engaged deeply with the team and with the workforce including senior management to create impact and engagement in the importance of art in technology settings.

The project did not aim to be a design solution, but took the form of a thinking tool to engage wide audiences in the future of human-robot coexistence as we begin to live and work in close proximity to robots. The artwork engages viewers on a deeply emotional level and draws in audiences from all backgrounds, ages and levels of expertise and creates a forum for discussion and debate.

IV. CO-CREATION PROCESS

Cyberspecies Proximity is a project by artists Anna Dumitriu and Alex May, created in collaboration with the Human Robot Co-Mobility Project of at Schindler.

The artists engaged with the engineers from Schindler over three visits to develop the project. The first visit coincided with the project kick off meeting and involved a tour of the facilities at the Schindler Headquarters in Ebikon including their industrial-scale workshop, apprentice training facility and high-end tooling and fabrication and in-depth introduction to the robotic research. The artists were introduced to the Schindler R.I.S.E robot (which automates the risky job of drilling the holes in the lift shaft for the elevator guide rails) followed by a visit to a construction site in Switzerland where the Schindler R.I.S.E. robot was first tested, and where a vast number of elevators were also being installed in the traditional way. There the artists learned about this process, the issues faced in installing elevators in such a complex location and received an introduction to the construction industry. The artists also visited Schindler's 'Showroom' on this trip, a facility filled with blue sky thinking and experimental projects such as a full dome projection of earthquake-proof hanging cities, as well as a demonstration of Schindler innovations such as destination control which improves the speed and wayfinding efficiency of buildings in a potentially button-free environment. During this visit they briefly met and saw a talk by Schindler innovator Paul Friedli who was a winner of the Golden Lion at the Venice Architecture Biennale for research into how communities evolved in the Torre David in Caracas, which was (at that time) the tallest vertical slum in the world.

The artists spent their second visit embedded at Schindler undertaking their own research and learning about the research projects being undertaken there by Schindler, including work with an elevator maintenance robot as well as work with drones. Additionally, the artists learned about SLAM (Simultaneous Location and Mapping) algorithms and Lidar methods of wayfinding for robots, as well as how to work with an Intel RealSense camera. We were also visited by Paul Friedli for an afternoon where we were able to discuss at length some of the future technologies he had been working with and also confront some of the potential ethical issues that might arise in a future cities filled with service robots. Dr. Friedli also discussed existing delivery robot installations in this field, particularly in the United States. The artists then returned to their UK studio to work on the piece and source the relevant materials.

For the third visit the artists worked with engineers and technicians at Schindler to significantly progress the robot build and test out the components they had purchased. They also joined Schindler representatives on a visit to ETH Zurich to learn about how the University's researchers might collaborate with Schindler in future. Working with the engineers they were able to create a precision design in CAD software for the robot's internal aluminium frame that fitted all the motors perfectly and they were able to work with Schindler workshop technicians who were able to precision tool the frame which was constructed during the period. The artists also participated in a successful talk panel discussion at the Schindler City Auditorium which was attended by several hundred participants and streamed on Facebook Live. As a final highlight, the artists climbed to the top of the iconic Schindler Test Tower and toured the elevator testing facilities and learn about the latest innovations in the field.

Finally the artists returned to their studio to complete the build of the robot and the digital twin. This process was interrupted by a work-in-progress STARTS exhibition at CENTQUATRE in Paris at the end of February 2020 during the beginning of the COVID-19 Pandemic in Europe and then completed after the event.

The STARTS Residency Days showcase event at CENTQUATRE in Paris went very well and the "Cyberspecies Proximity: Robot" was a popular addition particularly with local audiences and many international curators, including several we have worked with previously, visited the work and it is hoped that this will help in finding ways of disseminating the work further.

All subsequent visits and events, including returning to Switzerland and presenting the work with our producer/dissemination partner Waag Society in Amsterdam have been postponed until after the official residency period due to the closure of borders of the UK, Switzerland and EU countries. The artists and the team at Schindler have met online to discuss next steps for bringing the work to Ebikon as part of another event when borders re-open and the artists have also discussed the postponement of the event in Amsterdam with Waag Society and are awaiting a new date when the current situation improves.

