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Digital interactive art in public space

and the effect of public art on the community

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Index

RÉSUMÉ

La technologie joue un rôle clé dans notre vie quotidienne. Et comme cela fait partie de notre vie, c'est aussi un moyen d'expression pour des nombreux artistes contemporains. Depuis plusieurs décennies, la science a été connecté activement aux technologies numériques. Le nombre de scientifiques qui utilisent des environnements virtuels et de la technologie numérique en général, pour réaliser des expériences, ne cesse d'augmenter. L'effet de l'art sur la santé physique et mentale d'une personne mais aussi sur la communauté a également été le thème principal de nombreuses expériences et recherches scientifiques. Cette thèse porte sur l'art numérique interactif en particulier et sa possibilité de faire partie de l'espace public. Les principales questions auxquelles on va répondre sont les suivantes: Qu'est-ce que l'art public et l'interactivité? Pourquoi l'art est-il important pour la communauté? Comment pouvons-nous faire une installation numérique interactive ouverte à tout le monde? Quelques exemples pratiques d'art numérique interactif sont proposés, réalisés et présentés dans l'espace public dans le seul but de cette thèse.

ABSTRACT

Technology plays a key role to our everyday life. Since it is a part of our lives it is also a way of expression for many contemporary artists. For many decades science has been actively connected with digital technologies. The number of scientists who use virtual environments and digital technology in general, to perform experiments, keeps increasing. The effect of art on a person's physical and mental health but also on the community has also been the main theme for many scientific experiments and researches. This thesis focuses on interactive digital art in particular and its possibility to be part of the public space. The main questions that will be answered are: What is public art and interactivity? Why is art important for the community? How can we make an interactive digital installation open to everyone? A few practical examples of digital interactive art are described that were made for the sole purpose of this thesis and that were presented in public space.

INTRODUCTION: THE WHY

For those who have set aside a science that serves people, like doctors, nurses, psychologists and social workers, in order to pursue a career in the arts, it is unavoidable sometimes to experience feelings of guilt because of their choice. The great Russian surgeon and first Stalin prize winner, Luka Vojno-Yasenetsky, had the same dilemma in the beginning of his career, at the end of the 19th century. He, on the contrary, left his studies in fine arts to study medicine for the sake of humanity.

When I decided to change path from psychology to the arts, I experienced the same dilemma. It is personal fulfilment versus social benefit. My decision seemed selfish but I thought that I could still be useful and help people through art, if only I could find the way. I believed that an artist could become almost as important as a doctor, only in a different way. To some this equation sounds almost like "blasphemy" and it is understandable, but during difficult times people turn to art to find some form of encouragement and consolation. Ionesco in a lecture in 1961 highlighted the usefulness of art:

> "Modern, universal man is man in a hurry, he has no time, he is a prisoner of necessity, he does not understand that a thing need have no use; Nor does he understand that fundamentally it is the useful thing that can become a useless and overwhelming burden. If one cannot understand the usefulness of the useless, and the uselessness of the useful, one cannot understand art; and a country in which art is not understood is a country of slaves and robots, a country of unhappy people, who neither laugh nor smile, a country without mind or spirit; where there is no humour, where there is no laughter, there is anger and hatred."[1]

Someone might think that Ionesco's opinion on the importance of art might be exaggerated, but the truth is that there is no society in which there is not some kind of art present. This fact indicates the importance of art for human life. Sciences like psychology, sociology and medicine have been examining for decades the way the arts can affect a person's physical and mental health and furthermore how can art influence and affect the community.

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1   Ordine, The Usefulness of the Useless, 70.

THE IMPORTANCE OF ART FOR THE COMMUNITY

How can the environment affect our psychology?

Most of us have experienced a change of mood when the weather is gloomy or when we walk through an ugly neighbourhood or an industrial area. Environmental psychology is an interdisciplinary field of psychology that examines the interaction between people and their surroundings. The term environment includes natural environments, social settings, built environments, learning environments, and informational environments.[2]

Many experiments have demonstrated the effect that the environment — urban or natural — can have on humans. Research findings prove that stressed people feel significantly better after seeing nature scenes rather than urban scenes without natural elements. The main effect of the urban scenes was to increase the feeling of sadness.[3] In a more recent experiment, Meyer-Lindenberg et al. scanned the brains of the participants while they were doing a stressful task. The study showed that two of the activated brain areas were associated with the volunteers' history of living in a city. In particular, the amygdala, the part of the brain that processes emotion, was activated only in people who were living in a city. At the same time the cingulate cortex, the part that helps regulate the amygdala and handles negative emotions, was more activated in those brought up in cities.[4] This study shows the long term effects that the environment can have on our brains.

Urban Realities Laboratory at the University of Waterloo[5] has been carrying out psychological research on the streets of big cities, from 2011 to 2013. During this research the participants' psychological state was observed while they were walking in the city streets. The study indicated that many aspects of the urban environment affect significantly our emotions and influence our attraction to particular areas. Long, featureless facades caused feelings of unhappiness and boredom, while areas such as green space or a quiet courtyard, leaded the participants to experience positive feelings.[6] Another study in 2017 that used virtual environments, showed that most people feel better in rooms with curved edges and rounded contours than in sharp-edged rectangular rooms.[7] Accordingly, we

2   Australian Psychological Society, "What Is Environmental Psychology?"
3   Ulrich, "Visual Landscapes and Psychological Well-being," 17–23.
4   Meyer-Lindenberg et al., "City Living and Urban Upbringing Affect Neural Social Stress Processing in Humans," 498–501.
5   University of Waterloo,"Urban Realities Laboratory: Publications."
6   Ellard and Dzebic, "The Psychology of Architectural and Urban Design: Sensor-Based Field Methods Based on Guided Walks."
7   Shemesh et al., "Affective Response to Architecture – Investigating Human Reaction to Spaces with Different Geometry," 116–25.

can say that the structure and the visual characteristics of the space we live in affects our body functions and our feelings.

Works of art are often part of our vital space, either public or private. Art in public spaces in particular, affects the `sense of place' of public spaces and can become a landmark that attracts visitors or even a place for social bonding. A study by Kelson, Phinney and Lowry examined how Paul's Club, a social recreation group for people with young onset dementia, experience the public art they see on their daily strolls in the city of Vancouver, Canada. The results of the analysis suggest that public art helps members navigate urban spaces. What is more, it incites their curiosity leading to social interaction and site inspired conversations, contributing to group enjoyment and a sense of belonging to a community.[8]

The benefits of art to individuals and the community.

Art engagement has been considered for long as a factor for promoting social inclusion and public health. Many scientific papers evidence that participative arts can have a positive impact on health.[9] For example, several epidemiological studies in Scandinavia[10] have demonstrated the positive effect of cultural engagement on perceived physical health. Participation in some kinds of cultural events seems to also have a beneficial effect on longevity. Yet it is not clear if there is a causal link between attendance at cultural events and longevity. Perhaps people who can attend social events live longer because of socioeconomic factors. Or perhaps psycho-social factors and emotional states -including those caused by interaction with art- influence the progression of infectious autoimmune, and neoplastic diseases. These relations are being examined by Psychoneuroimmunology.[11]

What is already proven is the relation between attendance to cultural events and the reduction in the levels of blood pressure and the hormonal benefits.[12] Music is found in several studies to reduce stress[13] and the perception of pain.[14] It was also found to reduce the perception of nausea in patients

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8   Kelson, Phinney, and Lowry, "Social Citizenship, Public Art and Dementia: Walking the Urban Waterfront with Paul's Club."

9   Staricoff, "Arts in Health: A Review of the Medical Literature."

10   Bygren, Konlaan, and Johansson, "Attendance at Cultural Events, Reading Books or Periodicals, and Making Music or Singing in a Choir as Determinants for Survival," 1577–80; Bygren et al., "Cultural Participation and Health," 469–73; Cuypers et al., "Cultural Activities and Public Health," 6–26; Bygren, Konlaan, and Johansson, "Visiting the Cinema, Concerts, Museums or Art Exhibitions as Determinant of Survival," 174–78; Bygren, Johansson, and Konlaan, "Sustaining Habits of Attending Cultural Events and Maintenance of Health," 229–34.

11   Ader and Cohen, "Psychoneuroimmunology: Interactions between the nervous system and the immune system," 99–103.

12   Bygren et al., "Attendance at Cultural Events and Physical Exercise and Health," 316–19.

13   Knight and Rickard, "Relaxing Music Prevents Stress-Induced Increases in Subjective Anxiety, Systolic Blood Pressure, and Heart Rate in Healthy Males and Females," 254–72.

14   Taylor-Piliae, "Review: Music as a Single Session Intervention Reduces Anxiety and Respiratory Rate in Patients Admitted to Hospital," 86; Zimmerman et al., "Effects of Music in Patients Who Had Chronic Cancer Pain," 298–309; Beck, "The Therapeutic Use of Music for Cancer-Related Pain," 1327–37; Schorr, "Music and Pattern Change in Chronic Pain," 27–36.

who were under chemotherapy treatment.[15] Not only music has a positive effect but also visual arts. The perception of pain and stress was found to decrease in people who had blood taken in a room with visual art compared to those in a room with no visual arts.[16]

Nevertheless, the beneficial role of art doesn't end in physical well-being. Many arts organizations run participative arts programs for various underprivileged groups. For example, in 2013 the Australian Standing Council on Health in its report on a National Arts and Health Framework, stated that their commitment was to promote positive mental health through improved communication, self-expression and self-esteem.[17] This was to be implemented through collaborations that would enable access to the arts in both community and health care settings. In another Australian city, Victoria, the Art for Health program was designed for people whose self-image and community perception was damaged or unstable.[18] The benefits of participation in community art projects were among others: social connectedness, development of positive relationships and connecting diverse communities.

Strong evidence from research suggests that arts-based activities have a positive influence on mental health. Art galleries are progressively cooperating with health service users and health institutions. Shaer et al. created art-viewing and art-making groups at the Tate Britain Gallery in London for people with mental health problems and their caretakers. Caretakers and patients used the art works in Tate Britain and self-created pictures, as a means of communicating their experience with others who had similar conditions. The program seemed to help the participants. The positive aftereffects were the increased sense of social inclusion and the improved communication as the gallery space favoured the expression of difficult thoughts and feelings.[19]

The positive effect of art on people with mental health problems is documented in other studies as well. Various studies on people with dementia showed that cultural activities helped them improve their social, mental and psychological well-being[20], to increase their confidence, enthusiasm, enjoyment, and social contact[21] and to decrease depression[22]. The memories of people with dementia appeared to be stimulated during an art-viewing session at the National Gallery of Australia, compared to a different environment.[23] Another study reported that visual art and live music significantly

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15 Standley, "Clinical Applications of Music and Chemotherapy," 27–35.
16 Palmer et al., "The Effect of Art on Venipuncture Induced Stress."
17 Australian Standing Council on Health,"National Arts and Health Framework."
18 VicHealth,"Creative Connections: Promoting Mental Health and Wellbeing through Community Arts Participation," 30.
19 Shaer et al., "The Role of Art Therapy in a Pilot for Art-Based Information Prescriptions at Tate Britain," 25–33.
20 Rentz, "Memories in the Making," 175–81; Kinney and Rentz, "Observed Well-Being among Individuals with Dementia," 220–27; Roush et al., "Using the Arts to Promote Resiliency Among Persons with Dementia and Their Caregivers," 105–20.
21 MacPherson et al., "An Art Gallery Access Programme for People with Dementia," 744–52.
22 Musella et al., "Visual Art Improves Communication and Behaviour of AD Patients.," 15–20.
23 MacPherson et al., "Art Gallery Access," 744–52.

dropped the levels of anxiety and depression of patients having chemotherapy.[24] Cognitive and affective procedures take place while we are viewing art and as a result we experience a cognitive and emotional reaction.[25]

Moreover, art is not only significant for individuals, but also for social groups. Community psychologists explore the quality of life of individuals within groups, institutions, communities, and society. Their objective is to upgrade the quality of life through research and certain actions.[26] A community is defined as any set of social relations that are bound together by a sense of community.[27] However, community does not have geographic or sociographic limits.[28] The boundaries of communities, lie in the meanings which people give to them.

The effect of the community on the physical and mental health of its members is also proven. Research in social sciences has shown that the social structure of community can prevent or contribute to mental illness in many ways.[29] Dunne proved that the boost of community can be therapeutic for socially marginal people.[30] Moreover, Berkman and Syme conducted a nine-year study in a California county that eventually showed that people who lacked social and community ties were more likely to die.[31] Another study has proved that informal social control in strong communities can help significantly in crime prevention.[32] The participation of community members in collective problem-solving, through social structures such as the neighbourhood, the family, church, voluntary associations, schools, and the workplace is of paramount importance.[33] A healthy community can overcome social, psychological, and physiological problems and help its members to develop their potential.

The creation of social spaces, the urban planning or the incorporation of art in public space aiming to facilitate interaction and human connection, to promote conversation and fight feelings of isolation in the big cities, can boost citizen's mental health. The Center for Urban Design and Mental Health (UD/MH), an independent research collaborative, is working towards that direction. UD/MH recognizes the importance of mental health, stating that:

> "good mental health can improve our enjoyment, coping skills, and relationships, our educational achievement, employment, housing and economic potential, help reduce physical

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24 Staricoff and Loppert, "Integrating the Arts into Healthcare: Can We Affect Clinical Outcomes?," 64.
25 Leder et al., "A Model of Aesthetic Appreciation and Aesthetic Judgments," 489–508.
26 Kloos et al., Community Psychology.
27 Chavis and Newbrough, "The Meaning of 'Community' in Community Psychology," 335–40.
28 Cohen cited in Waterton and Smith, "The Recognition and Misrecognition of Community Heritage," 8.
29 Faris and Dunham, Mental Disorders in Urban Areas.
30 Dunne, "Sense of Community in l'Arche and in the Writings of Jean Vanier," 41–54.
31 Berkman and Syme, "Social Networks, Host Resistance, and Mortality," 186–204.
32 Greenberg, Rohe, and Williams, Safe and Secure Neighborhoods.
33 Berger and Neuhaus, To Empower People: The Role of Mediating Structures in Public Policy.

health problems, ease healthcare and social care costs, build social capital, and decrease sui-cides."[34]

A study by Newbury et al. has shown that growing up in a city doubles the chances of children to de-velop schizophrenia. It also increases the risk for other mental disorders such as depression and chronic anxiety. The explanation they give is the low social cohesion and crime victimization in the neighbourhood.[35] The lack of social bonding and cohesion in neighbourhoods is what researchers call "social stress". Social interactions that are necessary for mental health are not promoted in cities. The sociologist William Whyte, advised urban planners to arrange objects and artefacts in public spaces in ways that brings people physically closer and that way increase the probability of communication between them. He called this process "triangulation".[36]

Art can play a significant role in bringing people together and decreasing "social stress". It is also im-portant to increase the opportunities for individuals in disadvantaged communities to interact with art. This is almost of vital importance for groups of people who experience social exclusion because of health problems or ageing. According to Zebracki:

> "Public art encounter may implicate a pedagogical process crucial to making contact with the 'other' and to see, embody and organize the everyday living environment from different and reciprocally challenging vistas. Thus, public art can provide agency to mediate social dif-ferences and relationships..."[37]

Art programs can promote a sense of belonging to the community, help people develop social net-works and fight social stigma.[38] A study by Howells and Zelnik showed that making art helped the par-ticipants build new identities and roles, and that through meaningful interaction, a community of artists was developed with better access to the larger community.[39]

In conclusion, scientific research has signified the importance of the environment (natural, built, so-cial or informational) to the promotion of mental health. Part of that environment is made by artists and designers in the form of public art. Public art and art in general, is progressively proving its power to affect physical and mental health. Of course, much work needs to be done in the field of research on the therapeutic possibilities of art, to find which characteristics in a work of art have a positive ef-fect and through which mechanisms. However, what we already know is that art that promotes posit-

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34 Centre for Urban Design and Mental Health,"How the City Affects Mental Health."
35 Newbury et al., "Why Are Children in Urban Neighborhoods at Increased Risk for Psychotic Symptoms?," 1372–83.
36 Whyte, The Social Life of Small Urban Spaces.
37 Zebracki, "Public Art as Conversation Piece: Scaling Art, Public Space and Audience," 11.
38 Daykin et al., "Using Arts to Enhance Mental Healthcare Environments," 33–46; Spandler et al., "Catching Life," 791–99.
39 Howells and Zelnik, "Making Art : a qualitative study of personal and group transformation in a community arts studio," 215–22.

ive social encounters and interaction between people can surely improve not only the individual's mental and physical health but can also benefit the community in various ways. We should also not overlook the power of art to discuss issues, to spread messages, to inform the public about physical and mental health problems, to aesthetisize public space, to boost cultural tourism, to increase land values and reduce vandalism, to encourage public dialogue and be a diagnostic of social transformation and political change.

A. STATE OF THE ART : THE HOW

1. Can public art be open to everyone?

An increasing amount of artists chooses to work outside traditional art spaces such as museums and galleries, aiming to reach larger audiences. Whether a work of art is considered public or not depends on various factors like visibility and openness. When art is incorporated into public spaces, it enters the public sphere. Habermas, defines the public sphere as a space for citizens to dialogue and debate on how a state should be governed and led.[40] Critique to this theory has led to a more open definition of public sphere, that apart from public space it includes multiple domains such as newspapers and the Internet.[41]

Public art can facilitate the meeting of individuals from different backgrounds. As the audience opens up and becomes more diverse, public art becomes more polysemic. People from different backgrounds will perceive art in different ways. Their reactions and their ideas about public art will be accordingly different, and they will shape the places and the relationships that compose them.

However, art in public space is not necessarily democratic and open for all. Not everyone has equal opportunities to debate in the public sphere. Understanding and valuing art depends on education, social class, age and other factors. However, art in public space is at least accessible to everyone and contributes to the familiarization of people with it. Not all art is incomprehensible to the average viewer. Many types of art are part of our everyday lives and our vital space. Public art can deliver ideas and messages and stir up feelings. In the following chapters we will discuss what is public art, we will describe its many forms, set the limits between public and private space, and define interactivity.

1a. Public art

Definition of public art

A person who visits an art gallery, does it intentionally following a personal desire or interest, which can also be unrelated to art. On the contrary, art in public, especially in an urban environment, is a spectacle that it is not easy to avoid if one wants to. Art in public includes challenges, surprises, and interactions. That is not the case in a gallery space. When we try to define what public art is we are

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40 Habermas, The Structural Transformation of the Public Sphere.
41 Sinekopova, "Building the Public Sphere," 505–22.

obliged to answer the following questions: Is site the most important factor of whether art is public or not? What is public space? Who is the public? Is public art accessible to all? And finally, is the participation or interaction of the public mandatory?

Many scholars have tried to answer to those questions. For the purpose of this study we will mention the most important theories. UNESCO organized an international conference in Paris and Cergy-Pontoise in 2011. According to the official website of World Heritage Center the following definition of public art is given:

> "Public art refers to original works of art that use all kinds of artistic media, in temporary or permanent installation, in an outdoor or indoor environment. Accessible to all, public art seeks to enrich a community by providing a unique meaning to public realm."[42]

This definition states that the openness of the site is not imperative, but accessibility to all people is fundamental, while the main goal of public art is the enrichment of the community.

