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Transhuman Expression Human-Machine Interaction as a Neutral Base for a New Artistic and Creative Practice

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Abstract

Transhuman Expression is an interactive room installation created by Liat Grayver in collaboration with the EU-H2020-ICT project weDRAW in the context of a Vertigo STARTS residency at the Casa Paganini - InfoMus reseach center of DIBRIS - University of Genova, Italy. Data captured via motion detection of visitors is analyzed, processed, and projected on large screens positioned in the exhibition area. The collaboration benefited, was built on, and furthered experiences that both the artist and the research team have had in ongoing work exploring convergence of artistic and scientific practices. Grayver's work in robotics-assisted painting gained new tools that can be integrated into the system she works with at the University of Konstanz, whilst Casa Paganini - InfoMus has acquired new perspectives on the range, scope, and scale of real-time, automated movement analysis. This paper reports about goals, methodology, and results of such a joint multidisciplinary activity.

CCS Concepts

• ***Human-centered computing*** → ***Interactive systems and tools;*** • ***Applied computing*** → ***Fine arts; Performing arts;***

1. Introduction

This paper describes the design and development process of *Transhuman Expression*, an interactive room installation resulting from the collaboration between artist Liat Grayver and the Casa Paganini - InfoMus research team, in the framework of the EU-H2020-ICT project weDRAW. The installation was co-created during the course of a residency funded by the EU-H2020-STARTS Vertigo program in September-December 2019.

Using motion detection, data processing and projections, the work investigates the relation between physical actions and their visual representation with the goal of creating a new artistic tool that can also be pedagogically re-purposed. Behavioral patterns are extracted from the physical actions of visitors to the exhibition space, analyzed, and projected in the room in real-time with the goal of encouraging them to become active participants in the exploration of this interactive and location-specific generative artwork. Further, and with particular relevance to school children, the work assists in the perception of basic mathematical principles, which could be rewarding in terms of their learning paths, and at the same time be helpful in encouraging teachers to not evaluate their students' work as "good" or "bad", but rather to better understand the structure of thoughts behind it. More broadly, the work reflects on pedagogical aspects of how we learn from and process received information, stimulating us to re-evaluate our own learning methods.

The paper is organized as follows: Section 2 presents some related work, Section 3 introduces the artwork, Section 4 presents the methodology we adopted to design and develop it with a particular focus on the co-creation process, and Section 5 concludes the paper with perspectives for future work.

2. Related work

Transhuman Expression investigates aspects and exploit technologies related to two major areas of human-computer interaction: affective computing [Pic97] and social signal processing [BMPV17]. The artwork primarily addresses analysis of expressive qualities of human full-body nonverbal behavior, with particular focus on movement. This is an area which has received a growing interest from the research community and that produced promising scientific and technological results (e.g., see [KB13][KSG*13] for a survey). The artwork also explores social interaction in small groups of visitors, by analyzing and visualizing features realted to proxemics and coordination (e.g., see [CPV*11] for an early computational work on proxemics and [DCM*12] for a survey on methods for automatic measurement of interpersonal synchrony).

Several experiences of cross-fertilization between science, technology, and the arts bear witness of the benefits that scientific and artistic research get from interdisciplinary collaboration. In the areas of affective computing and social signal processing, for exam-

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ple, Alaoui and colleagues [ABJ15] developed an interactive installation featuring the analysis and visualization of movement qualities; the artistic performance *tanGO – Touching Music* represented and visualizeed social behavior phenomena through the interaction of four dancers with an automatic analysis system [CCF*11]. Activities at Casa Paganini - InfoMus are at the intersection of art and technology [CV16]. Collaborations with artists date back to the early interactive technologies developed for Italian composer Luciano Berio (e.g., for *Outis*, Teatro alla Scala, Milan, 1996, and *Cronaca del Luogo*, Salzburg Festival, 1999), which produced the requirements for the EyesWeb hardware and software platform [CHR*00][VAC*16]. More recent research on automated analysis of movement qualities was carried out in collaboration with Italian choreographer Virgilio Sieni and resulted in four public performances in Genova (*ATLANTE DEL GESTO_Genova*, 2017).

Liat Grayver's artistic work in recent years has increasingly involved collaborations with scientists, technologists, and art theorists and practitioners. Since 2016, the artist has been collaborating with Prof. Oliver Deussen (e-David project, Visual Computing Group, University of Konstanz) on the use of robotics as a painterly tool. Complementarily, in order to collect information and investigate parallel contemporary researches relevant to her cross-disciplinary artistic research and practice, she has communicated and worked with MIT's StartLab and Tel Aviv University's Curiosity Lab. The room installation she developed in 2018, *Traversing the Threshold* (Figure 1), was comprised of robotics-assisted calligraphic works made with contributions by computer scientist Marvin Gülzow (e-David Project) alongside video works made by and in collaboration with media artist Marcus Nebe. This project stretched into and exposed the temporal and physical space of the artist's creative process through the mediums of painting and video.