V. IMPACT

A. Research Impact on Schindler

Engineering solves technical problems in a structured and systematic manner. The artists' residency was very different to what we are used to because there was no technical problem to solve. We were given the opportunity to openly exchange and work with artists who have a breadth of knowledge and a rich experience in robotic artworks and related artistic domains. This opportunity was to some extent very interesting but also challenging because we needed to invest time into our relationship besides the daily work.

Schindler robots help increasing worker's safety and health, and delivering higher quality and efficiency, e.g., in elevator and escalator factories or during the installation of an elevator at the customer's site. The topic of socially-aware robots and its application in the mobility context is for us a novel and interdisciplinary research topic which requires technical as well as non-technical expertise, e.g., in social and behavioural sciences. The more we explored the topic of robotics in mobility together, the more we were confronted with questions regarding user experience, social norms and behaviour. Even the topic of thousands of homeless robots appeared in one of our discussions, a dimension that we never thought about. Would they populate the sidewalks and block our elevators and escalators in the future, we asked ourselves? Research on co-mobility with robots shifted from a primarily technical challenge (how to navigate, how to execute specific tasks at speed) to a non-technical exploration (how and when to communicate, how should robots behave in an elevator, what could be the consequences).

As a result, user experience considerations and human-centred design have become an essential element of our future product development approach. Besides high-quality physical products, our future business will very likely put more emphasis on creating services that are much more broadly related to the elevator and socially-responsible technologies. The decline of traditional ownership of physical products, e.g., shifting from possessing robots to orchestrating specific robot services, will certainly be an important aspect to consider. For example, how can our elevators interact with and meet the needs of future human and non-human passengers?

During the residency and the introduction of the artists to the different domains within Schindler, we were reminded of how many professionals contribute visibly and invisibly to keep up global mobility, starting with service technicians and fitters to the researchers using machine learning and data-driven technologies to improve service and our products without ever touching an elevator. In that spirit, and with the inclusion of many different expert domains and backgrounds, we had the chance to involve the entire Schindler campus in a panel discussion on "Art, Innovation, and Society", hosted by the Chairman of Schindler. The panel discussion revolved around the impact of digital technologies on the future of human work, e.g., through robotization in its various forms. The panel was a truly unique opportunity to leapfrog company hierarchies and democratize feedback on how we can innovate differently.

Towards the end of the residency, we were able to link not only art and technology but also bring the topic to another area of future work: inclusion and diversity. The design of a robot is subject to decisions that eventually shape its perception, including gender expression. The robot would be an ideal embodiment or "tangible" platform to discuss and further create awareness about inclusion and diversity within the company.

We regret that we cannot follow up directly and host the artwork right after completion of the residency, but we are looking forward to welcoming the mobile robot artwork and its digital twin later this year. The COVID-19 pandemic showed us how important the physical and digital representation of work as well as art can be. The experiences from the residency and open-ended collaboration has hopefully also increased our resilience to uncertainty that will very likely increase in the future.

B. Artistic Impact

Working with Schindler has opened the artists minds to a completely different environment that they would never normally experience. Whilst the Schindler Innovation Lab was somewhat familiar, the environment of the Schindler Headquarters with their industrial-scale facilities and infrastructure gave the artists a fantastic perspective on the importance of the elevator industry and how inventions and innovations in this field have impacted how the cities we live in are designed, for example high-rise cities. The artists were also able to gain a strong understanding of the issues of building large-scale constructions and how robots can and will be used in the future.

Importantly, by working with the expert engineers at Schindler, the artists were supported to convert their 3D models in Blender to professional CAD software in order to produce the metal framework of the robot in the Schindler workshop. The artists noted that the precision is incredible and that they would never have been able to achieve this without working with the Schindler engineers.

The residency has given the artists time to develop new methods of interaction which are highly innovative. The robot's body-language does not mimic participants behaviours but instead stimulates interactions through movement, both in the robotic form itself and in its movement around the space which is controlled by a SLAM algorithm. The residency also enabled the artists to enter into a period of deep research around the ethical implications of robot design with close regard to racial and gender biases commonly found in robots.

The artists have completed two artworks, "Cyberspecies Proximity" a mobile robotic work and "Cyberspecies Proximity: Digital Twin", an interactive screen-based version that uses the same sensor and computer as the robot as well as utilizing the same codebase, which they plan to exhibit widely moving forward.