Sharp et al. though, give a slightly different definition of public art. They insert the sense of participation or interaction in public art, which shapes the space, whether this is material or intangible. So it is more inclusive of different kinds of media. In particular, they claim that:

> "...public art is art which has as its goal a desire to engage with its audiences and to create spaces—whether material, virtual or imagined—within which people can identify themselves, perhaps by creating a renewed reflection on community, on the uses of public spaces or on our behaviour within them. Public art, then, does not have only to be expressed visually. It can be expressed in terms of soundscapes, media (non-)places such as the Internet, on television, as well as in material spaces of inhabited landscapes."[43]

Cox, on the other hand, stresses another immaterial aspect of public art: its purpose. She states that public art is not actually an art form, but a principle. A principle of improving the changing environment, utilizing the arts to help those involved in that process.[44]

Of course, maybe we must also distinguish public art from art in public space and community art. According to Abreu, public art requires the involvement of the community and includes the idea of public sphere.[45] In that case public art is at the same time community art. Community art can be any "artistic activity that is based in a community setting, characterised by interaction or dialogue with

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42   UNESCO, "Colloque international "Quel destin pour l'Art Public ?"
43   Sharp, Pollock, and Paddison, "Just Art for a Just City," 1003–4.
44   Cox, "Public Art Forum," 124.
45   Abreu, "Public Art as a Means of Social Interaction," 159–74.

the community and often involving a professional artist collaborating with people who may not otherwise engage in the arts."[46] To better understand the difference between public and community art we can say that community art is not necessarily based in public space or an indoor environment that is accessible to everyone.

Public sites could be considered public spaces, if they are they host random and different interactions between people. That way, public space is connected with the public sphere, the realm of our social life in which something approaching public opinion can be formed. Access to public sphere is guaranteed to all people. A part of the public sphere comes into existence in every conversation in which private individuals take part and form a public body.[47] Therefore, we can safely say that all human activity can be part of the public sphere, including making art, whether this is interactive or not.

What is space, private or public.

To fully understand what public art is we must first grasp the meaning of space and the difference between public and private. Many researchers and theorists have tried to define the meaning of space. The theory of proxemics in communication psychology examines how humans use space and the effects that population density has on behaviour, communication, and social interaction.[48]

Hall -a cultural anthropologist who was the first to use this term in 1963- described four zones of space between people: (1) intimate space, (2) personal space, (3) social space, and (4) public space. The space close to our body is the intimate space and is reserved for close friends, lovers, children and close family members. Personal space is the area between intimate space and social space. We regard this area as psychologically ours, and we feel discomfort, anger, or anxiety when "non-authorized" people enter that region. It is open for conversations with friends, associates, and group discussions. What people usually do to avoid those negative feelings when they have to share their personal space with an intruder is either to adjust the distance, if possible, or to psychologically isolate themselves, for example, by closing their eyes, avoiding the other person's gaze or by putting on their earphones. Personal space distance fluctuates according to culture or sex.[49] Social space, on the other hand, is a zone for strangers, newly formed groups, and new acquaintances. Finally, public space is used for speeches and theatre addressing to larger audiences.[50]

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46 Tate, "Community Art – Art Term."
47 Habermas, Lennox, and Lennox, "The Public Sphere," 49–55.
48 Dictionary.com, "Definition of Proxemics."
49 Kreutz and Roberts, "Proxemics 101: Understanding Personal Space Across Cultures."
50 Hall, The Hidden Dimension; Engleberg and Wynn, Working in Groups, 140–41.
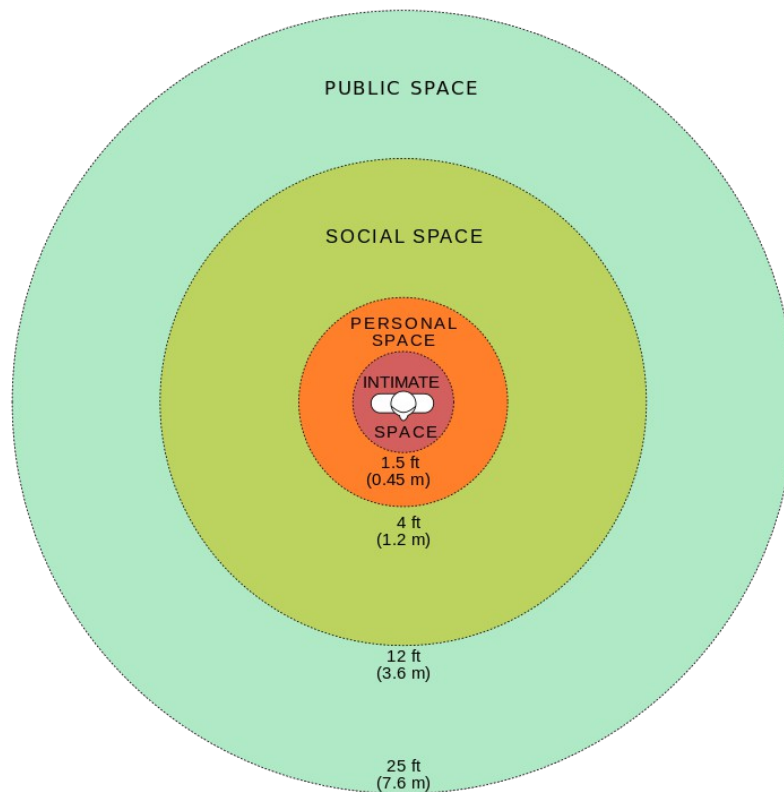
Image 1: Proxemic theory: Chart depicting Hall's interpersonal distances of man, showing radius in feet and meters

Additionally, Moore is using the term territory to refer to the area which a person may defend against others.[51] There are four forms of human territory: (1) Public territory: a place where any person can freely enter. Usually it is not under constant control. However, people might come to temporarily own areas of public territory. (2) Interactional territory: a place where people converge informally (3) Home territory: this is where people continuously pursue to have control over their individual territory (4) Body territory: the space closely surrounding our body.[52]

The sociologist Henri Lefebvre defines space as a social product, rather than as a physical space. According to him, spaces are, social constructions produced through physical, mental, social and historical perspectives, and are not divided by geographical boarders. Physical subdivisions of space are parts of one space. Society and space coincide, as society is constituted through and/or in space. The formation of space is affected by its history. Accordingly, space and time are tightly connected, as space entails time, and time implies space. History is created in the course of time, based on the

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51 Moore, Hickson, and Stacks, Nonverbal Communication: Studies and Applications.
52 Lyman and Scott, "Territoriality," 237–43.

characteristics of the specific space.[53] Supporting Lefebvre's theory, Kelly claims that the true meaning of a space is related to its ability to absorb connections and relationships.[54]

The anthropologist David Harvey claims that space is made by physical, social and cultural processes that are dependent on the relations between different kinds of individuals.[55] Moreover, social scientist and geographer Doreen Massey suggests that space has no existence out of its relations. Space is the product of interrelations; this signifies that it is constituted through multiple possible heterogeneous interactions. Thus, space is always under construction and therefore it is never completed.[56] Social geographer Marcus Doel, epitomizing Massey's theory of space, argues that space should be treated rather as a verb than as a noun. Consequently, we should talk about spacing that is an action and a way of being.[57]

Couldry & McCarthy make the distinction between public space, as the urban inhabited space, and private space, as the individual personal space formed by the personal individual engagement with mediated content. Private is not site specific, but rather a space constructed between content and users in any space.[58]

When we are talking about space in the context of art then the limits between private and public are surely blurred out. Public space and private space coincide when we interact with media content and when at the same time we are moving in public space.[59] For example, internet art or art involving portable media can be considered public art. It makes boundaries between the private and public collapse, as it exists in a non-local space.[60] Shaun Moores uses the term "pluralized space" which describes the situation where a person believes that he or she is at the same time in multiple places merging all places into one.[61] A familiar example of our everyday lives is the case of a person who thinks he is having a private conversation on the telephone while he is in a bus crammed with people.

When media are interlaced with space, it is difficult to speak of public space. Broeckmann uses the term "public domain" instead of "public space" to describe a hybrid of physical and virtual spaces.[62] Likewise, Couldry and McCarthy argue that electronic media and social space cannot be separated and that together they shape our perception and use of space while they create "Mediaspace".[63]

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53 Lefebvre, The Production of Space.
54 Kelly, New Rules for the New Economy.
55 Harvey, Justice, Nature and the Geography of Difference.
56 Massey, For Space, 9.
57 Crang and Doel, "Un-Glunking Geography. Spatial Science after Dr Seuss and Gilles Deleuze," 117–35.
58 Couldry and McCarthy, MediaSpace: Place, Scale and Culture in a Media Age.
59 Couldry and McCarthy.
60 Paul, "Digital Art/Public Art: Governance and Agency in the Networked Commons," 162–85.
61 Moores, "The Doubling of Place.," 21–31.
62 Broeckmann, "Public Spheres and Network Interfaces.," 378–86.
63 Couldry and McCarthy, MediaSpace.

The Internet has been considered as a social immersive space.[64] When virtual communities migrate from cyberspace to physical spaces because of the use of mobile technologies, "hybrid spaces" are created. De Souza e Silva used this term to talk about spaces that are created by the constant movement of users who carry portable devices continuously connected to the Internet and to other users. De Souza e Silva concludes that digital media could be stimulating sociability and changing our ways of communication in urban spaces.[65]

However, the use of media not only shapes our relations but also the space itself. The use of surveillance devices, like cameras, extracts data from physical space. On the contrary other technologies like display screens, mobile telephones and PDAs add data into physical space. The flow of information from and into physical space creates a new "augmented space" and the physical space is transformed into a "dataspace". The borders between cyberspace[66] and physical space are then abolished.[67]

Many scholars agree that virtuality and reality are not separate phenomena.[68] Nevertheless, sociologist and philosopher Jean Baudrillard claims that the virtual world is false, an imitation of reality. Media creates virtual, or in Baudrillard's view, false worlds. He claims that, by the continuous use of media, our lives become unreal.[69] On the contrary, philosopher Pierre Levy argues that the virtual is parallel to the real, not false.[70] Milgram and Colquhoun use the term "mixed reality" to describe the situation where it is not clear whether the predominant elements in the environment are real or virtual.[71]
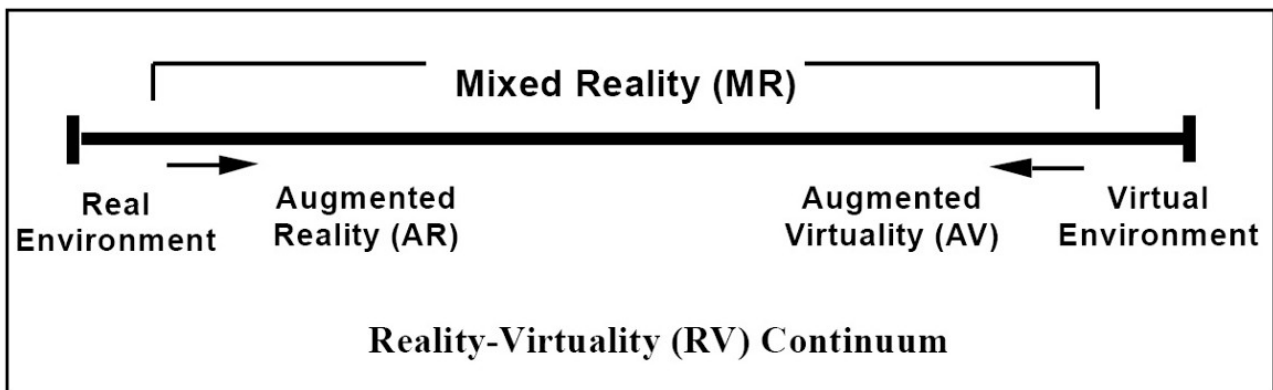

Image 2: Mixed reality continuum.

64 Dibbell, My Tiny Life; Donath, "Inhabiting the Virtual City: The Design of Social Environments for Electronic Communities"; Kim, Community Building on the Web; Rheingold, Smart Mobs; Smith and Kollock, Communities in Cyberspace.
65 De Souza e Silva, "From Cyber to Hybrid."
66 Gibson, Neuromancer. Gibson used the term cyberspace to talk about an array of networked computer image spaces that would find millions of users daily.
67 Manovich, "The Poetics of Augmented Space."
68 Hayles, How We Became Posthuman; Hayles, Writing Machines; Massumi, Parables for the Virtual: Movement, Affect, Sensation.
69 Baudrillard, Selected Writings.
70 Levy, Becoming Virtual.
71 Milgram and Colquhoun, "A Taxonomy of Real and Virtual World Display Integration," 5–28.

The incorporation of virtual objects into a three-dimensional real space or, the incorporation of real elements in a digital environment creates a mixed reality.[72] It is the distance of the continuum between reality and virtuality.[73] On one side there is virtual reality, where everything is digital, and on the other side we find reality as we understand it without any devices. When we add digital elements to physical space, we create an augmented reality. Inversely, when real elements are added to a three-dimensional digital environment we talk about augmented virtuality. It is also possible to remove elements from the real environment. This is called mediated or diminished reality. Augmented reality can also be applied to the other senses, like sound[74] and sense[75]. An augmented reality experience must combine real and virtual elements, it must use real time interactivity and be registered in three dimensions.[76] When mixed reality is merged with augmented spaces, mobility, and social relations, a new hybrid reality is created.[77]

Ultimately, the theory of space and public art is very complex, crowded with many terms. This is because the advancement and complexity of technologies change our conceptions of art and space. Before the invention of portable electronic devices and the internet our notion of space was simpler. But, the creation of hybrid spaces and mixed realities have changed the way we see public art and public spaces.

Types and examples of public art.

It is uncertain when the history of public art begins, as there are many views on what public art is. We cannot tell if caves, like the one in Lascaux, can be considered as public art. Those depictions of animals were used by the community for initiation ceremonies and religious practice, but we don't know if they were accessible to everyone, including women and children. However, if we go further in time, the ancient Greek temples, with reliefs attached to their exterior surfaces and statues placed in public areas close to the temple, can be a good example of art in public space.

There are many ways to categorize the various forms or art in public spaces. One of them is to classify by medium. The variety of media for public art can be vast, from architecture and sculpture to new

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72 Milgram et al., "Augmented Reality," 42–48.
73 Milgram and Colquhoun, "A Taxonomy of Real and Virtual World Display Integration," 1321–29.
74 Durlach and Mavor, Virtual Reality.
75 Hayward et al., "Haptic Interfaces and Devices," 16–19.
76 Azuma, "A Survey of Augmented Reality," 355–85.
77 De Souza e Silva, "From Cyber to Hybrid," 261–78.

media art. Another way is to sort them by their integration in the environment and the way the artists worked.[78] In that case we would have the following types:

1. Stand-alone public art is art that is not embedded in any kind of building or build space.

Image 3: Anish Kapoor, *Cloud gate*, Chicago, USA, 2004-2006, photo: Petr Kratochvil

2. Integrated art into a building or built space. It could be in the interior as well as in the exterior surface. A good example is Olafur Eliasson's "Your rainbow panorama" at the ARoS Aarhus Kunstmuseum in Denmark.

Image 4: Olafur Eliasson, *Your rainbow Panorama*, 2006-2011, part of the ARoS Aarhus Kunstmuseum, Denmark, photo by: the artist.

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78   Department of Culture and Arts, "Forms of Public Art ~ DCA"; NAVA, "Types of Public Art."

3. Applied art that is attached on an interior or exterior surface.

Image 5: Francisco Brennand, Ceramic tile mural covering the surfaces of Bacardi Buildings in Miami, 1963, USA, photo: Robin Hill

4. Installations created with a certain plan or designed for a specific space. In that case the artwork and the space are essential to each other. In the image below, Charles Fort building was partially burnt by fire in the 1920s. The artist replaced the burnt windows with coloured glass. The glass reflects the changing light to create an ever-changing atmosphere.

Image 6: Anya Gallaccio, *Charles Fort*, 2007, Kinsale, Ireland, photo from: Lehmann Maupin website.

5. Ephemeral art like digital projections, games in hybrid space, performances and other temporary works of art. For example, Sean Yoro painted on the broken ice with eco-friendly pigments to send a message about the climate change.

Image 7: Sean Yoro (a.k.a. Hula), painting on ice, Iceland, 2015, photos: Gabe Yoro.

6. Non-site-specific art, located in a public place primarily for display purposes.

Image 8: Alisha Wormsley, There Are Black People In The Future, exhibited in East Liberty in 2018, photo: Jon Rubin.

7. Participative or interactive public art. The amount and type of community participation can vary from just interacting to deciding on the content, the planning and the implementation or the project. The artwork in the image was displayed at the Baltimore port. It was made of several loops that were activated when people worked a hand lever, activating a cylinder that animated image and sound.

Image 9: Loop, *Ecumen*, Baltimore lightcity, 2019, photo: Olivier Girouard.

8. Art by individual artists who develop a concept in response to a brief and then usually subcontract others to construct and install the work.

Image 10: Christo and Jeanne-Claude, *Wrapped Reichstag*, Berlin,1971-95, Photo: Volfgang Volz

9. Projects by design or artistic teams, including different professionals such as architects, landscape architects, graphic designers. For example, the artwork below was created by a team of artists, architects, designers, planners, managers are other collaborators.

Image 11: Art In Public Space, *Dandelion Lights*, Dubai, photo: Art in Public Space.

Ultimately, I should also mention that there is also art performed without any permission in public space, the so-called "guerrilla" public art like graffiti. Most notable example is Keith Haring's or Banksy's works. There is not much consensus as to whether graffiti is public art or vandalism. Many argue that graffiti is illegal, because it vandalizes public space and it is not financed by the community or ordered by a public authority. However, many forms of public art are ephemeral, unpaid and/or driven by self-initiative of the artist. Moreover, street art has been hosted in galleries and artists, as we mentioned above, have painted on public spaces. There are also cases of local authorities or individuals that ask graffiti artists to paint on public or private property. Their work beautifies neighbourhoods and is a powerful tool of gentrification. Graffiti can also be digital, in the form of large scale projections. A message or an image painted or projected on a surface in a public space is unavoidable, forcing the viewers to think whether they will stop and think or just ignore it. For the above reasons I consider that street art could be a form of public art depending on its content and purpose.

There are many ways to categorize the numerous forms of public art and each example can fit to other categories simultaneously. We are using this basic system of understanding the main characterist-

ics of public art and in the following chapters we will analyse further what is interactivity and how this is represented in public digital art in particular.

Image 12: Gabriel Pulecio, digital graffiti during the COVID-19 pandemic, 2020, Brooklyn, USA, photo by the artist.

1b. What is interactivity in art?

Brief history of interactive art

Progress in the field of technology has influenced artists who are always searching for new ways of expression. Although interactivity or participation in art is not a new idea, the use of digital technologies to create mixed reality and hybrid spaces is relatively new. Digital interactive art is exposed today in galleries and museums as well as in public spaces, calling for the spectators to become users.

If we accept the definition of interactivity that does not consider the use of digital media obligatory, then interaction between a work of art and the audience probably starts with the invention of theater in Greece. It is there that we have the first documented types of artistic performance in history. In the amphitheater the audience used to give feedback to the actors about the play during the performance.

However, Maurice Benayoun, argues that the first interactive work of art was probably Parrhasios' painting of a curtain in the fifth century B.C. The story about the painting contest between Zeuxis and Parrhasios was described by Plinius in his book "Naturalis Historia". Both of their paintings were hid-

den behind a curtain. Zeuxis unveiled first his painting of fruits that was so realistic that a bird tried to eat them. The audience was impressed and Zeuxis couldn't wait and tried to unveil Parrhasios' painting. Only, he discovered that the curtain was actually the painting. Parrhasios' artwork deceived Zeuxis and what is more important is that the work of art this time was not only the painting but also Zeuxis' action towards it. Those two elements created an interactive work of art.[79]

Many centuries after when the radio was invented in the 19th century and television much later, the audience's interaction was limited to pressing a few buttons. They could change the radio frequency or television channel, the volume of the sound and modify the image. The invention of video players later would add a new interaction parameter, time and speed.

In the field of fine arts an early interactive work of art was Marcel Duchamp's "Rotary glass plates", made in 1920. The artwork required the viewer to turn on the mechanism and stand at a distance to see the optical illusion. Another example from 1959 is the "Change-paintings" of Roy Ascott, which required participants to overlay different panels of plexiglass with oil-painted elements. In his essays The "Construction of Change" and "Behaviorist Art and the Cybernetic Vision", Ascott analyzed the educational purpose of art. He claimed that its purpose is to create mental, conceptual and conscious changes in behaviours, forming the relation between the artist, the work of art and the audience. He wanted the viewer to be an active participant and experiment with the artwork.[80]

Image 13: Roy Ascott, *Change-Paintings*, 1959, photo: Syncretica Archive.