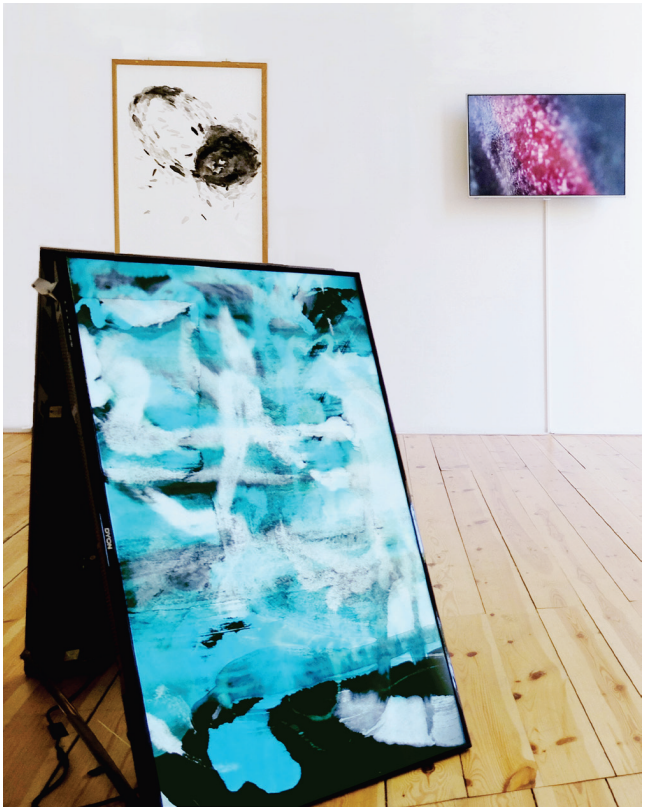

Figure 1: *Traversing the Threshold at Exgirlfriend Gallery Berlin, 14 July - 4 August 2018. © Liat Grayver.*

3. Artwork

The interactive room installation Transhuman Expression examines and reflects upon the artistic potential of the structure as well as the experience of the medium of painting positioned within the context of contemporary technological innovations. Methods of information visualization in the post-digital age constitute a key focus. In recent works, the artist explored the act of creating a painting from the perspective of its most primordial act – the process of committing a singular brushstroke to canvas or paper. See, e.g., Traversing the Threshold (2018), notably the freely hanging rice paper and ink works [Gra]. The identity indicators of such artworks are located and perceived within the experience of understanding the artistic and production process, rather than externally represented as a singular artistic object. In Transhuman Expression, a similar approach to the exploration of the creative process is extended into open space using advanced technological means – here, the canvas is replaced with a room of variable size and the brushstrokes with visitors to the installation work (see Figure 2).

In its current form, the work results from the convergence of several concepts in which the artist employed robotic technologies, motion tracking, video art, printmaking, and painting. As a whole, the artwork investigates the relation between physical, human-level activities and machine-based systems, both of which act – within a feedback system – synchronously upon each other via structures built using data extracted from the physical actions of participants (visitors) in the exhibition area. Participants are fitted with motion-tracking sensors before entering the exhibition space. Once inside they are free to move about as individuals or to interact with other visitors. The computer system analyzes the movements and evolution of both individual participants and group dynamics, and continuously captures data relating to these actions. The data is processed and visualized according to different rules of representation defined by the artist in collaboration with researchers. The entire process takes place in real-time (as it occurs "on stage"), i.e., participants see the live video projection (output) that results from their actions (input). They are free to explore and examine how they become part of a larger structure of situations and constellations: how their own movement, in relation to the space and to other participants, shapes the visualization (see Figure 3).

Using motion tracking and analysis, pre-defined characteristics of temporally based physical activities can be digitally recorded as they occur in a given space (gallery, theater, hallway, or outdoor square), and this data can subsequently be extracted, decomposed, and recomposed into the material world in the form of a new artwork. As this process is made visible to the participants, it translates into an artistic experience that assists them in the discovery of patterns and structures, the perception of which can help augment their understanding and appreciation of artwork in general.

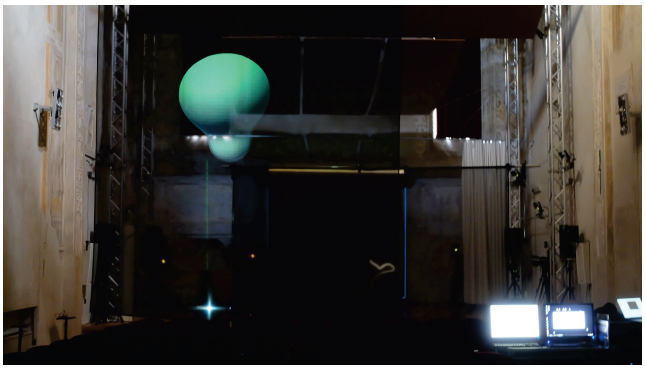

Figure 2: *Transhuman Expression at Casa Paganini (Genova, Italy) in December 2018. © Liat Grayver.*