- There was a panel discussion with the artists, Nicolas Henchoz from EPFL+ECAL Lab and Silvio Napoli at the Schindler City Auditorium, this was streamed over Facebook live and had over 1600 views.
- The robot has been exhibited as work in progress at CENTQUATRE in Paris as part of the STARTS Residency Days

Due to the COVID-19 Pandemic the artists have been unable to physically exhibit the project further as yet however they have given online lectures featuring the project for:

- Art and Science students at Aalto University in Finland.
- The BioComputation Research Group at the University of Hertfordshire, UK.

VI. ART-SCIENCE INTER-RELATIONSHIPS

The artists have extensive hands-on lab experience gained through being embedded in science settings and they are experienced in creating their artwork as much in the laboratory as in the studio, combining robotics, digital technologies and expertise in visual arts. They also bring the tools and techniques of art into the lab and encourage collaborators to work and think artistically to open up a genuine cross-disciplinary dialogue. The Schindler Headquarters was a new environment for the artists and it was the first time that they worked in with engineers and in a construction industry setting. This proved to be very exciting as the facilities were state of the art and the engineers were working on blue sky experimental research and brought new perspectives to the artworks. Through this the artists also learned more about forms of value in innovation as well as gaining an insight into how blue-sky research becomes product innovation. The artists were also able to engage with senior management and given an opportunity to demonstrate the importance of involving arts in science and technology settings.

VII. FUTURE DIRECTION AND ACTIONS

The work now exists in a time when debates about the future of delivery robots and AI are becoming even more prescient. For example, past discussions on the risk of self-driving cars now must be balanced with the risks of infection from taxi driver to passenger and vice-versa. This also throws human-robot co-mobility into question as we now face the risk of catching infections from human delivery service persons who can catch and spread viruses over time. In contrast, a robot cannot catch and spread a virus, but can only be contaminated with virus particles (known as fomites) and can be made of materials that are antimicrobial such as copper (including 3D printed 80% copper material). This may be beneficial to explore in future healthcare settings also. This area of research is closely linked to Anna Dumitriu's past artworks in the area of infectious diseases and seems set for exploration.

The next steps for the project are to return to Schindler to showcase the project and hopefully to exhibit the work there in the new Schindler Visitor Centre. Due to the COVID-19 Pandemic many of our plans are on hold and we are awaiting the re-opening of borders across Europe before any venue/curator will commit to a date for exhibiting this newly completed work.

However, discussions have already taken place with the following curators/venues:

- Plans are being made to exhibit "Cyberspecies Proximity: Robot" and "Cyberspecies Proximity: Digital Twin" at Schindler Headquarters in Ebikon, Switzerland.
- "Cyberspecies Proximity: Robot" and "Cyberspecies Proximity: Digital Twin" will be showcased in a special event at Waag Society in Amsterdam in the Netherlands.
- The artists are in talks with curator Ine Gevers of Niet Normaal INT Foundation <https://www.nietnormaal.nl/> (who previously curated the major exhibition "Robot Love") with regards to exhibiting the work as part of the (Im)Possible Bodies Festival in the Netherlands. They have already had a Skype meeting and were planning to meet for the (now postponed) Waag Society event. She is particularly interested in exhibiting "Cyberspecies Proximity: Digital Twin"

- The artists are in talks with curator Sonja Schachinger of Proper Partner <http://proper-partner.net/> who is keen to bring “Cyberspecies Proximity: Robot” or “Cyberspecies Proximity: Digital Twin” and they have had a face to face meeting to discuss plans which the curator is now putting into action
- The artists have submitted the work to the Prix Ars Electronica 2020 in the Interactive Art Category.
- The artists continue to work with Lucas Evers at Waag Society (who was able to experience the work face to face in Paris at the STARTS Residency Days) to further disseminate the work.
- The artists will continue to work with Schindler to further disseminate the work.

VIII. CONCLUSION

A. Concluding Remarks

The residency and project have been extremely successful and aside from delays in the project due to the legal and contractual issues at the start and issues with final outcomes and events due to the closure of borders and lockdown caused by the COVID-19 Pandemic, we had no problems on either side and everyone involved found the project enjoyable, eye-opening, thought-provoking and productive. We are all grateful to the support for the project from STARTS.

APPENDIX

Appendixes, if needed, appear before the acknowledgment.

ACKNOWLEDGMENT

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Work designed by Anna Dumitriu and Alex May with the support of the VERTIGO project as part of the STARTS program of the European Commission, based on technological elements from Schindler, with the support of Stichting Waag Society