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79   Benayoun, "L'art coupable mais toujours libre."
80   Ascott, "The Construction of Change"; Ascott, "Roy Ascott: Behaviourist Art and the Cybernetic Vision."

In 1968, Wen Ying Tsai exhibited his interactive cybernetic sculptures made of vibrating steel rods, stroboscopic light and audio feedback, at the Institute of contemporary arts in London. In the 1970 the use of new technology such as video and satellites inspired artists to set up live performances and interactions with direct broadcast of video and audio.[81]
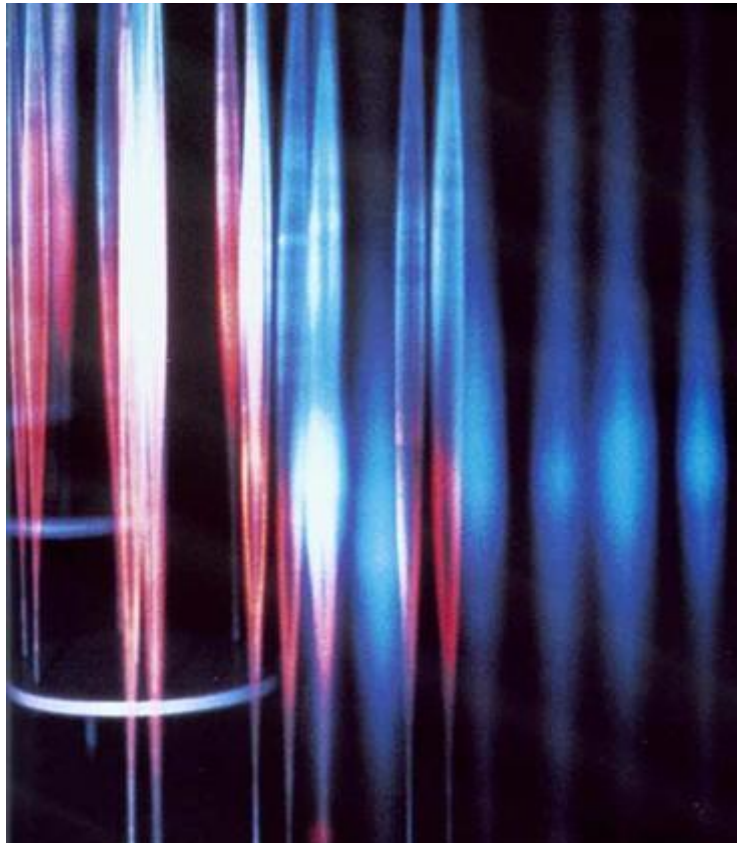

Image 14: Wen Ying Tsai, Interactive *cybernetic sculptures*, 1968, photo by: Studio 14.

The history of computer graphics started in 1963, when Ivan Sutherland, wrote the code for Sketch-pad system. Theodore Holme Nelson was the first to create video arcade games in the early 1970s. Computer-based multimedia appeared in 1978 with the new interactive video by the Architecture Machine Group at MIT. Headed by Nicholas Negroponte, the team connected a Philips laser disc system to a computer to allow users to tour the city of Aspen, Colorado by using a joystick.

Towards the end of the 1980s, faster computer speeds and higher storage capacities made real-time three-dimensional animation possible. Inventions like data gloves and headsets were some of the models that were developed in the following decades for the interaction of human and machine. Nevertheless, these devices were not practical for exhibitions in galleries, because the cost was high,

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81 Paul, Digital Art, 18.

and they were only able to be used by one visitor at a time. The idea of interactivity reemerged in the 1990s following the technological development.

Since the mid 1970s, Myron Krueger was projecting his computer generated graphics on walls and was opening the way for fully interactive environments and projections. For example, the "Video-place" was the creation of an artificial reality that responded to the users' actions.

Finally, the invention of the World Wide Web by Tim Berners-Lee in 1989 changed the future of human to human communication and art accordingly. Internet art has become an art form of its own. The internet combined with portable devices and locative media gave another sense of interactivity and space, creating what we call, a mixed reality. Interactive digital art is found today not only in galleries and museums but also in public spaces, shaping the space itself and the user to user relations.

Definition and types of interactivity

The concept of interactivity is rather complicated and difficult to fully define. It is not a constant feature and is partly dependent on the development of technology. Many theorists have tried to set its rules and categorize its characteristics. There is not unanimous agreement between various theories, but we will try in this section to present the most significant views on interactivity. The application of the term is ranging from describing technical characteristics of the medium to the psychological experience of the user.

Artists who are creating interactive works of art do not design a finished work. Their artworks are closer in their content to Umberto Eco's idea of "open work of art". Eco described this type of art created by the artist to be open, and further to be completed by the performer, viewer, reader or audience.[82] In a similar way, interactive art is not finished work, it demands participation to be completed. The author is just choreographing a process.[83] Different users can have common experiences by interacting with the artwork but at the same time each participant, has their own experiences based on their previous knowledge and experience.[84]

In social studies and psychology interaction refers to reciprocal human communication. Cognitive psychologists indicate that all media are 'interactive', as they require active participation from the recipient of the message, who is called to interpret all the stimuli.[85] However, there's a difference between

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82 Eco, The Open Work.
83 Kwastek, "Interactivity – A Word in Process," 15–26.
84 Kluszczynski, "Strategies of Interactive Art."
85 Kluszczynski, "Strategies".

participation and interaction. Participation depends on the users as it requires some form of exchange with other humans, in a social and cultural context. As a result, it can also be a consequence of interactivity, but not necessarily. In that sense it is considered one of the forms of interactivity.[86] Theorists like Bucy and Newhagen argue that interactivity should not be applied to unmediated face-to-face communication.[87]

In informatics, interactivity refers to human-machine communication. On the contrary, in communication studies interaction includes reciprocal and mediated human to human communication and the relationship between text and the reader.[88] The latter constructs "interactivity" as a communication process, while the human–computer interaction (HCI) approach, constructs "interactivity" as the product of a medium characteristic or as interface design.[89] Sundar et al. argue that face-to-face interaction is the highest form of interactivity, and user-to-system interactivity is the lowest.[90]

Rafaeli describes interactivity as an exchange of messages that are related to each other, and refers to any type of communication between humans. In particular, it is any third (or later) transmission (or message) related to earlier transmissions.[91] Williams et al. consider interactivity as the level of control that participants have over the communication process, and their ability to exchange roles.[92] Steuer adds that it is necessary that the changes of the content happen in real-time.[93] Jenkins claims that if participation depends on the users, interactivity is dependent from the technology. He believes that interactivity is the way technologies have been designed to respond to users and that the level of interactivity differs according to technology. [94]

Many scholars agree that interactivity is determined by technology.[95] Jensen for example, argues that interactivity is a medium's potential ability to allow the user to influence the content and/or the form of the mediated communication.[96] Sundar and Stromer-Galley both agree with Jensen that Interactivity is a message or medium attribute, that is dependent from the presence of specific characteristics of the user interface, like control, choice and contingency.[97] Stromer-Galley argues that this does not mean that the social aspect is overlooked.[98]

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86 Jenkins, Convergence Culture.
87 Bucy, "Interactivity in Society"; Newhagen, "Interactivity, Dynamic Symbol Processing, and the Emergence of Content in Human Communication."
88 Jensen, "Interactivity," 190.
89 Stromer-Galley, "Interactivity-as-Product and Interactivity-as-Process," 393.
90 Sundar, Kalyanaraman, and Brown, "Explicating Web Site Interactivity Impression Formation Effects in Political Campaign Sites," 30–59.
91 Rafaeli, "Interactivity: From New Media to Communication," 111.
92 Williams, Research Methods and the New Media, 10.
93 Steuer, "Defining Virtual Reality," 84.
94 Jenkins, Convergence Culture.
95 Green, Communication, Technology and Society; Steuer, "Defining Virtual Reality"; Jensen, "Interactivity"; Richards, "Users, Interactivity and Generation," 531–50; Manovich, The Language of New Media; Bolter and Gromala, Windows and Mirrors; Sundar, "Theorizing Interactivity's Effects"; Stromer-Galley, "Interactivity-as-Product and Interactivity-as-Process."
96 Jensen, "Interactivity," 201.
97 Sundar, "Theorizing Interactivity's Effects," 386.
98 Stromer-Galley, "Interactivity-as-Product and Interactivity-as-Process," 391–94.

On the other side, Ihde focuses on the emergence of interactivity not as an independent phenomenon but as a result of human interaction with the environment.[99] Taking the significance or the user's role in the concept of interactivity one step further, Newhagen, considers interaction as a completely internal mental state that creates content within the individual who is trying to make meaning of his experience.[100] This is a completely subjective view on interactivity. Kiousis also focuses on human to human interaction but he is trying to combine the different definitions into one:

> "Interactivity can be defined as the degree to which a communication technology can create a mediated environment in which participants can communicate (one-to-one, one-to-many, and many-to-many), both synchronously and asynchronously, and participate in reciprocal message exchanges (third-order dependency). With regard to human users, it additionally refers to their ability to perceive the experience as a simulation of interpersonal communication and increase their awareness of telepresence."

He also pinpoints three factors: technological structure of the media used, characteristics of communication settings, and individuals' perceptions.[101]

McMillan suggests that we should avoid definitions and try to see interactivity as a phenomenon. She further divides interactivity into specific types and says that these must sometimes be used together to describe interactivity. These types are (1) user to user interaction, often called computer mediated communication (CMC); (2) user-to-documents interaction between humans and the exploration of any form of media document; (3) user-to-system interactivity usually named Human-Computer Interaction (HCI).[102]

Heeter mentions six factors in her definition of interactivity: (1) complexity of choice available; (2) effort that users must exert; (3) responsiveness to the user; (4) monitoring of information on participant's use; (5) ease of adding information; and (6) facilitation of interpersonal communication.[103] Ha and James claim that interactivity is "the extent to which the communicator and the audience respond to, or are willing to facilitate each other's communication needs", including the following factors: playfulness, choice, connectedness, information collection, and reciprocal communication.[104]

McMillan offers a five-dimensional definition of interactivity consisting of: (1) direction of communication. Two-way communication is more interactive than one-way communication; (2) timing flexibil-

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99   Ihde, Technology and the Lifeworld.
100 Newhagen, "Interactivity, Dynamic Symbol Processing, and the Emergence of Content in Human Communication," 395.
101 Kiousis, "Interactivity."
102 McMillan, "Exploring Models of Interactivity from Multiple Research Traditions," 163–76.
103 Heeter, "Implications of New Interactive Technologies for Conceptualizing Communication," 217–35.
104 Ha and James, "Interactivity Reexamined," 457–74.

ity; the level of control of the users in the timing of messages. (3) sense of place. Place is the equivalent of Ha and James' "connectedness". (4) level of control during interactive communication; (5) responsiveness (the effort required by users to react) and the perceived purpose of communication.[105]

On another publication based on the work of Bordewijk and van Kaam[106], McMillan analyses interactivity as having four uses:

(1) Allocution, the case of broadcasting content from a single, central broadcaster to multiple receivers. For example, mass media like television, and real-time events like speeches.

(2) Consultation of a database, where a user is searching for pre-provided information in a base of data.

(3) Registration, is the opposite of allocution. Here information is accumulated from the periphery in a central registry.

(4) Conversational interactivity, the case of direct human to human interaction through computer-mediated technologies.[107]

To conclude, Kiousis mentions the following characteristics as basic elements for an interactive experience, based on bibliographic review :

(1) Two-way or multi-way communication is essential, usually through a mediated way.

(2) The roles of message sender and receiver should be interchangeable among participants.

(3) An amount of third-order dependency among participants is usually necessary. Third-order dependency refers to the extent to which messages respond to and/or implicate previous messages[108]

(4) there must be at least two participants in interactive communication.

(5) Participants can be human or machine, often depending on whether they can participate both as senders and receivers. Usually it will be human-to-machine or human-to-human via machine communication, but it could be machine-to machine sometimes.[109] In fact machine-to-machine communication includes many of the prerequisites of interactivity, like two-way or multi-way mediated message transmissions and the interchangeability of roles as senders and receivers.

(6) Some technology used for the exchange of information between users must also be present.

105 Downes and McMillan, "Defining Interactivity," 157–79; McMillan, "Interactivity Is in the Eye of the Beholder. Function, Perception, Involvement, and Attitude Toward Web Sites," 71–78.
106 Bordewijk and van Kaam, "Towards a New Classification of Tele- Information Services," 16–21.
107 McMillan, "A Four-Part Model of Cyber-Interactivity," 271–91.
108 Rafaeli, "Interactivity: From New Media to Communication," 110–34.
109 Williams, Research Methods and the New Media.

(7) The possibility for users to modify the mediated environment must exist. Individuals should be able to manipulate the content, form, and pace of a mediated environment in some way.

(8) Interactive experiences are not necessarily fast or happen in real time.

(9) Users should be able to perceive differences in levels of interactive experiences.[110]

Finally, Kluszczynski proposes eight different strategies of categorizing interactive art :

(1) the Strategy of Instrument refers to art forms of purely performing character where the user interface acts as a device that generates audiovisual events and is used by the audience to create a performance.

(2) the Strategy of Game, characterizes works of art where a task must be performed. The viewers -users participate by having at their disposal rules and tools and space dedicated to the game.

(3) the Strategy of Archives, is the collection of data, usually audio/visual, that are organized and made available to the audience, who explores the resources of the collection. Their search can play a role during the experience.

(4) the Strategy of Labyrinth regards the hypertext structure of information. This structure might change throughout the experience, depriving the user of any knowledge gained about it or any usefulness.

(5) the Strategy of Rhizome, includes a structure of organizing information resources in the form of cybertext. Cybertext makes it possible to create new paths. That strategy is characterized by multi-direction, endlessness and unpredictability of the development of the interactive experience. The works that use the Strategy of Rhizome are mostly found on the Internet;

(6) the Strategy of System is about a system-software and hardware, that is controlling the functioning of mechanisms. It is often used without consent of the people, taking place only within the magnitude of technology.

(7) the Strategy of the Network is designed to organize relationships that link the participants of an artistic event. It involves cultural participation and takes place mostly in public space. This results in hybrid art, aimed at community. Community art, that uses locative media, creates hybrid spaces. The Strategy of Network is not always connected with interactive technologies. For Kluszczynski, the social network is enough to characterize the work of art as interactive.

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110 Kiousis, "Interactivity," 368.

(8) the Strategy of Spectacle points to the interactive experience during which the observer watches a spectacular event and performs various activities for the spectacle to take place.[111]

Analyzing more the "nature" of interactivity we could mention the following characteristics: Interactivity is mental because it helps users to create an experience and create their own meaning of the experience. Interactivity is social, because it encourages social relations and creates virtual communities, developing a sense of togetherness. Interactivity is also temporal, referring to actual time or history. In present time, participants create meaning during the use of the work of art through their subjective experience from it. Extensive use of the artwork engages the viewer and generates meaning. What is more, previous knowledge and understanding of the history of the space where the work of art is presented influences the overall understanding of the installation and affects their engagement with it. Finally, interactivity is spatial in the sense of the users' change of perception of space and of their relation to others within that particular space.[112]

By reading all the above definitions we can conclude that there is not much consensus on what exactly interactivity is. Whether it is a medium characteristic or user related. What must the characteristics of a work of art be in order to be considered interactive? It is often impossible to match a work of art with only one type of interactivity. The core of interactivity is the exchange of content and this content must be able to be modified in the process and because of it. I believe that we shouldn't follow definitions strictly and be bound by them, because definitions constantly change while technologies advance.

2. Technologies that are being used for public interactive digital art:

2a. Public interactive digital art.

Definition

In this study we focus on public art that is interactive and is using digital technologies as medium. Digital technologies include television, cameras, computers, portable devices like mobile phones etc. As we have described in a previous chapter, public art can be exhibited in physical, virtual or hybrid spaces (see 1.a). Public art has long history, the use of digital technologies in public space though is relatively new.

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111 Kluszczynski, "Strategies of Interactive Art."
112 Ryan Bengtsson, "Re-Negotiating Social Space: Public Art Installations and Interactive Experience."

History and examples of public digital interactive art

Digital art was born with the invention of the computer, at the end of the 1940s. Still in the early 1960s computer technology was not enough developed, and access to computers was not an easy task. Computers were expensive and heavy. The first digital artworks were made by researchers of scientific or mathematical background. By the 1970s, artists had begun to learn programming languages themselves. In the 1980s digital technologies were part of everyday life. Computers were now used both for business and for personal use. Computer graphics and special effects were used in the cinema industry and television. Personal computers and other peripheral devices, like printers, had now become smaller and more affordable. Along with the advance in hardware technology, software for creative use was developed. Even though digital television was made available in 1990, the history of digital art includes works of art that appeared on analog television as well.

If we accept television as a medium with small interactivity then probably the first public interactive digital works of art were the musical compositions after the invention of radio, or the films broadcast after the invention of television. In visual arts though one of the first digital interactive artworks in public view was "The Medium is the Medium", produced by WGBH-TV in Boston, in 1969. It was a collaboration between public television and video artists in the U.S. The channel commissioned artists, like Allan Kaprow, Nam June Paik, Otto Piene, James Seawright, Thomas Tadlock and Aldo Tambellini, to create art works for television. Their purpose was to explore this new medium, television.

One of the artistic projects was "Hello" of Allan Karpow. It was a "tele-happening." Kaprow collaborated with the television station, to create a network of people in four different locations who could exchange audio and sound, interacting with the people standing in front of each camera-monitor. Kaprow would direct the order and the transmission of each channel, through the station's control room. The participants could both see and hear each other. However, the result was often chaotic, due to Kaprow's intervention. The main concept was that digital communication could sometimes be confusing.

Image 15: Allan Karpow, *Hello*, 1969, USA, Image by WGBH.

Image 17: Aldo Tambellini, *Black*, 1969, USA, Image by WGBH.

Image 16: Otto Piene, *Electronic light ballet*, 1969, USA, Image by WGBH.

The rest of the projects were "Black" by Aldo Tambellini, "Electronic light ballet" bye Otto Piene and "Electronic opera #1" by Nam June Paik.

Nam June Paik chose television as a medium to broadcast digital art also in his later projects. His project "Good Morning, Mr. Orwell", in 1984, questioned the role of television in society. There was a live broadcast on New Year's Day in 1984. WNET TV in New York was connected with the Centre Pompidou in Paris live via satellite and with broadcasters in Germany and South Korea. The program reached an audience of over 25 million viewers worldwide. Paik directed a cast of actors, musicians, and artists and added his graphics to create a 38-minute program. The cast of artists included Laurie Anderson, Peter Gabriel, Yves Montand, Allen Ginsberg, Joseph Beuys, Philip Glass, and others.

Image 18: Nam Junen Paik, *Good Morning Mr. Orwell!*, Charlotte Moorman performing TV Cello, 1984, New York, WNET tv.

Interactivity was a new concept in storytelling in the 90s. In 1991, television became slightly more interactive when Oliver Hirschbiegel produced a TV thriller called "Mörderische Entscheidung" (Murderous Decision). It was an effort to give to his work a form of interaction through zapping. The viewer could choose between two plots that were broadcast at the same time on two different channels, Das Erste and ZDF.

Another technology that was used by artists was telerobotics. Its purpose was to control actions from distance. Ken Goldberg's and Joseph Santarromana's "Telegarden" installation, was first located at the University of Berkeley and then at the Ars Electronica Center in Linz. From 1995 until 2005 the installation was accessible online. A small garden with living plants could be viewed by online visitors, watered and planted with the movement of an industrial robot arm that was con-

trolled through the project website. Thus, a worldwide community was formed that had as a goal to attend and cultivate a small garden.