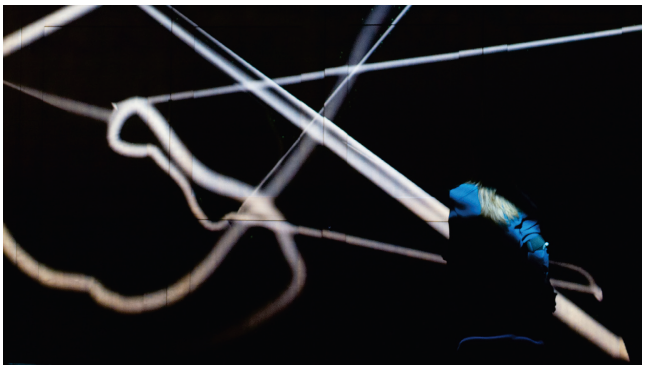

Figure 3: *A visitor experiencing Transhuman Expression at Casa Paganini (Genova, Italy) in December 2018. © Liat Grayver.*

4. Methodology and co-creation process

An iterative development cycle for the artwork involved participants with different background, including the artist, researchers in computer engineering, a group of children, and six master's students in Digital Humanities at the University of Genova.

The first two months involved continuous exchange of information between the artist and the computer engineers in order to familiarize each with the other's work, experiences, and skill sets, and to conceptualize the artwork itself. Initially, the artist presented her ideas and artistic concepts and computer engineers presented the available technologies. As an exploratory work, the artist used a video of two dancers provided by the engineers to extract and reduce motion data into visual representation as a means to investigate movement as a medium. Through the collaboration of computer scientist Antonín Šulc (University of Konstanz), three motion analysis programs were created to track simple parameters such as velocity, distance, and direction, each describing a different interpretation of the time-based perspective on the changing situation when the artwork is running. Brainstorming sessions followed that helped progressively converge the artistic and technological ideas, taking into account conditions such as an extremely limited timeframe and seeking to maximally exploit existing resources in service of the evolving concept of the artwork. In order to adjust to unanticipated time restrictions, it was decided very early to focus efforts primarily on the development of the visualization system for the live movement tracking, and to relegate initial plans for more extensive exploration of pedagogical applications to a future stage of research and implementation.

For the second stage, a group of children from a local school was invited by weDRAW to participate as an audience and test group. Movement analysis was used to structure easily comprehensible visual concepts for these young collaborators: lines (trajectories) and forms (grouping). This created a reductive link between time- and location-specific physical acts (movement) and their visual representation (at the moment digital) as a platform to explore structural elements in a controlled environment (see Figure 4).

The third stage was concentrated on the final technical and structural development. The research team created the technology and the system architecture for the artwork. The visualization platform used EyesWeb to track the visitors' movements, to compute movement features, and to generate multisensory feedback; data from a thirteen-cameras Qualysis motion-capture system was used for this purpose. The artist conceived and coordinated the construction of the physical installation (scaffolding, screens, cameras, and so on), which comprised three projectors, each assigned one of the three different visualizations to project on three large, transparent black screens hung in the exhibition space. This approach arose out of Grayver's recent practices exploring layering of materials and using transparency and light as artistic materials. The projected images are thus visible from both sides as well as on the frescoed walls beyond the screens (see Figure 5).

The final interactive installation was featured at the end of the residency in a public exhibition at Casa Paganini (December 20, 2018). Six master's students in Digital Humanities were invited to contribute to the project. They were asked to develop a separate work for the exhibition that would be positioned at the installation's entrance. The integration of this Kinect-based digital work in the exhibition was supervised by the artist and transformed the visitor's movements into trajectories, thus serving as an introduction to the installation. During the exhibition the students greeted visitors and introduced them to and prepared them for their experience with the works. Prior to the exhibition they had also taken on the tasks of creating and distributing online and print publicity.

5. Conclusions

The residency undertaken at Casa Paganini was ultimately a very fruitful arts and sciences collaboration that succeeded in defining and exploring common ground for artistic and scientific research and practice. The artwork was well received by a very curious public attending the final exhibition. The interest by the users was most encouraging and we look forward to being able to build on the flexible framework developed during the residency to present this and related work to other audiences. Since the beginning, the artwork has been indeed conceived as a "modular" interactive room installation so that components can be added or removed, and the entire work scaled according to the individual needs of future venues. It can thus easily travel to be presented in other cities and locations. Indeed, fragments of the work are already set to feature in

Figure 4: *The first prototype for Transhuman Expression, involving a test group of school children in November 2018. © Liat Grayver.*

Figure 5: *Transhuman Expression at Casa Paganini, (Genova, Italy) in December 2018. © Liat Grayver.*

upcoming exhibitions the artist has scheduled for 2019 and 2020. These include Jüdisches Museum Berlin (June 2019), Kunstraum Kreuzlingen (Switzerland, November 2019), Centre Pompidou as part of the Vertigo STARTS 2020 exhibition (Paris, March 2020), and Richentalsaal (Konstanz, spring 2020). Future instances of the project would require more time for adjustments and development than was possible in the present context. That said, and despite the limited forays we were able to make (for the same reason), we remain very optimistic about the broader pedagogical relevance, applications, and potential of the project, and look forward to exploring this aspect of the artwork more extensively in future iterations.

6. Acknowledgments

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