In the category of web art, an early work from the 90s was Graham Harwood and Matthew Fuller's "Natural Selection", in 1996. The artists had hacked an internet search engine, making sure that every time that people searched for racist material, they would be directed to a network of anti-racist web-sites set up by the artists, along with a global network of collaborators.

One more example of interactive art in cyberspace is Margot Lovejoy's "Turns", in 2001, created with the help of Hal Eager, John Legere, and Marek Walczak. Visitors could share their stories of life turning experiences. On the website, stories were visualized as pebble-like shapes that can be opened by users. Visitors of the website could reorganize and filter stories. They can also draw a visual map of the course of their lives.

The shared experiences of unknown people was a point of inspiration for many artists. Marisa Olson and artist Abe Linkoln produced in 2006 a collaborative work of art under the title "Abe and Mo sing the blogs". The artists created an album with songs made with lyrics taken from blogs that they used to read online. The songs were made available online, and were linked to the original blogs. They were compared to Blues songs because or their confessional nature.

Furthermore, the internet also hosted alternative theatrical performances. Lisa Brenneis and Desktop Theater troop created "Desktop theater", from 1997 to 2002. The artists that participated could "invade" the Palace virtual environment and use their avatars to perform. One of their first plays was an adaptation of Beckett's "Waiting for Godot". Later they continued with avatar-based improvisations.

Image 19: Lisa Brenneis and Desktop Theatre, *Waiting for Godot*, 1997

Interactive projections on public buildings are another form of interactive digital art in public space. Raphael Lozano- Hemmer's work in 1997, under the title "Emperadores Desplazados" (Displaced emperors) was an installation that used an interface to modify the surface of a building. With wireless 3D sensors the system managed to detect the area to which the users would point on the facade of the building. A large animated projection of a hand would appear on that point. As people on the street "touched" the Castillo de Chapultepec building in Mexico City with a virtual hand, they would uncover the interior of the Habsburg residence. Moreover, people could press a button and trigger the projection of the Aztec head-dress that is kept at the Museum für Völkerkunde in Vienna, and of many images of jewels from the Austrian-Hungarian Empire, accompanied by the music of Toña la Negra.
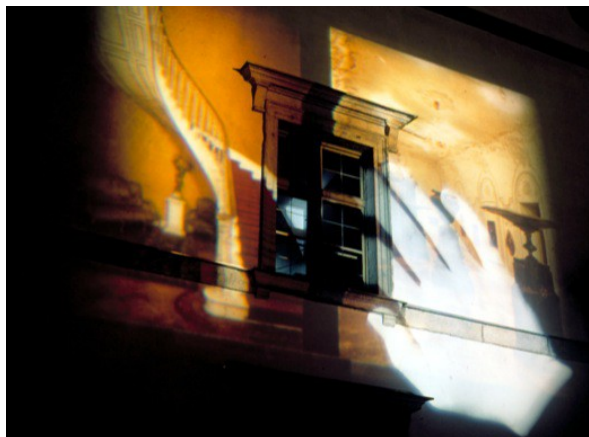
Image 20: Raphael Lozano-Hemmer, *Emperadores desplazados*, 1997, Mexico, photo by the artist.

In 2006 Theo Watson and Eyebeam Graffiti Research Lab created "Generative Graffiti". They set up a particle based drawing system projected on the surface of Maritime Hotel, that generates particles from the lit up windows of the Maritime Hotel. Those particles were attracted when windows were lit, but they were repelled from the non-lit ones.
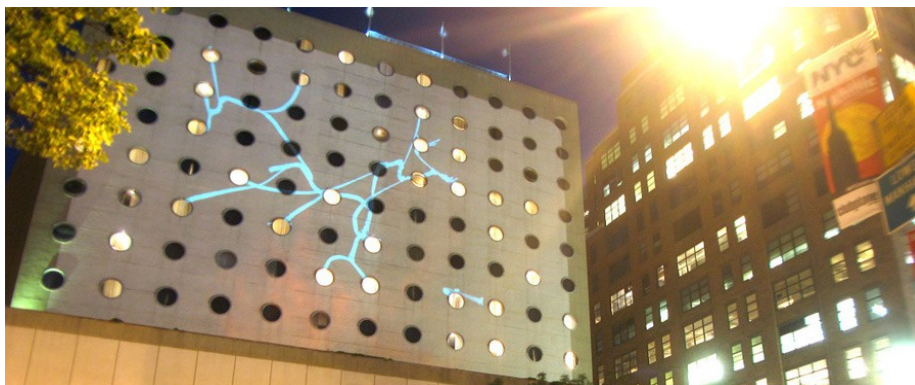
Image 21: Theo Watson and Eyebeam graffiti research lab, *Generative graffiti*, 2006, New York Maritime hotel, photo by the artist.

In Stockholm, the installation "Color by Numbers" was first inaugurated at Telefonplan in 2006, and was afterwards installed in the Perdigones Tower in Seville, Spain, in the Seville Biennial. It was created by a collaboration between interaction designer Loove Broms, architect Milo Laven, and artist Erik Krikortz. The tower at Telefonplan was 72 meters high and had 20 floors. The top ten floors were used for the light installation. The participants could alter the colors on the building by using their mobile phones. The windows of the building were lit in different colors that could be seen from a radius of ten kilometers. The inhabitants of this region developed close relations through this artwork. They also got back a sense of local identity that they had lost when the Erickson factory closed. The tower used to be a part of the Ericsson factory. After the artistic intervention it had become from a dark, anonymous building to a visual landmark.

Image 22: Erik Kirkortz, *Colour By Numbers,* at Telefonplan, 2006, Stockholm, photo by Holger Ellgard.

Of similar sense was Q.S. Serafijn and Lars Spuybroek's "D-tower" in 2012. It was an art piece commissioned by the city of Doetinchem in the Netherlands and co-developed by V2_lab. The physical tower, designed by NOX, is an eleven-meter high sculpture with a polyester surface, that has been computer-generated. D-tower visualized the emotions of the inhabitants of Doetinchem by concentrating on happiness, love, fear, and hate. The project consists of a tower, a questionnaire, and a website. Participants had to answer four questions almost every day and their answers were transformed into a graph. In the Web page one could find "landscapes" that were formed by the participants in the form of peaks and valleys. All data were connected to the map of the city of Doetinchem. The map could give information based on participants' zip codes, such as where in the city people are

most scared or happy, and also give the reason. The four emotions are represented by four colors, green, red, blue and yellow, which corresponded to the color of the lamps illuminating the tower. All this information was visualized in physical space and engaged people in reflecting on their collective psychological state, encouraging empathy.

Image 23: Q.S. Serafijn and Lars Spuybroek, *D-Tower*, Doetinchem, 2012,
photo by V-Lab

An example of interactive art that at the same time falls in the category of "strategy of game" was "Aarhus by Light" created by CAVI (Center of advanced visualization and interaction) in 2008. CAVI is a research center of the department of Digital Design and Information Studies at the School of Communication and Culture in Aarhus University. "Aarhus by Light" was an installation that consisted of 180 m^2 semi transparent Led screen attached on the facade of the Concert Hall and of multiple sensors placed on the street lights. The screen was on 24 hours per day. The people could control with their movement the animation of digital creatures on the screen. In 2009, the team created another project, called "Climate on the wall". Its purpose was to make viewers think about the climate change and the environment. Along the bottom of a building, words were projected that could be rearranged

by the people's movement in a playful manner. Words would appear in bubbles and the passers-by had to put them in a right order by moving.

Another public interactive game that encouraged social participation and interaction was projected in the city of Madrid in 2010, during the White Nights. "Lummo blocks" was created by Lummo and Media -Lab Prado, to be a public game similar to Tetris. Players in pairs could move the blocks with their body movement, by being tracked by the system. The game created a memorable social experience to participants and simple viewers. This artwork is a good example of community art, as it created social bonds in the community. It was so successful that it was installed in other cities as well, both in Spain and abroad.

Works of art that create public happenings can have a positive effect on the community and also inform the public about various issues. In 2004, Usman Haque created "Sky-Ear". Sky Ear was a thirty meter carbon-fiber "cloud", made of one thousand glowing helium balloons and dozens of mobile phones. The balloons had small sensor circuits embedded on them that reacted to electromagnetic fields of the mobile phones. When the sensor circuits were activated, they illuminated bright colored LEDs attached on the "cloud" that glowed brightly in the dark sky. As the viewers on the ground used their mobile phones to call into the cloud, they were able to hear the natural electromagnetic sounds of the sky and alter the glow patterns of that part of the "cloud". They could change the local hertzian topography and understand that mobile phones affect the new and existing electromagnetic fields.

Image 24: Usman Haque, *Sky-Ear,* 2004, Greenwich park, London, photo by David Rothschild.

A few years later Haque created another impressive interactive digital public work of art. It was specially commissioned by the City of Santa Monica, California, for Glow 08 festival. "Primal Source" was an interactive installation that lasted all night. A large-scale outdoor water/mist screen projection system created a mirage-like installation of glowing colors and patterns formed by the voices, music and sounds from the people around. Responding to the various sounds coming from the crowd, the visuals changed faster whenever there was more noise. The effect was memorable and entertaining for the festival visitors.

Image 25: Usman Haque, *Primal Source*, 2008, California Glow Festival, photo by the artist.

In the field of locative media and mixed reality, one of the earliest examples of gaming and mobile technologies was "imaHima", released in Japan in 2001. Each user was asked to agree to share his location with the application. By doing so, he could contact any person whose profile matches his request. imaHima connected people within a close distance in physical space. Access to the imaHima service was given through i-mode and wireless application protocol phones.

Finally, a simpler but equally interactive public project was "Dead Drops" by Aram Bartholl that started in 2010 and still continues as an open work of art free for everyone to imitate. Bartholl embedded USB flash drives in different public places in New York, facilitating an anonymous, offline, peer to peer file-sharing network in public space. Everyone can transfer files on and from a dead drop. USBs are installed empty with only a readme.txt file explaining the project. This was an example of mediated human-to-human interaction.

Image 26: Aram Bartholl, *Dead Drops*, 2010, New York, photo by the artist.

To sum up, public interactive digital art has a broad "palette" of media and technologies available for use. From the simple forms of technology like a USB stick to telerobotics and locative media. The artist can chose according to the concept of the project, which medium to develop and communicate it in the best way. In the following section I will focus on public digital projections as a medium, which is the medium I used to create my personal projects and I will analyze a technique that is used to project on irregular surfaces: projection mapping.

2b. Video projections and projection mapping.

What is projection mapping?

Projection mapping is the display of any visual content on a non-flat or non-white surface. It has other alternative names including the original academic term "spatial augmented reality" and "video mapping."[113] It turns objects or surfaces, often irregularly shaped or of various materials, into a display surface for projection. Various surfaces could include landscapes, buildings, fabrics, solid or liquid, transparent, opaque or semi-transparent surfaces of any size and any shape. Special software adjusts the visual content for each kind of surface. This technique is used by artists both indoors and in public spaces. It can be combined with sound and other technologies, like motion tracking to create interactive experiences. This technique is also used in the context of cultural heritage as it combines entertainment with education of the public. Finally, it is also seen in stage design and in advertisement.

History of projection mapping technology.

The first known and successful projection onto a non-flat surface was made for the opening of the Haunted Mansion ride in Disneyland in 1969. The ride included several optical illusions. One of them was a disembodied head and five more singing busts. The technical and artistic crew of the show filmed the heads of the singers (with 16 mm film) and then they projected it onto the busts that were copies of their faces.

In 1980, Michael Naimark created an immersive film installation, called "Displacements". A living room with two performers was filmed by a rotating camera. The room's surfaces were afterwards

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113 Jones, "What Is Projection Mapping?"

painted white. A projector was placed where the camera was. The rotating projector was revealing the real room wherever it was pointed at.

Disney was probably the first to patent the technology of video mapping in 1991.[114] They described the way to paint an image onto a three-dimensional object. General Electric patented in 1996 the method of "superimposing images of computer models in three-dimensional space to a corresponding physical object in physical space."[115] Raskar et al. at the SIGGRAPH conference in 1998 talked about their vision of the "Office of the future."[116] They described an office where projectors could display video and 3D content on any surface and in which we would communicate with life-size virtual images of our colleagues. Moreover, a real-time 3D scanner, a forerunner of Kinect, was included in the office of the future.

Projection mapping went a step further with the research of John Underkoffler, Daniel Chak, Gustavo Santos and Hiroshi Ishii in 1998. "The I/O Bulb"[117] and the "Luminous Room"[118] where two projects that made interactive projection mapping possible. The system included a projector and a camera. This way every surface could display image from the projector and at the same time collect data with the camera. In return the camera would give feedback to the projector and then readjust the projection according to new data. Models of lasers, mirrors and lenses were also used to complete this interactive system.

Raskar et al. presented in 2001 his work on "Shader lamps."[119] The projectors were called shader lamps because they could animate graphics on real physical objects. The were also able to reproduce specular appearance with the use of two projectors and a computer and digitally paint real-time the objects' surfaces. Each projector could calibrate the object in a five minutes taking a few coordinates. The next step of their research was "Dynamic shader lamps."[120] They made possible to light paint moving objects through a projector. Finally, in 2004 with the "RFIG lamps"[121] the projectors became movable and hand-held. They could store data from tagged objects and process and re-store that data. This is made possible through RFID technology and a projector enhanced with a camera, lasers, mouse buttons and inertial sensors to enable stabilization and interaction. These projectors could help in warehouse inventory and repair of damaged goods.

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114 Monroe and Redmann, Apparatus and method for projection upon a three-dimensional object.
115 Graham, Wang, and Stephens, Projection of images of computer models in three dimensional space.
116 Raskar et al., "The Office of the Future: A Unified Approach to Image-Based Modeling and Spatially Immersive Displays."
117 Underkoffler, "The I/O Bulb and the Luminous Room."
118 Underkoffler, Ullmer, and Ishii, "Emancipated Pixels."
119 Raskar, Welch, and Chen, "Table-Top Spatially-Augmented Reality: Bringing Physical Models to Life with Projected Imagery."
120 Raskar, Bandyopadhyay, and Fuchs, "Dynamic Shader Lamps."
121 Raskar et al., "RFIG Lamps."

Finally, Bimber et al. created a system of a projector combined with a camera that could scan the projection surface and make color and shape corrections, making possible the combination of background and projected image and the projection on curved surfaces like colorful drapes.[122] Lightform made object surface mapping possible for consumers with the new Lightform projector that has a camera and a computer embedded. The device scans the projection surface and contains software for the instant creation of visuals adapted on the specific surface. Alternatively, they provide the LFC kit that can be attached to any projector.

Powerful projectors (of high-lumens and high-resolution) and software are essential tools for video mapping. The software maps the coordinates of the objects and adjusts the image in the case of multiple projections or complex shapes. There is also the possibility to bring 3D models into the software and adapt the visuals on them. The 3D model can be created with the technique of photogrammetry, especially when the projection is designed for large buildings, to achieve better results. There is a variety of software available for projection mapping (Watchout, Touchdesigner, Modulo Pi, Smode, MadMapper, vpt8 etc.), each one with different features. Projection mapping is a new medium for artistic expression. Combined with other equipment like cameras, sensors and microphones, Arduino or Raspberry Pi and other devices it can lead to interactive experiences for large audiences.

Public art with interactive video projections.

Projection mapping has become popular over the years as many artists use this technique. Many projects could be mentioned, but we will describe only a few. One example of interactive projection mapping in public space is the project "Diagonales" by Théodore Ushev and Iregular, in 2014. "Diagonales" uses a three-metre-high steel monolith to "sense" people's scratching on its surface and it triggers audio and visuals relevant to three Norman McLaren films: "Horizontal Lines", "Vertical Lines" and "Synchromy". McLaren was one of the pioneers in animation. He experimented with film and sound. By scratching magnetic tape he created sound for his films. This artwork is a tribute to his work. The technology used was contact microphones, sound monitors and projectors. The graphics were projected on the building of the "Bibliothèque et Archives nationales du Québec" in Montreal.

In the same year, Klaus Obermaier presented the "Dancing House" at the Light Festival in Gent. The project was an interactive projection mapping and sound installation. Users could distort the visual

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122 Bimber et al., "Superimposing Pictorial Artwork with Projected Imagery"; Bimber, Emmerling, and Klemmer, "Embedded Entertainment with Smart Projectors."

graphics projected on a house simply by moving their arms back and forth. The image was accompanied by sounds of wild wind.

Video mapping is also used in stage design and theater costume. In 2002, the composer Andre Werner was asked to compose an opera for the Biennale of Munich. He cooperated with Buro Staubach and ART+COM to design interactive scenography that would support the musical composition. The opera was called "The Jew of Malta" adapted by the text of Christopher Marlowe in 1590. A 3D model of a convent was projected on three large planes. The view of the 3D model would change perspective following the protagonist's movement, tracked by a camera. Other graphics were projected on the singers' costumes. A tracking system developed especially for this opera, could produce digital masks in real-time. The graphics were then projected on the masks exactly fitting onto the singers. A different texture corresponded to each psychological state of the singers.

Image 27: Klaus Obermaier, Dancing house, 2014, Ghent, Light Festival, photo by the artist.
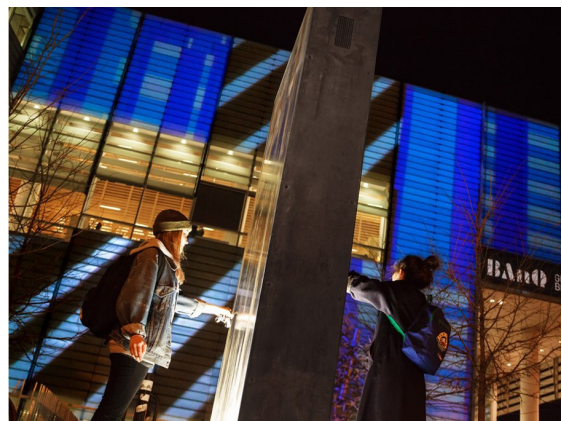
Image 28: Théodore Ushev and Iregular, Diagonales, 2014, Montreal, photo by Emesval.

Projections are also preferred by many street artists. Video projections for guerrilla art could be a positive alternative. They are not permanent, and they don't vandalize buildings. Thus, most of the times they are not illegal. It is a way to spread art in the city in an impressive way. Some street artists even project while they are driving a bike or car, specially adapted to carry all the necessary equipment. This way they can project on many different and unusual spaces, giving life to the urban environment.

Video mapping and projections of visual art in general have the power to create memorable experiences and it can be exploited as a medium for interactive art in public spaces. Its ephemeral nature makes it ideal for urban environments where many different people meet and a public consensus

would be required for a permanent public work of art. Apart from its entertaining side, it can carry messages, it can educate the public and provoke thought on various issues. However, there are practical and ethical issues concerning public art in general, that should be taken into consideration by artists.

Image 29: Vj Suave with his projection tricycle, photo by the artist.

Image 30: James Powderly, L.A.S.E.R. Tag, 2007, Rotterdam, Graffiti research lab.

3. Points of consideration for the public:

Practical problems

The process of creating a work of art for a public space involves the consideration of issues that are uniquely related to the particularity of the space. Very often art is made to cover practical needs like shading or seating or for commercial purposes. In other cases artists have to change the concept of their project in order to win the acceptance of city councils or community committees and get the commission. It would be ideal if all art was paid, but it would be better if it was not done at the expense of the artistic purpose. Likewise, sometimes the public doesn't accept the work of art because they cannot understand or identify with it. The permanent nature of some works of public art "forces" the inhabitants to confront them every day. Public art must be made durable and be protected from vandalism or even from damages from natural causes. In the case or interactive art it should also be fortified against extensive or bad use. Concerning the content of the art work, creators should also consider whether their work will be just a display of technological achievements or if it will have a real importance for the community.

Ethical issues

Apart from the practical issues, ethical also emerge. A public work of art, especially in urban spaces that are highly populated by people from different backgrounds, should not cause social conflict. It cannot offend or incite hate for any ethnic, religious or social group of people. Artists should be sensitive to local ethics and values, because a public artwork cannot be avoided. One can chose not to go to an art gallery if he does not appreciate a certain form of art, but its not easy to avoid seeing a work of art when it is on the street. The streets belong to all the citizens. There are many cases of vandalism worldwide just because a public work of art was not accepted by a group of people. A good example is the statue of Donald Dewar, father of the Scottish Parliament, in Glasgow. The statue has been repeatedly vandalized since it was unveiled by Tony Blair outside the city's Royal Concert Hall in May 2002. Moreover, public art should not disturb the life of the inhabitants, violate their privacy, or endanger their health and safety in any way. Finally, in the case of art in the natural environment, ecologic materials should be used, so as not to cause pollution and environmental degradation.

Conclusion

In the first part of this thesis, we saw that public art has long history and many forms, and we focused on interactive digital art in public space and digital projections in particular. Moreover, the importance of art for human mental and physical health has been discussed extensively in this thesis. We also talked about the power that public art has to affect the community. The social aspect of art was the starting point for this thesis. Many artists have and will continue to work for this purpose. Public artists, more and more think about their role and their responsibility towards their viewers and the community as scientific research is further investigating the effect of art on humans. Art has the ability to make a difference in people's lives, to inspire people and communicate with them. Artists themselves can be inspired by this possibility and maybe redefine their role in society. This thesis is being written at the time of the confinement due to the COVID-19 pandemic. Now more than ever, people understand how important art can be for people. Artists can give hope, give food for thought, unearth the truth, express the public feeling, create a sense of community and make life in the community better.

B. CREATION : THE WHAT

In the spring of 2019 I decided I was more interested in digital interactive art and in particular projections is physical space. I tried various projection mapping software programs, like VPT8, the Keystone library for Processing, Smode and Modulo Pi. After some experimentation in decided that I was more familiar with the logic of nodes used in Touchdesigner software, because I was working in the past with Blender. Touchdesigner had a lot of potential for various complex uses and it was not designed only for projection mapping. It could also be customized through python code to fulfill many purposes.

1. Airport project

In the summer of 2019 I started working at the Athens International Airport as a check in agent. Every day I was meeting hundreds of people from all over the world. It was a thought-provoking experience for me. People can be very interesting but also very rude. I was interacting with people from various backgrounds. I was wondering where do they come from, what are they thinking, why are they here and what were their lives like. Do they have anything in common?

So I thought of using this experience as a theme for an interactive installation at an airport. Almost every day I was recording noise and sounds from the airport. However, I was also wondering about the people and their stories. So I thought of using data as a source. I made up a list of fictional names, flights, dates, seat numbers etc. and put all these in a data sheet. Then I thought of adding the people's thoughts. So it would be interesting if the users/viewers could type in their thoughts along with their names and project them on a surface at the airport.

I added the data as a source for this project because I wanted it to seem personal in contrast with an impersonal public space from which almost everyone's presence is ephemeral and communication is established mainly on text. According to anthropologist Marc Augé, airports are non-places. They are places from where people pass thought and where time is the most important factor. People's identity is examined only on entering or exiting the space and not for forming a relation. So Augé claims that: "If a place can be defined as relational, historical and concerned with identity, then a space which cannot be defined as relational, or historical, or concerned with identity will be a non-place."[123]

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123 Augé, Non-Places, 77–78.

The project was created in TouchDesigner. The data from the table is showing up line by line in a random order. This was implemented by using a Table DAT and several Convert, Select and Merge DATs to select only the data I needed and present them in the right form and order for my purpose. The final Convert DAT was set as DAT parameter to a Text TOP and connected with a Math CHOP that gave a random raw number to a slider COMP. The slider was programmed to move automatically with an LFO CHOP connected with a Math Chop that was triggered by a CHOP Execute DAT with Python code. The text was visualized with a Constant MAT and a Geometry COMP connected with the Render TOP.

The particles were created with a Particle SOP. The particles were following the shape of a curved animated line, as seen in the image. Channel 1 was selected from the sound input and was set as a CHOP parameter to a CHOP to SOP. That way the line was animated based on the sound input. For the testing of this project I used prerecorded sound. Yet in real space the real sound would be used instead as input with an Audio Device In and an Audio Device Out CHOP.

The birth parameter of the particles was modified by the Timer Fraction parameter of a Timer CHOP, mapped by 600 with a Math CHOP and connected with an Animation COMP. Both the particles and the text were sent to a Render TOP connected with a Camera COMP to become visible. Then their appearance was changed with several TOPs, including a Ramp and a Level TOP for the color and Feedback and Blur TOPs for the general appearance.
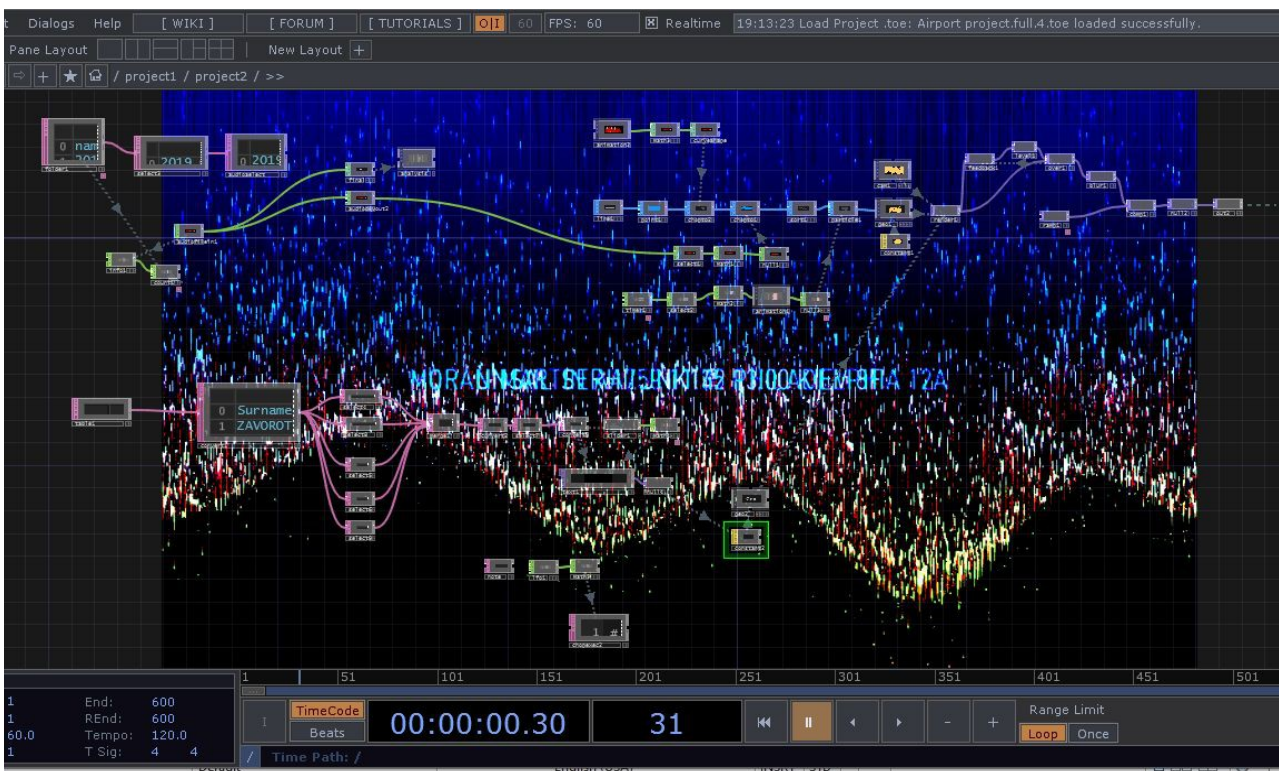
Image 31: Airport project, projection 1, node composition.

In the second screen of the installation the users would be able to type text to be projected in space. A similar structure was used. I made a few changes in the structure of the particles. Now they could move vertically from bottom to top. I replaced the Line SOP with a Sphere SOP and simplified the sequence of nodes. I also changed the Mass and Drag parameters of the Particle SOP.

The biggest difference in the second projection screen is the text. The text was not stored now, it was generated by the user. For that reason an interface was needed. In a Container COMP I created two fields of text input with two Field COMPs. The Container was set to be visible in the projection so that the user and the viewers could see what is typed in real time, before it is visualized. Then each text input was visualized with a Text TOP, a Geometry COMP and a Constant MAT as usual.

Image 32: Airport project, projection 2, node composition.

Finally, both screens were set as texture material in the shapes created in Kantan Mapper Interface. This way projection mapping would be possible. In a real airport the two screens could be projected on a corner of a room or on two large objects like two white suitcases. However, a test at an airport was not possible for this thesis. Instead, I tested my project by creating a composition of two white canvases as seen in the image below and with the recorded sound of the airport. Therefore, I consid-

er this as an experiment that helped me learn how to use the software and advance my skills. It has the potential to be projected in the future in a real public space, like an airport or a metro station.
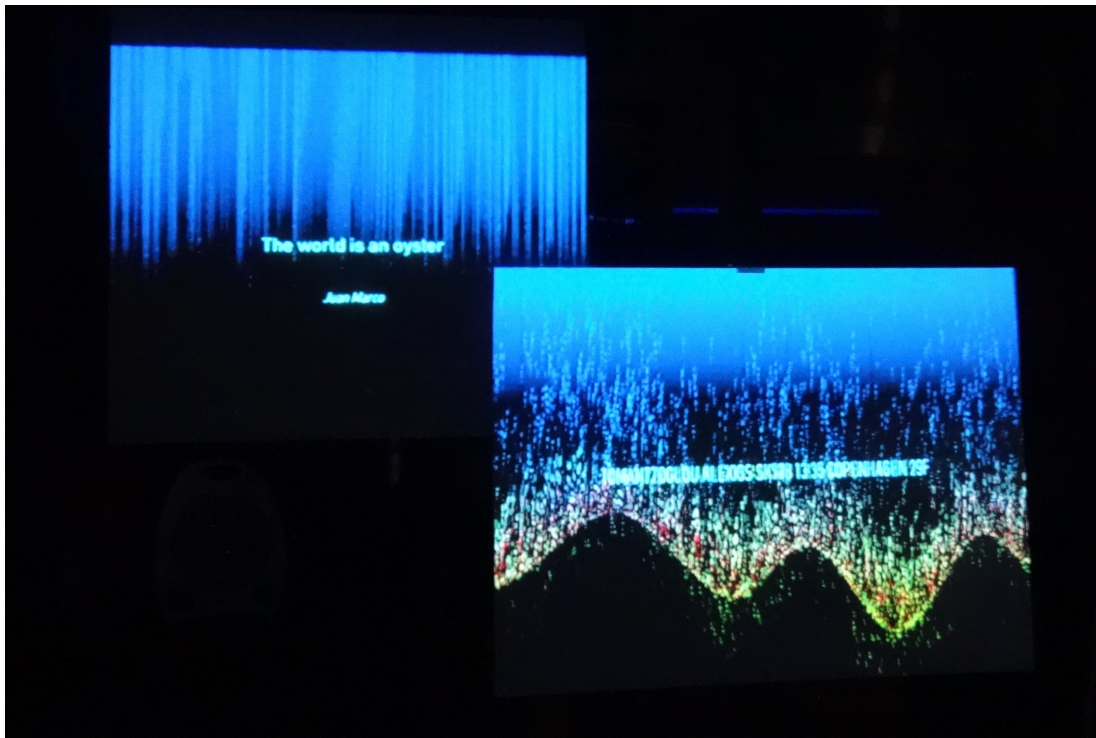
Image 33: Airport project, projection mapping with Kantan mapper on a composition of canvases.

2. Experiments with Kinect- January intensive project

In January 2020, I had the chance to experiment on the idea of movement interaction and the combination of different types of software with the purpose of combining various forms of input and output. It was a group project with Elena Charopoulou, Katerina Kardasi and Houssem Mtir. We worked on the idea of making a 3D face model interact with the movement of a real face. We used Kinect to capture motion of a real face in combination with Unity software. Our intention was to project graphics on the digital face that would change by a trigger incident. At a second level, the position of the face would create sound through OSC and Super Collider. We also wanted to include physical objects in the installation and therefore we worked with Arduino as well.

I started working with the 2D animations. We decided that the projected graphics on the digital head should be abstract. Therefore, I used Processing software to generate animated graphics and I exported every frame as a png file. Elena also created animations with After Effects. I also created a few 3d objects in blender and 3Ds Max to be used in our scene. Then, we decided that the trigger that would

change the various animations would be a collision of a 3D object with the 3D face. For this reason I created a code that would be added to the video player component in our scene. This code would change the video clips in the render texture of the video composer every time a certain animated 3D object, tagged with a specific name, would collide with the video component added on the 3D face.

During this project I had the opportunity to research on the connection of Arduino and Unity and on how to control 3D objects through a sensor. I hadn't used Arduino for a project before and this was a good occasion to study. I managed to make the connection, and I was able to change the position of an object by pressing Arduino buttons. After the end of the project, I researched more on the various inputs for my personal project. I managed to have a similar effect with other sensors, like photoresistors, thermistors, sonar sensors etc. But in the end I didn't include Arduino sensors in my projects.

Katerina had already worked with Arduino before, and thus, she handled the construction of the cubes and the connection with Unity. Apart from Arduino, I also looked for a way to project multiple cameras from the Unity scene through a projector in physical space. This was possible by connecting Unity with TouchDesigner and by using the Kantan Mapper interface. The connection between Unity and TouchDesigner was possible with the KlakSpout add on by Keijiro. I imported it into Unity and attached a Spout sender to each camera. Respectively, for each spout sender corresponded a "Spout in" component in Touchdesigner, that was set as texture in every shape created in Kantan Mapper. Our initial plan was two project two cameras on a corner. In the end, we put all our objects in one scene, and we only used one camera and only one projection surface. Our project was already too complex. Nevertheless, the research I did, helped me with my personal projects.

So the final project consisted of a 3D face that followed the movement of a real face through Kinect technology. The rotation of the head affected the creation of sound via OSC and SuperCollider. The user's touch on the cubes with the photoresistors affected the position of five rotating planets. The projected patterns on the face were changing every time a certain planet collided with the face. To sum up, this group project helped me advance my research for my personal project, because through it I experimented with projection mapping, the communication between different software packages, the creation of animations with Processing and coding.
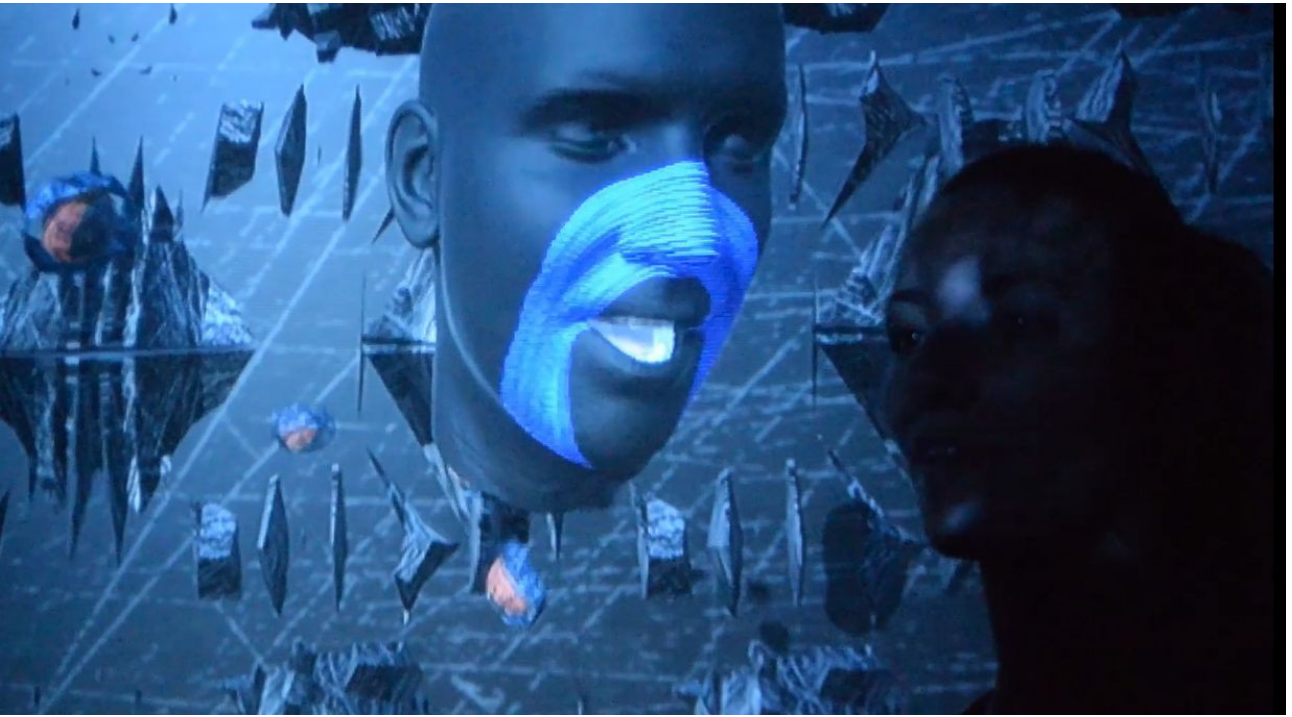
Image 34: Image from the final projection.

Image 35: Screenshot from Unity.

3. User Interaction through motion

The human form and its transfiguration is a subject that interests many artists. The history of theater and fine arts is connected to this idea. An artist is using color and form to represent reality. Abstraction disconnects the parts of a whole, to use them independently or present them in a different way. On the other hand, technology can create new and mixed realities.

Any performative art consists of three elements: the speech or sound stage, the play stage and the visual stage. Each stage form has a representative. The speech/ sound stage has the author (writer or composer), the play stage the performer, and the visual stage the designer. In interactive art the user can be at the same time a performer and a viewer. On a stage we see form and color in motion. The transformation of human figure in theater is possible through costume, make-up, masks and acting.[124] However, with new media technology there are infinite ways to transform the human form.

Working with Kinect X-Box 360, gave me the power to capture real form and movement and lead it to abstraction, to create a transformed reality. This new reality would be present in physical public space though projection, and compliment it in parallel to real presence and movement. That way, a new augmented space would be created and hopefully this would lead to social interaction between the participants and a positive experience.

I created two projects with the same equipment. The hardware I used was a Kinect X-Box 360 v1, a laptop and an Apeman LC550 portable mini projector. It was impossible to use Kinect v2, due to USB compatibility issue with my laptop.

3.1 Me³

For the first project, "Me³", I used two different kinds of software, Processing and TouchDesigner. In Processing I wrote the Java code that would create the visual graphics. In order to connect Kinect with Processing, it was necessary to import the Kinect4WinSdk library. I also installed the Minim library to import sound and the Spout library to connect Processing with TouchDesigner. I got the depth value from the Kinect with kinect.GetDepth(); command and I stored it in a variable in Processing. Then I loaded the sound with minim.loadFile ("filename.wav", 2048); and set up the Spout sender. Then with two for loops I set the index and the x,y coordinates for every three-dimensional cube I would draw in my frame. Then, I stored in a value the brightness of an array of the pixels in my

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124 Huxley and Witts, The Twentieth-Century Performance Reader.

image and mapped it from -150 to 150. The mapped brightness value was then related to the color and the size of the cubes. Then I added a rotation to the cubes in X and Z axis related to the frame-Count. That way the cubes would have a different rotation in every frame. Finally, everything was sent to TouchDesinger with this command : spout.sendTexture(); In TouchDesinger a Syphon/Spout in component would get all the data from Processing and send it as a texture of a shape created in Kantan Mapper interface. That way the Processing image could be mapped on the projection surface.

The equipment and the projection surface were set on the pavement outside my house. As a projection surface I chose a white cardboard of 70x100 cm, placed on a small easel. The projector was placed 63 cm from the ground and 146 cm from the projection surface. There was an inclination on the ground and on the projection surface that I tried to adjust with Kantan Mapper. The projector was put in a paper box to protect it from damages and give it the desired height. Kinect was wrapped with bubble cover and other protective material and placed on a tripod. Using equipment outdoors involves many dangers. All hardware must be protected by accidents, humidity, theft or bad treatment. Finding a power source in public space is also a problem, if the art project is not funded or supported by a local authority. The power supply and the type of projector I had, limited my choices of space. I used a power cable extension to get power from my house. There was not a big white surface available close to the projector and visible by the passers-by and the users, and that is why I chose the cardboard. I put it next to the Kinect to be visible by the users.

Image 36: Image from the testing of the project in public.

The people that participated played with Kinect for a long time. Initially one by one and then in groups of two or three, interacting with each other and inventing a spontaneous "choreography". The sound was calming and I think it inspired them to stay longer. After the end of their experience, I asked for feedback. They described "Me[3]" as a work of art that is playful and that encourages self-expression and freedom of movement. They also said that it reminded them of an abstract and interactive shadow play. Their overall experience was highly positive. It was also interactive with the computer but also with the other users.

"Me[3]" can be projected in the future on other more irregular surfaces, both in open or closed spaces. If I had the necessary equipment and power supply I would choose to project on the walls of the factory at the end of the street or on a big white semi-transparent sphere on a beach. Also in another time and place there would be more people to interact with the artwork. Nevertheless, this first test gave me the necessary feedback. I would classify this interactive project in the strategy of spectacle.

Image 37: People playing in groups.

3.2 Dancing Globes

In the same space and setting and with the same equipment I put my second project to the test. "Dancing globes", was created entirely in TouchDesigner. It is an interactive project that combines visuals with sound. The user's hand movement affects the position of the globes and the creation of sound. The experience of the user resembles that of a game, although there are no strict game rules or a task to be performed. The user is free to create visuals and sound. So, I am not sure whether to categorize it in the strategy of spectacle or the strategy of game.

The user's movement is detected with Kinect XBOX 360 v1 and through a Kinect CHOP component it is imported into TD. Then, four Select CHOP components, select the X and Y coordinates of the left and right hand. The values are then mapped with Math CHOP components and limited to the size of the screen with Limit CHOP. The X and Y coordinates of both hands are set as reference coordinates to the center of the globes. The X mapped coordinate of the right hand is also set as a reference for the amplitude parameter of one Audio Oscillator, and the Y mapped coordinate of the left hand is set as a reference for the base frequency of another Audio Oscillator CHOP. Each Audio Oscillator CHOP is connected to a Beat CHOP. The two globes -one for each hand- were created by a sphere SOP connected with a Particle SOP. A Wireframe MAT is set as a material to the Geometry component and a Noise CHOP as a reference CHOP to the Z axis of the scale parameter of the globes to add a pulse on their shape. Finally, a Feedback, a Level and an Over TOP were attached to the Render TOP to create
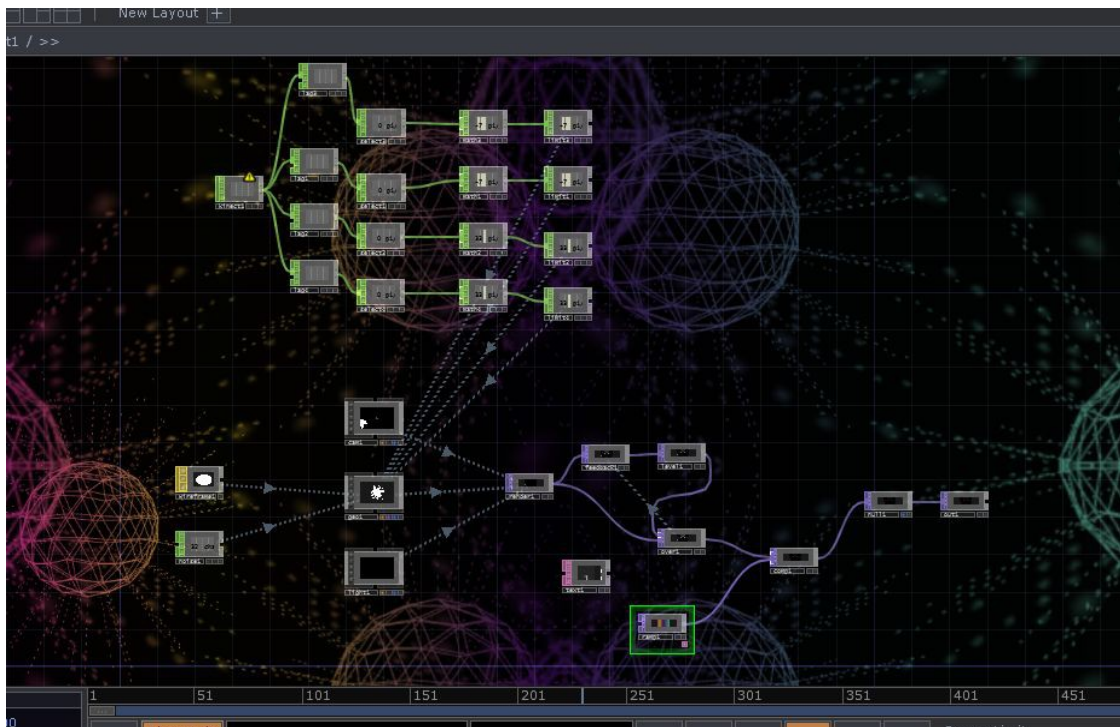
Image 38: Dancing globes, node composition in TD.

a mirror effect and a Ramp TOP to add color on the globes and the particles. Everything was then sent to Kantan Mapper Interface as a texture of the desired shape of the final projection in real space. I adjusted my projection in this way to fit the size of the surface.

The participants interacted with Kinect one by one this time. This was because of the different technical structure of the project. Kinect was programmed to detect one pair of hands each time. The users needed a small amount of time to practice their hand movement. They had to learn how to use both of their hands at the same time but in different directions, horizontally and vertically. It was almost like learning to play the piano. They described the "Dancing globes" project as more brainy, as an activity that requires a certain level of concentration. At the same time they said it was complex, unpredictable and impressive. One also described it as a quarantine rave party.

Image 39: Testing "Dancing globes".

The users that interacted with both projects valued their experience from the "Me³" project slightly higher than the "Dancing globes". I believe this is because "Me³" had no instructions of use and it allowed freedom of actions. Unfortunately, due to the COVID-19 pandemic the people that finally tested the project were not many. The de-confinement had started a few days before and the menace of infection was still present. Most people, even though they seemed interested in what was going on, they were prohibited from stopping, approaching and eventually interacting. I believe that the response would be different if the projects were set on a more central area and if the projections were of large scale.

Image 40: A man playing with Dancing globes.

4. #helloWorld : The real space becomes a dataspace

During the confinement period caused by the COVID-19 pandemic, artists around the globe were thinking of ways to continue making art and showing it to the world. Human contact with non family members was prohibited. Even art in public spaces was not an easy task if it presupposed human interactions. Therefore, I thought that the only possible way of making interactive public art for these circumstances was the cyberspace. Many artists performed live on the internet in front of a global audience that could interact by sending messages or by a camera. In my case, the space had to be also physical. Therefore, I thought of bringing the internet in the real space and create a hybrid space without the need of physical human contact.

Being unable to present the Airport project at a real airport I thought of keeping the idea of sharing people's thoughts, but on a specific subject: the COVID-19 confinement. This time the users were not limited by location. Any person having access to the internet could participate. I chose Twitter as my pool of data because it is a platform that it is primarily designed to share ideas in text and not to share personal data with a closed group of friends. I was interested only in text messages and not media and web links.

In the beginning I tried to connect TouchDesigner with Twitter. The connection was made but I could not find a way to pick one status at a time and visualize it. The status updates were flowing the one after the other. What is more, I didn't know how to visualize that data. Therefore, I started looking for a way to connect Processing software with Twitter.

This was made possible through, Twitter4J, an unofficial Java library for the Twitter API. It was also necessary to create a developer's account on Twitter and create an application, to get the four access keys that would connect my Twitter account with my Processing sketch. After that, I added the four Twitter4J library files into a sub-folder in my Processing sketch folder and imported the library into my sketch. I also created an Array list for the incoming tweets and initialized my variables. The next step was to make three void functions. One that would set up the four access keys, configure the connection with Twitter and set the keywords and criteria for the query like so:

```
void openTwitter(){

ConfigurationBuilder cb = new ConfigurationBuilder();

cb.setOAuthConsumerKey("xxxxConsumer Keyxxx");

cb.setOAuthConsumerSecret("xxxConsumer Secretxxxx");
```

```
cb.setOAuthAccessToken("xxxAccess Tokenxxxx");

cb.setOAuthAccessTokenSecret("xxxAccess Token Secretxxx");

twitterInstance = new TwitterFactory(cb.build()).getInstance();

queryForTwitter = new Query("#helloWorld"+"+exclude:links"+"+exclude:retweets"); }
```

As seen above I set the keyword to be the hashtag #helloWorld and also to exclude the tweets with links or retweets. This function is called inside the void setup () function.

The next two functions are called in void Draw () function. The first — the void GetTweets() function — includes all the necessary code to make a twitter query and get related tweets according to our search criteria. This function stores the search results in an Array list with the try keyword. In case Twitter API calls fail, catch keyword will catch a TwitterException and a message will be printed to the console area.

Then, the void DrawTweets() function selects what kind of data we will collect from the tweets and makes that data visible to our screen. With getUser().getScreenName(); we get the users screen name. With getText(); we get the content of the tweet and with getUser().getLocation(); we get the location that each user has typed as his location on his profile. If the user hasn't given his location then no location appears on the screen. With text() function our data becomes visible after we set the text font and size, the color and other parameters.

After calling the GetTweets and DrawTweets functions in void Draw(), I set a delay of 8 seconds. Twitter has a limit of status queries per day per application. That means that without this delay Processing will make a search in every frame, until we reach very soon the allowed limit of requests. In void Draw () I also draw the hashtag text with a transparency as a background watermark.

I tried to connect my Processing sketch with TouchDesigner through spout library in order to map my projection with Kantan Mapper interface, but I was getting the following error: "Target VM failed to initialize". I tried to make my sketch three-dimensional with "P3D" in the size (); function but then each frame was accumulating on top of the previous and I would get the result seen in Image 41.

So the only option I had was to adjust the projection with code. My projector was fixed on the balcony of my house and it was facing down on the pavement. The height of the projector was about 3 meters and 40 cm from the ground and its maximum distance from the bottom border of the projection surface was 5 meters and 35 cm. The projection surface was plain gray cement.
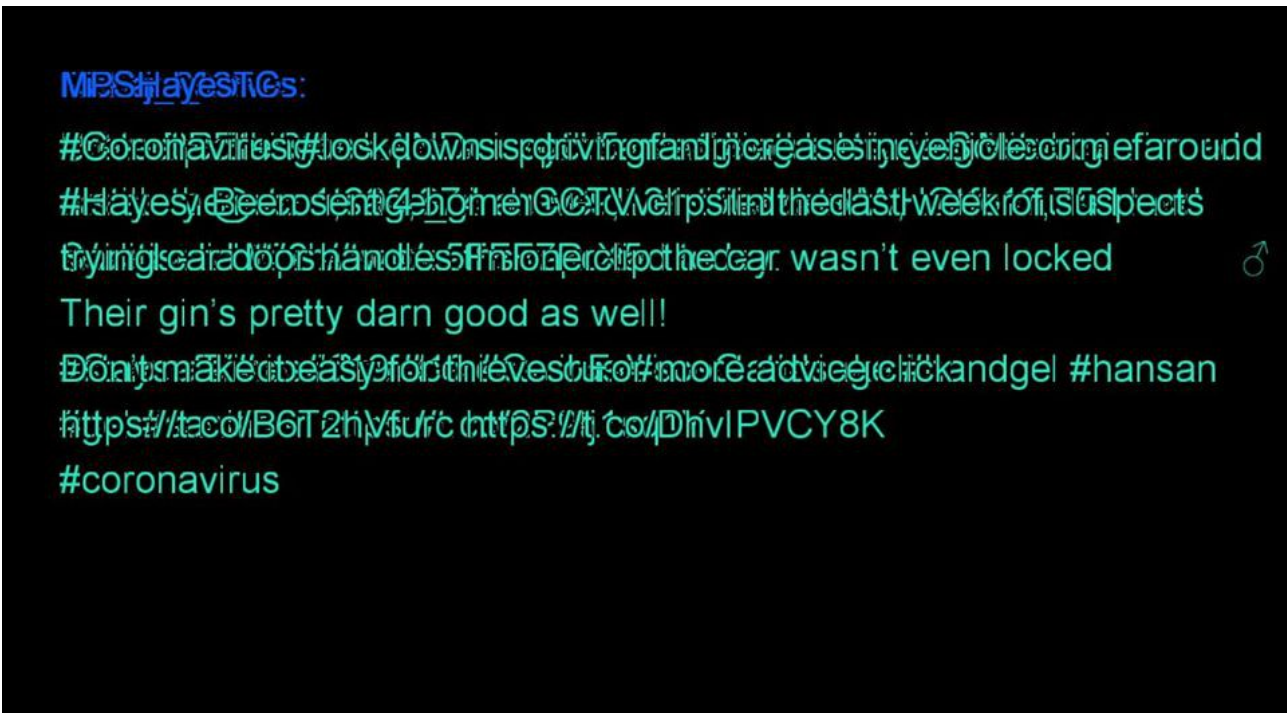
Image 41: Error after adding P3D or P2D in the Size () function.

I wanted the text to be readable from the passers-by, so I had to flip my image horizontally and vertically and scale it, with pushMatrix/popMatrix () and scale() functions respectively. I also used translate () to bring my projection more to the center of the surface. The font that I used was Arial because it can work with many languages. I didn't know what languages the texts would be in or how long they would be. So, I had to leave enough space before the location text that was on the bottom right of my frame. This made my screen look somehow empty in small texts but full in really big texts in languages like Arabic for example. I used a minimal aesthetic in the format of the text because I wanted to put the emphasis on the content and not the form.

The projection space was at the end of a small boulevard in Alimos, a southern suburb of the greater Athens city. I chose the hashtag #helloWorld that is not so often used on Twitter and it is the first thing someone learns when he or she is learning to code. It is also relevant to my concept: the message everyone would send to the world during the COVID-19 pandemic. I created an event on Facebook to call people to participate at a certain day and time. The event took place in two consecutive nights. Live and recorded videos from the projection were broadcast from my twitter account (@New_Medea).

At the end I realized that those who participated enjoyed the experience. I asked the opinion of those that I knew, after the end of the project. This is how they described their experience:

"It was an interesting experience that initially I felt it as a desire to share a personal thought and afterwards as a desire to communicate with the passers-by at the projection space, but also with all the others who tweeted. I also felt like a castaway who is sending messages in the hope that they will be read." *Vasiliki Michalopoulou*

"Original, fun, motivating" *Elena Charopoulou*

"Even though when you are writing a tweet it is certainly public and anyone can see it, I somehow had the sense that by projecting it on the street it became even more public, because it is in real space. I had this sense, even though on twitter more people will see it, it stays there etc. With the projection I felt that what I am writing is in the public discourse sphere..." *Anna Gradou*

Of course all messages in public spaces are part of the public sphere and public discourse. Every person that reads it will consciously or subconsciously interpret it and decide what he or she thinks about it. However, we don't know if a message that is displayed in physical space is viewed by more people than that displayed in a virtual community, a forum or on a social media platform. It depends on how much "traffic" there is on the street or in the virtual space.

Another participant that had no previous experience of how Twitter works had a different view :

"It didn't seem that public to me, that's why I was writing nonsense. The real time feedback was fun, where you could see what you were writing instantly. I also didn't have tweeter before, and I created a profile only for this event. So, I didn't have followers and a social entourage. I was completely clueless about Twitter."

Katerina Kardasi

Perhaps the fact that the camera in live view showed mainly the projected screen image and not the people passing by and reading the text messages, may have given to some the idea that there was no real audience. In the demo video and in the pictures, it is obvious that it is a street with traffic and people passing by. Of course, it was not a central part of the city with large traffic. Unfortunately, I did not have this option, because of the lack of power supply and stable wireless connection. That would require an agreement with the municipality or a private entity.

Nevertheless, many people stopped and read the texts and the sign with the calling to participate. Unfortunately, participation from the passers-by was very low. I think the reasons behind this were probably site specific. If the event had taken place in a more central area with public or private spon-

sor and it was advertised before, then people would be familiar with the idea, and trust the organizers more. It would be a bigger social event and everyone would feel safe to participate and share their account information in public. What is more, the presence of a camera might have stopped some from participating and people in this city are not used to seeing that kind of projects in the neighborhood. Usually digital art is hosted by large cultural foundations and festivals. It is not common to see digital art outside of this context and maybe those who passed by were not familiar with this idea and could not understand it. Some might also be suspicious and afraid of being hacked. Others might not have had a Twitter account. I believe that if the project was repeated in another setting and with official support the participation would be higher.

However, the application is not developed enough to filter irrelevant or unwanted messages with the right hashtag. For example, some used the #helloWorld hashtag but their message was an advertisement of themselves or a message irrelevant with the COVID-19 pandemic. There can also be ethical or legal issues involved in the case of messages that are offensive or abusive or the content that is not approved for all ages. A street is open to everyone and it does not come with a remote control to turn off something you don't want to see, or with a ticket to decide whether you want to buy or not. In public advertisement there are laws that define what can be shown in public and to which audience. In art things are different. You have to simply deal with it. Consequently, artists who show their work in public spaces should take this into consideration as well. Probably in the future I could find a way to develop the code to filter abusive or irrelevant content and also use the real location of each user by their IP address. Only that way this project could be presented to a larger audience.

Image 42: My projector attached to the exterior of the balcony.
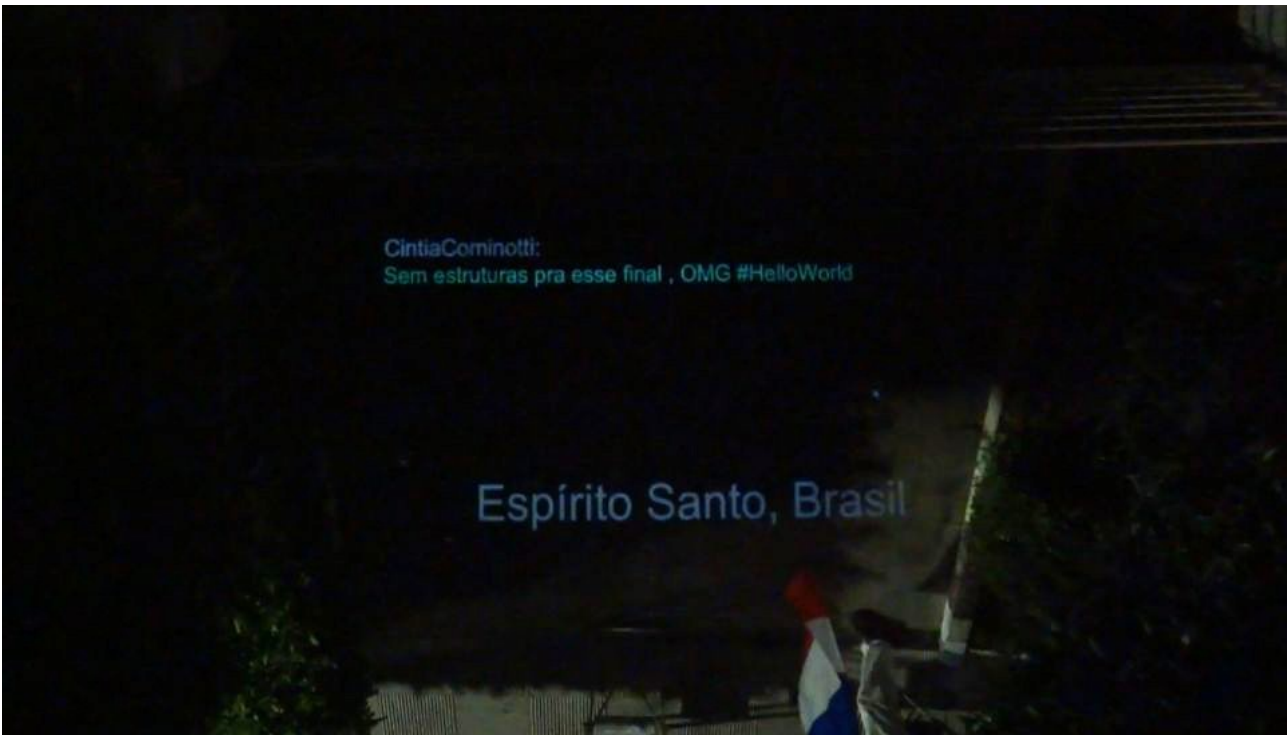
Image 43: Twitter message from Brazil.
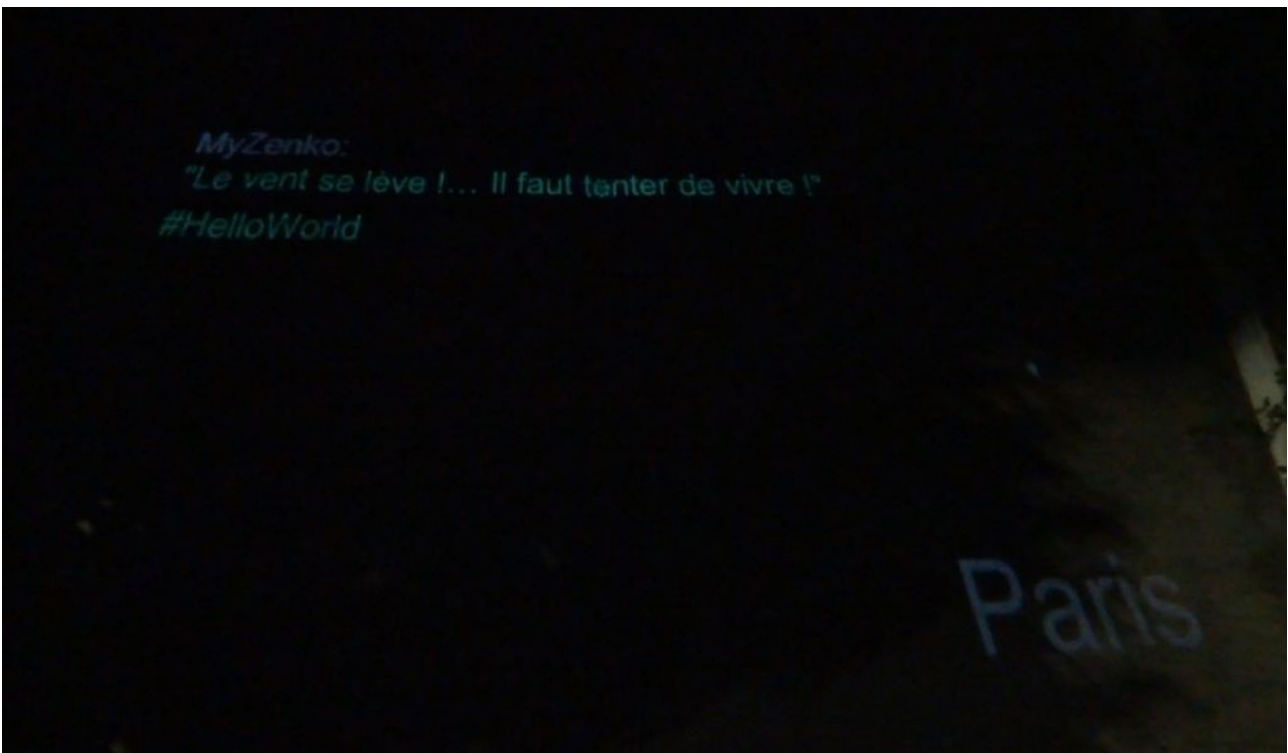
Image 44: Twitter message from Paris.

Image 45: Greetings from Paris to Athens.

Image 46: Twitter messages about the pandemic.

Image 47: Message about social distancing.
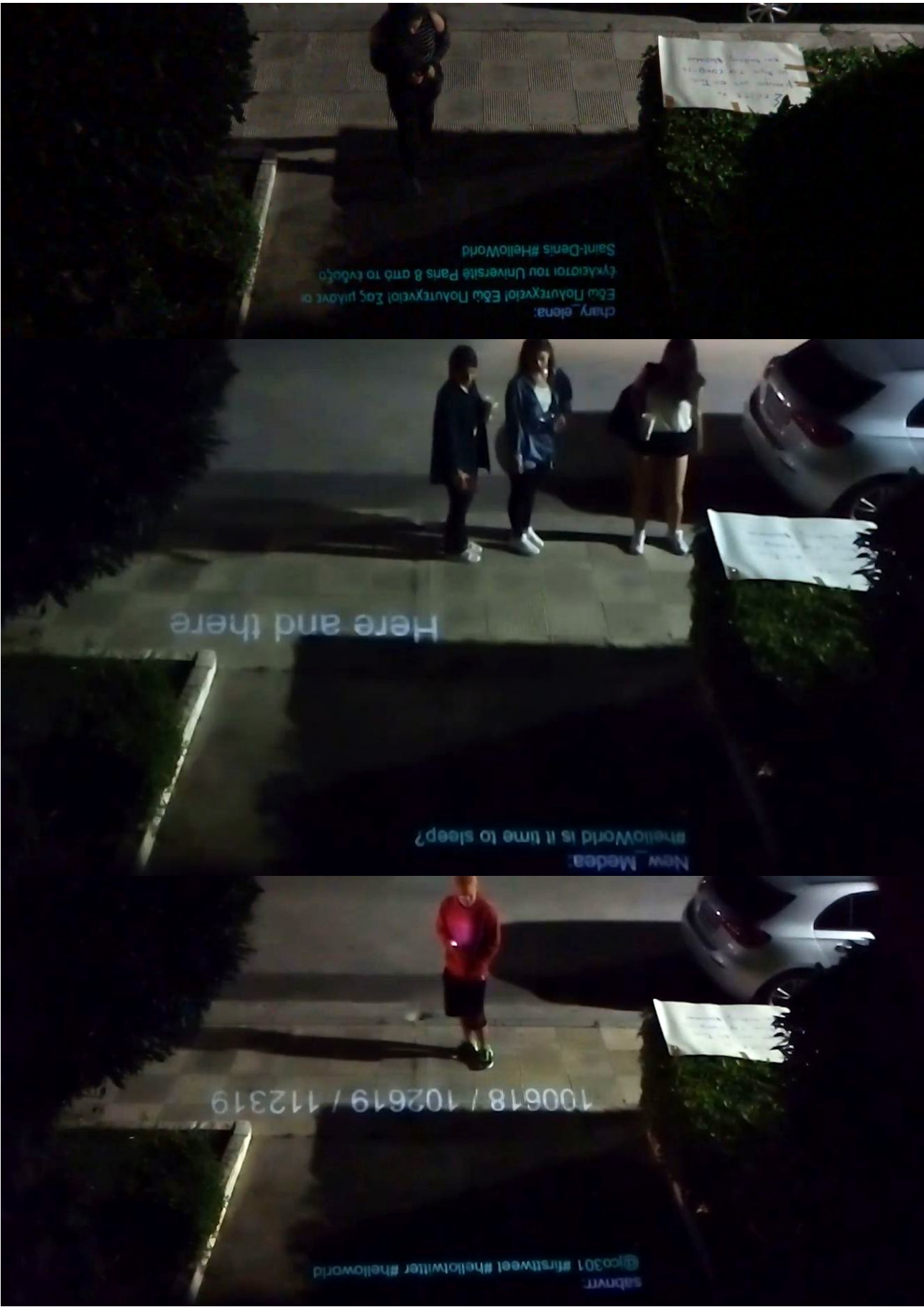
Image 48: People on the street interacting with #helloWorld.

Conclusion

Through my experiments and the projects, that I finally completed and put to the test, I gained a wider knowledge of various software packages and of coding. I also learned how to use hardware like the Kinect, projectors and Arduino. I tried to include Arduino in one of my projects but I realized that this kind of material is sensitive and it can only be used when there is no contact with the user. A humidity or another environmental sensor would detect really slow changes and it would not lead to user interactivity. The sensors would have to stay outdoors for long, along with all the equipment. An ultrasonic sensor alternatively, would offer more interactivity but not more than a Kinect.

The equipment used cannot stay outdoors without supervision, unless another way was found to secure it from theft, humidity, heat or vandalism. Hence, I consider my projects as ephemeral public art in their current state. If all the equipment could be secured behind the window of a gallery, then the artworks could be in available for interaction for longer. However, there could be no sound. Sound in inhabited areas can be annoying if it lasts long and if it is not imitating natural sounds. "Me^3" and "Dancing globes" are therefore ephemeral forms of public art. However, they are not limited to open spaces and neither is "#helloWorld". They could also be presented indoors as long as access to the public is unlimited.

Concerning the response of the users, we can conclude that the projects that are less complex and promote free expression are mostly enjoyed. "Me^3" was the most human-to-human interactive project, compared to the other two. Of course, it is impossible to measure the impact of the projects on the community in such a short time of trial. These effects can be measured by long term research and many factors would have to be considered. It could be the subject of a longitudinal social study. However, this certainly exceeds the purpose and limits of this thesis.

Perhaps the next challenge for art is to open its "doors" to everyone. This would mean that the people would have to become familiar with seeing other forms of art in their neighborhood, apart from sculptures in forgotten places and paintings behind the windows of galleries. They should be invited to participate and interact with art and with each other. Digital art offers infinite possibilities to bring art to the street, and to be engaging even for the less educated. It also has the potential to create relations, to strengthen the social bonds in neighborhoods and change the life of local communities. It is up to the artist to decide what will his place in the community be and what is the impact that he wants to leave on people with his art.

BIBLIOGRAPHY

Abreu, José Guilherme. "Public Art as a Means of Social Interaction: From Civic Participation to Community Involvement," 2019, 159–74.

Ader, Robert, and Nicholas Cohen. "Psychoneuroimmunology: Interactions between the Nervous System and the Immune System." *Lancet* 345, no. 8942 (January 14, 1995): 99–103. https://doi.org/10.1016/S0140-6736(95)90066-7.

Ascott, Roy. "Roy Ascott: Behaviourist Art and the Cybernetic Vision," 2005.

———. "The Construction of Change." *Cambridge Opinion*, no. 41 (1964): 37–42.

Augé, Marc. *Non-Places: Introduction to an Anthropology of Supermodernity*. London ; New York: Verso, 1995.

Azuma, Ronald T. "A Survey of Augmented Reality." *Presence: Teleoperators and Virtual Environments* 6, no. 4 (August 1, 1997): 355–85. https://doi.org/10.1162/pres.1997.6.4.355.

Baudrillard, Jean P. *Selected Writings*. Edited by Mark Poster. 2nd edition. Stanford: Stanford University Press, 2001.

Beck, Suzan L. "The Therapeutic Use of Music for Cancer-Related Pain." *Oncology Nursing Forum* 18, no. 8 (December 1991): 1327–37.

Berger, Peter L., and Richard J. Neuhaus. *To Empower People: The Role of Mediating Structures in Public Policy*. Ex-Seminary Library edition. Washington: Aei Press, 1989.

Berkman, Liza F., and Leonard S. Syme. "Social Networks, Host Resistance, and Mortality: A Nine-Year Follow-up Study of Alameda County Residents." *American Journal of Epidemiology* 109, no. 2 (February 1979): 186–204. https://doi.org/10.1093/oxfordjournals.aje.a112674.

Bimber, Oliver, Franz Coriand, Alexander Kleppe, Erich Bruns, Stefanie Zollmann, and Tobias Langlotz. "Superimposing Pictorial Artwork with Projected Imagery." *IEEE MultiMedia*, 2005, 11.

Bimber, Oliver, Andreas Emmerling, and Thomas Klemmer. "Embedded Entertainment with Smart Projectors." *Computer* 38, no. 1 (January 2005): 48–55. https://doi.org/10.1109/MC.2005.17.

Bolter, Jay David, and Diane Gromala. *Windows and Mirrors: Interaction Design, Digital Art, and the Myth of Transparency*. Cambridge, MA: The MIT Press, 2005.

Bordewijk, Jan L., and Ben van Kaam. "Towards a New Classification of Tele- Information Services." *InterMedia* 14, no. 1 (1986): 16–21.

Broeckmann, Andreas. "Public Spheres and Network Interfaces." In *The Cybercities Reader*, edited by Steve Graham. London ; New York: Routledge, 2003.

Bucy, Erik P. "Interactivity in Society: Locating an Elusive Concept." *The Information Society* 20, no. 5 (November 1, 2004): 373–83. https://doi.org/10.1080/01972240490508063.

Bygren, Lars Olov, Sven Erik Johansson, and Benson Boinkum Konlaan. "Sustaining Habits of Attending Cultural Events and Maintenance of Health: A Longitudinal Study." *Health Promotion International* 16, no. 3 (September 2001): 229–34. https://doi.org/10.1093/heapro/16.3.229.

Bygren, Lars Olov, Benson Boinkum Konlaan, and Sven Erik Johansson. "Attendance at Cultural Events, Reading Books or Periodicals, and Making Music or Singing in a Choir as Determinants for Survival: Swedish Interview Survey of Living Conditions." *BMJ (Clinical Research Ed.)* 313, no. 7072 (December 21, 1996): 1577–80. https://doi.org/10.1136/bmj.313.7072.1577.

Bygren, Lars Olov, Boinkum Benson Konlaan, N. Björby, Gosta Weissglas, Lena G. Karlsson, and Maria Widmark. "Attendance at Cultural Events and Physical Exercise and Health: A Randomized Controlled Study." *Public Health* 114, no. 5 (September 2000): 316–19.

Bygren, Lars Olov, Boinkum Benson Konlaan, and Sven Erik Johansson. "Visiting the Cinema, Concerts, Museums or Art Exhibitions as Determinant of Survival: A Swedish Fourteen-Year Cohort Follow-Up." *Scandinavian Journal of Public Health* 28, no. 3 (September 2000): 174–78.

Bygren, Lars Olov, Gösta Weissglas, Britt-Maj Wikström, Boinkum Benson Konlaan, Andrej Grjibovski, Ann-Brith Karlsson, Sven-Olof Andersson, and Michael Sjöström. "Cultural Participation and Health: A Randomized Controlled Trial among Medical Care Staff." *Psychosomatic Medicine* 71, no. 4 (May 2009): 469–73. https://doi.org/10.1097/PSY.0b013e31819e47d4.

Chavis, David M., and J. R. Newbrough. "The Meaning of 'Community' in Community Psychology." *Journal of Community Psychology* 14, no. 4 (n.d.): 335–40.

Couldry, Nick, and Anna McCarthy. *MediaSpace: Place, Scale and Culture in a Media Age*. Routledge, 2004.

Cox, Lorraine. "Public Art Forum." In *Heritage Interpretation*, by Alison Hems and Marion Blockley. London and New York: Routledge, 2006.

Crang, Mike, and M. Doel, eds. "Un-Glunking Geography. Spatial Science after Dr Seuss and Gilles Deleuze." In *Thinking Space*, 1 edition., 117–35. London ; New York: Routledge, 2000.

Cuypers, Koenraad Frans, Margunn Skjei Knudtsen, Maria Sandgren, Steinar Krokstad, Britt Maj Wikström, and Töres Theorell. "Cultural Activities and Public Health: Research in Norway and Sweden. An Overview." *Arts & Health* 3, no. 1 (March 2011): 6–26. https://doi.org/10.1080/17533015.2010.481288.

Daykin, Norma, Ellie Byrne, Tony Soteriou, and Susan O'Connor. "Using Arts to Enhance Mental Healthcare Environments: Findings from Qualitative Research." *Arts & Health* 2, no. 1 (March 1, 2010): 33–46. https://doi.org/10.1080/17533010903031408.

De Souza e Silva, Adriana. "From Cyber to Hybrid: Mobile Technologies as Interfaces of Hybrid Spaces." *Space and Culture* 9, no. 3 (August 2006): 261–78. https://doi.org/10.1177/1206331206289022.

Dibbell, Julian. *My Tiny Life: Crime and Passion in a Virtual World*. Julian Dibbell, 1998.

Donath, Judith. "Inhabiting the Virtual City: The Design of Social Environments for Electronic Communities." Massachusetts Institute of Technology, 1997. http://hdl.handle.net/1721.1/29120.

Downes, Edward J., and Sally J. McMillan. "Defining Interactivity: A Qualitative Identification of Key Dimensions." *New Media & Society* 2, no. 2 (n.d.): 157–79.

Dunne, John. "Sense of Community in l'Arche and in the Writings of Jean Vanier." *Journal of Community Psychology* 14, no. 1 (1986): 41–54. https://doi.org/10.1002/1520-6629(198601)14:1<41::AID-JCOP2290140105>3.0.CO;2-T.

Durlach, Nathaniel I., and Anne S. Mavor, eds. *Virtual Reality: Scientific and Technological Challenges*. Washington, D.C: National Academies Press, 1995.

Eco, Umberto. *The Open Work*. Cambridge, Mass: Harvard University Press, 1989.

Ellard, Colin G., and Vedran Dzebic. "The Psychology of Architectural and Urban Design: Sensor-Based Field Methods Based on Guided Walks." San Diego, CA, 2014.

Engleberg, Isa N., and Dianna R. Wynn. *Working in Groups: Communication Principles and Strategies -- Books a La Carte*. 7 edition. Boston: Pearson, 2016.

Faris, Robert E. L., and Warren H. Dunham. *Mental Disorders in Urban Areas: An Ecological Study of Schizophrenia and Other Psychoses*. Mental Disorders in Urban Areas: An Ecological Study of Schizophrenia and Other Psychoses. Oxford, England: Univ. Chicago Press, 1939.

Gibson, William. *Neuromancer*. Ace Books, 1984.

Graham, Michael Evans, Weiping Wang, and Paul Stanley Stephens. Projection of images of computer models in three dimensional space. United States US5687305A, filed April 12, 1996, and issued November 11, 1997. https://patents.google.com/patent/US5687305/en.

Green, Lelia. *Communication, Technology and Society*. First edition. London: SAGE Publications Ltd, 2002.

Greenberg, Stephanie W., William M. Rohe, and Jay R. Williams. *Safe and Secure Neighborhoods: Physical Characteristics and Informal Territorial Control in High and Low Crime Neighborhoods*. U.S. Department of Justice, National Institute of Justice, 1982.

Ha, Louisa, and E. Lincoln James. "Interactivity Reexamined: A Baseline Analysis of Early Business Web Sites." *Journal of Broadcasting & Electronic Media* 42, no. 4 (September 1, 1998): 457–74. https://doi.org/10.1080/08838159809364462.

Habermas, Jürgen. *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*. Sixth Printing edition. Cambridge, Mass: The MIT Press, 1991.

Habermas, Jurgen, Sara Lennox, and Frank Lennox. "The Public Sphere: An Encyclopedia Article (1964)." *New German Critique*, no. 3 (1974): 49–55. https://doi.org/10.2307/487737.

Hall, Edward T. *The Hidden Dimension*. First edition. New York: Anchor, 1990.

Harvey, David. *Justice, Nature and the Geography of Difference*. Oxford: Wiley-Blackwell, 1997.

Hayles, N. Katherine. *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*. 1 edition. Chicago, Ill: University of Chicago Press, 1999.

———. *Writing Machines*. Massachusetts: The MIT Press, 2002.

Hayward, Vincent, Oliver R. Astley, Manuel Cruz-Hernandez, Danny Grant, and Gabriel Robles-De-La-Torre. "Haptic Interfaces and Devices." *Sensor Review* 24, no. 1 (March 2004): 16–29. https://doi.org/10.1108/02602280410515770.

Heeter, Carrie. "Implications of New Interactive Technologies for Conceptualizing Communication." In *Media Use in the Information Age: Emerging Patterns of Adoption and Computer Use*, edited by J.L. Salvaggio and J. Bryant, Lawrence Erlbaum., 217–35. Hillsdale,NJ, 1989.

Howells, Valerie, and Thomas Zelnik. "Making Art: A Qualitative Study of Personal and Group Transformation in a Community Arts Studio." *Psychiatric Rehabilitation Journal* 32, no. 3 (2009): 215–22. https://doi.org/10.2975/32.3.2009.215.222.

Huxley, Michael, and Noel Witts. *The Twentieth-Century Performance Reader*. Psychology Press, 2002.

Ihde, Don. *Technology and the Lifeworld: From Garden to Earth*. Indiana University Press, 1990.

Jenkins, Henry. *Convergence Culture: Where Old and New Media Collide*. NYU Press, 2008.

Jensen, Jens Fog. "Interactivity: Tracking a New Concept in Media and Communication Studies." In *Nordicom Review*, 19:185–204, 1998.

Kelly, Kevin. *New Rules for the New Economy: 10 Radical Strategies for a Connected World*. Penguin Books, 1999.

Kelson, Elizabeth, Alison Phinney, and Glen Lowry. "Social Citizenship, Public Art and Dementia: Walking the Urban Waterfront with Paul's Club." *Cogent Arts & Humanities* 4, no. 1 (August 4, 2017). https://doi.org/10.1080/23311983.2017.1354527.

Kim, Amy Jo. *Community Building on the Web : Secret Strategies for Successful Online Communities*. 1 edition. Berkeley, CA: Peachpit Pr, 2000.

Kinney, Jennifer M., and Clarissa A. Rentz. "Observed Well-Being among Individuals with Dementia: Memories in the Making, an Art Program, versus Other Structured Activity." *American Journal of Alzheimer's Disease and Other Dementias* 20, no. 4 (August 2005): 220–27. https://doi.org/10.1177/153331750502000406.

Kiousis, Spiro. "Interactivity: A Concept Explication." *New Media & Society* 4, no. 3 (2002): 355–83. https://doi.org/10.1177/146144480200400303.

Kloos, Bret, Jean Hill, Elizabeth Thomas, Abraham Wandersman, and Maurice J. Elias. *Community Psychology: Linking Individuals and Communities*. Stamford, CT: Wadsworth, Cengage Learning, 2012.

Kluszczynski, Ryszard W. "Strategies of Interactive Art." *Journal of Aesthetics & Culture* 2, no. 1 (January 2010). https://doi.org/10.3402/jac.v2i0.5525.

Knight, William E., and Nikki S. Rickard. "Relaxing Music Prevents Stress-Induced Increases in Subjective Anxiety, Systolic Blood Pressure, and Heart Rate in Healthy Males and Females." *Journal of Music Therapy* 38, no. 4 (2001): 254–72. https://doi.org/10.1093/jmt/38.4.254.

Kwastek, Katja. "Interactivity – A Word in Process." In *The Art and Science of Interface and Interaction Design*, edited by Christa Sommerer, Laurent Mignonneau, and Lakhmi C. Jain, 2008 edition., 15–26. Berlin: Springer- Verlag Berlin Heidelberg, 2008.

Leder, Helmut, Benno Belke, Andries Oeberst, and Dorothee Augustin. "A Model of Aesthetic Appreciation and Aesthetic Judgments." *British Journal of Psychology (London, England: 1953)* 95, no. Pt 4 (November 2004): 489–508. https://doi.org/10.1348/0007126042369811.

Lefebvre, Henri. *The Production of Space*. Translated by Donald Nicholson–Smith. Malden, Mass.: Wiley-Blackwell, 1991.

Levy, Pierre. *Becoming Virtual: Reality in the Digital Age*. New York: Perseus Books, 1998.

Lyman, Stanford M., and Marvin B. Scott. "Territoriality: A Neglected Sociological Dimension." *Social Problems* 15, no. 2 (1967): 236–49. https://doi.org/10.2307/799516.

MacPherson, Sarah, Michael Bird, Katrina Anderson, Terri Davis, and Annaliese Blair. "An Art Gallery Access Programme for People with Dementia: 'You Do It for the Moment.'" *Aging & Mental Health* 13, no. 5 (September 2009): 744–52. https://doi.org/10.1080/13607860902918207.

Manovich, Lev. *The Language of New Media*. Reprint edition. Cambridge, Mass.: The MIT Press, 2002.

———. "The Poetics of Augmented Space." *Visual Communication* 5, no. 2 (June 2006): 219–40. https://doi.org/10.1177/1470357206065527.

Massey, Doreen. *For Space*. 1 edition. London ; Thousand Oaks, Calif: SAGE Publications Ltd, 2005.

Massumi, Brian. *Parables for the Virtual: Movement, Affect, Sensation*. First Edition. Durham, NC: Duke University Press Books, 2002.

McMillan, Sally J. "Exploring Models of Interactivity from Multiple Research Traditions: Users, Documents, and Systems." In *Handbook of New Media: Social Shaping and Consequences of ICTs*, edited by Leah A. Lievrouw and Sonia Livingstone, 163–82. 55 City Road: SAGE Publications, Ltd, 2002. https://doi.org/10.4135/9781848608245.

———. "Interactivity Is in the Eye of the Beholder. Function, Perception, Involvement, and Attitude Toward Web Sites." In *Proceedings of the 2000 Conference of the American Academy of Advertising*, edited by Mary Alice Shaver, 71–78. Richmond, VA: Amer Academy of Advertising, 2000.

McMillan, S.J. "A Four-Part Model of Cyber-Interactivity: Some Cyber-Places Are More Interactive than Others." *New Media & Society* 4, no. 2 (June 1, 2002): 271–91. https://doi.org/10.1177/14614440222226370.

Meyer-Lindenberg, Andreas, Florian Lederbogen, Peter Kirsch, Leila Haddad, Fabian Streit, Heike Tost, Philipp Schuch, et al. "City Living and Urban Upbringing Affect Neural Social Stress Processing in Humans." *Nature* 474, no. 7352 (June 2011): 498–501. https://doi.org/10.1038/nature10190.

Milgram, Paul, and Herman Colquhoun. "A Taxonomy of Real and Virtual World Display Integration." In *Mixed Reality*, edited by Yuichi Ohta and Hideyuki Tamura, 5–30. Berlin, Heidelberg: Springer Berlin Heidelberg, 1999. https://doi.org/10.1007/978-3-642-87512-0_1.

Milgram, Paul, Haruo Takemura, Akira Utsumi, and Fumio Kishino. "Augmented Reality: A Class of Displays on the Reality-Virtuality Continuum." edited by Hari Das, 282–92. Boston, MA, 1995. https://doi.org/10.1117/12.197321.

Monroe, Marshall M., and Willian G. Redmann. Apparatus and method for projection upon a three-dimensional object. United States US5325473A, filed October 11, 1991, and issued June 28, 1994. https://patents.google.com/patent/US5325473/en.

Moore, Nina-Jo, Mark Hickson, and Don W. Stacks. *Nonverbal Communication: Studies and Applications*. Oxford University Press, 2013.

Moores, Shaun. "The Doubling of Place." In *MediaSpace: Place, Scale and Culture in a Media Age*, edited by Nick Couldry and Anna McCarthy, 1 edition., pp 21-31. New York: Routledge, 2004.

Musella, Orsola, A. Carloni, E. di Bartolo, L. de Marino, G. Gaeta, P. di Maggio, and A.M. Fasanaro. "Visual Art Improves Communication and Behaviour of AD Patients." In *New Trends in Alzheimer and Parkinson Related Disorders: ADPD*, edited by A. Fisher and I. Hanin, 15–20. Bologna, Italy: Medimond, 2009.

Newbury, Joanne, Louise Arseneault, Avshalom Caspi, Terrie E. Moffitt, Candice L. Odgers, and Helen L. Fisher. "Why Are Children in Urban Neighborhoods at Increased Risk for Psychotic Symptoms? Findings From a UK Longitudinal Cohort Study." *Schizophrenia Bulletin* 42, no. 6 (November 1, 2016): 1372–83. https://doi.org/10.1093/schbul/sbw052.

Newhagen, John E. "Interactivity, Dynamic Symbol Processing, and the Emergence of Content in Human Communication." *The Information Society* 20, no. 5 (November 1, 2004): 395–400. https://doi.org/10.1080/01972240490508108.

Ordine, Nuccio. *The Usefulness of the Useless*. Translated by Alastair McEwen. Paul Dry Books, 2017.

Palmer, J., C.M. Kuhn, C. Taylor, B.S. Turner, and W.T. Coombs. "The Effect of Art on Venipuncture Induced Stress." Duke University Medical Center: Society for the arts in healthcare, USA, 1999. www.societyhealthcare.org.

Paul, Christiane. *Digital Art*. London ; New York, N.Y: Thames & Hudson, 2003.

———. "Digital Art/Public Art: Governance and Agency in the Networked Commons." In *The Art and Science of Interface and Interaction Design*, edited by Christa Sommerer, Lakhmi C. Jain, and Laurent Mignonneau, 162–85. Berlin Heidelberg: Springer Verlag, 2008.

Rafaeli, Sheizaf. "Interactivity: From New Media to Communication." Edited by R.P. Hawkins, J.P. Wiemann, and S. Pingree. *Sage Annual Review of Communication Research: Advancing Communication Science: Merging Mass and Interpersonal Processes* 16 (1988): 110–34.

Raskar, Ramesh, Deepak Bandyopadhyay, and Henry Fuchs. "Dynamic Shader Lamps : Painting on Movable Objects." In *Proceedings IEEE and ACM International Symposium on Augmented Re-

ality, 207–16. New York, NY, USA: IEEE Comput. Soc, 2001. https://doi.org/10.1109/ISAR.2001.970539.

Raskar, Ramesh, Paul Beardsley, Jeroen van Baar, Yao Wang, Paul Dietz, Johnny Lee, Darren Leigh, and Thomas Willwacher. "RFIG Lamps: Interacting with a Self-Describing World via Photosensing Wireless Tags and Projectors." *ACM Transactions on Graphics* 23, no. 3 (August 1, 2004): 406–415. https://doi.org/10.1145/1015706.1015738.

Raskar, Ramesh, Greg Welch, and Wei-Chao Chen. "Table-Top Spatially-Augmented Reality: Bringing Physical Models to Life with Projected Imagery," April 2, 2001.

Raskar, Ramesh, Greg Welch, Matt Cutts, Adam Lake, Lev Stesin, and Henry Fuchs. "The Office of the Future: A Unified Approach to Image-Based Modeling and Spatially Immersive Displays." In *Proceedings of the 25th Annual Conference on Computer Graphics and Interactive Techniques*, 1998. https://doi.org/10.1145/280814.280861.

Rentz, Clarissa A. "Memories in the Making: Outcome-Based Evaluation of an Art Program for Individuals with Dementing Illnesses." *American Journal of Alzheimer's Disease and Other Dementias* 17, no. 3 (June 2002): 175–81. https://doi.org/10.1177/153331750201700310.

Rheingold, Howard. *Smart Mobs: The Next Social Revolution*. Basic Books, 2007.

Richards, Russell. "Users, Interactivity and Generation." *New Media & Society* 8, no. 4 (August 1, 2006): 531–50. https://doi.org/10.1177/1461444806064485.

Roush, Robert, Michelle Braun, Anne Basting, Jerald Winakur, Francesca Rosenberg, and Susan Mcfadden. "Using the Arts to Promote Resiliency Among Persons with Dementia and Their Caregivers." *Resilience in Aging: Concepts, Research, and Outcomes*, September 1, 2011, 105–20. https://doi.org/10.1007/978-1-4419-0232-0_7.

Ryan Bengtsson, Linda. "Re-Negotiating Social Space: Public Art Installations and Interactive Experience." Karlstad University, Faculty of Economic Sciences, Communication and IT, Department of Media and Communication Studies., 2012. http://kau.diva-portal.org/smash/get/diva2:504314/FULLTEXT01.pdf.

Schorr, Julie Anderson. "Music and Pattern Change in Chronic Pain." *ANS. Advances in Nursing Science* 15, no. 4 (June 1993): 27–36. https://doi.org/10.1097/00012272-199306000-00004.

Shaer, David, Kirstie Beaven, Neil Springham, Silke Pillinger, Alan Cork, Jane Brew, Yvonne Forshaw, Pauline Moody, and Chris 'S.' "The Role of Art Therapy in a Pilot for Art-Based Information Prescriptions at Tate Britain." *International Journal of Art Therapy* 13, no. 1 (June 1, 2008): 25–33. https://doi.org/10.1080/17454830802069877.

Sharp, Joanne, Venda Pollock, and Ronan Paddison. "Just Art for a Just City: Public Art and Social Inclusion in Urban Regeneration." *Urban Studies* 42, no. 5/6 (2005): 1001–23.

Shemesh, Avishag, Ronen Talmon, Ofer Karp, Idan Amir, Moshe Bar, and Yasha Jacob Grobman. "Affective Response to Architecture – Investigating Human Reaction to Spaces with Different Geometry." *Architectural Science Review* 60, no. 2 (March 4, 2017): 116–25. https://doi.org/10.1080/00038628.2016.1266597.

Sinekopova, Galina V. "Building the Public Sphere: Bases and Biases." *Journal of Communication* 56, no. 3 (September 1, 2006): 505–22. https://doi.org/10.1111/j.1460-2466.2006.00298.x.

Smith, Marc A., and Peter Kollock. *Communities in Cyberspace*. Routledge, 1999.

Spandler, Helen, Jenny Secker, L. Kent, S. Hacking, and J. Shenton. "Catching Life: The Contribution of Arts Initiatives to Recovery Approaches in Mental Health." *Journal of Psychiatric and Mental Health Nursing* 14, no. 8 (December 2007): 791–99. https://doi.org/10.1111/j.1365-2850.2007.01174.x.

Standley, Jayne M. "Clinical Applications of Music and Chemotherapy: The Effects on Nausea and Emesis." *Music Therapy Perspectives* 10, no. 1 (January 1, 1992): 27–35. https://doi.org/10.1093/mtp/10.1.27.

Staricoff, Rosalia Lelchuk. "Arts in Health: A Review of the Medical Literature." *Arts Council England*, no. Research Report 36 (n.d.): 91.

Staricoff, Rosalia Lelchuk, and Susan Loppert. "Integrating the Arts into Healthcare: Can We Affect Clinical Outcomes?" In *The Healing Environment: Without and Within*, edited by Deborah Kirklin and R. RIchardson, Chapter 5. Royal College of Physicians., 2003.

Steuer, Jonathan. "Defining Virtual Reality: Dimensions Determining Telepresence." *Journal of Communication* 42, no. 4 (1992): 73–93. https://doi.org/10.1111/j.1460-2466.1992.tb00812.x.

Stromer-Galley, Jennifer. "Interactivity-as-Product and Interactivity-as-Process : Where Interactivity Resides." *The Information Society*, no. 5 (2004): 391–94.

Sundar, Shyam. "Theorizing Interactivity's Effects." *The Information Society* 20, no. 5 (November 2004): 385–89. https://doi.org/10.1080/01972240490508072.

Sundar, Shyam, Sriram Kalyanaraman, and Justin D. Brown. "Explicating Web Site Interactivity Impression Formation Effects in Political Campaign Sites." *Communication Research* 30, no. 1 (2003): 30–59.

Taylor-Piliae, Ruth. "Review: Music as a Single Session Intervention Reduces Anxiety and Respiratory Rate in Patients Admitted to Hospital." *Evidence Based Nursing* 5, no. 3 (July 1, 2002): 86. https://doi.org/10.1136/ebn.5.3.86.

Ulrich, Roger S. "Visual Landscapes and Psychological Well-being." *Landscape Research* 4, no. 1 (March 1, 1979): 17–23. https://doi.org/10.1080/01426397908705892.

Underkoffler, John Stephen. "The I/O Bulb and the Luminous Room." Massachusetts Institute of Technology, 1999. https://trackr-media.tangiblemedia.org/publishedmedia/Papers/300-The%20IO%20Bulb/Published/PDF.

Underkoffler, John, Brygg Ullmer, and Hiroshi Ishii. "Emancipated Pixels: Real-World Graphics in the Luminous Room." In *Proceedings of the 26th Annual Conference on Computer Graphics and Interactive Techniques - SIGGRAPH '99*, 385–92. Not Known: ACM Press, 1999. https://doi.org/10.1145/311535.311593.

Waterton, Emma, and Laurajane Smith. "The Recognition and Misrecognition of Community Heritage." *International Journal of Heritage Studies* Vol 16, no. No1-2 (2010): p 4-15. https://doi.org/DOI.10.1080/13527250903441671.

Whyte, William H. *The Social Life of Small Urban Spaces*. Unknown edition. New York, NY: Project for Public Spaces, 2001.

Williams, Frederick. *Research Methods and the New Media*. New York: Free Press, 1988.

Zebracki, Martin. "Public Art as Conversation Piece: Scaling Art, Public Space and Audience." *Belgeo* 3 (December 19, 2014): 1–17. https://doi.org/10.4000/belgeo.13381.

Zimmerman, Lani, Bunny Pozehl, Kathleen Duncan, and Rita Schmitz. "Effects of Music in Patients Who Had Chronic Cancer Pain." *Western Journal of Nursing Research* 11, no. 3 (June 1989): 298–309. https://doi.org/10.1177/019394598901100304.

WEBOGRAPHY

Australian Psychological Society. "What Is Environmental Psychology?" Accessed March 29, 2020.
www.psychology.org.au/About-Us/What-we-do/advocacy/Advocacy-social-issues/Environment-climate-change-psychology/Psychology%E2%80%99s-role-in-environmental-issues/What-is-environmental-psychology

Australian Standing Council on Health. "National Arts and Health Framework.," 2013, Accessed May 19, 2020.
https://www.arts.gov.au/sites/default/files/National%20Arts%20and%20Health%20Framework%20May%202014.pdf?acsf_files_redirect

Benayoun, Maurice. "L'art coupable mais toujours libre." In *MOBEN*. Athens, 1999, Posted November 1999, Accessed May 19, 2020.
https://benayoun.com/moben/1999/11/11/lart-coupable-mais-toujours-libre/

CAVI. *Aarhus by Light*. 2008.
https://www.youtube.com/watch?v=xv4XfEQU1nk

Centre for Urban Design and Mental Health. "How the City Affects Mental Health." Accessed April 4, 2020. https://www.urbandesignmentalhealth.com/how-the-city-affects-mental-health.html

Desktop Theater, and Lisa Brenneis. "Desktop Theater," n.d.
http://desktoptheater.net/

Dictionary.com. "Definition of Proxemics." Accessed April 8, 2020.
https://www.dictionary.com/browse/proxemics

Department of Culture and Arts. "Forms of Public Art ~ DCA." Text. Department of Local Government, Sport and Cultural Studies | Government of Western Australia. Accessed April 9, 2020.
https://www.dca.wa.gov.au/DevelopingArtsandCulture/publicart/forms-of-public-art/

Goldberg, Ken, and Joseph Satnarromana. *Telegarden*. 1995. Telerobotics.
https://www.youtube.com/watch?v=BCEC1tfc5Jc

Haque, Usman. *Primal Source*. 2008.
https://vimeo.com/1378892

Haque, Usman. *Sky-Ear*. 2004.
https://vimeo.com/1531759

Jones, Brett. "What Is Projection Mapping?" Projection Mapping Central, November 15, 2012.
http://projection-mapping.org/what-is-projection-mapping/

Kreutz, Roger, and Richard Roberts. "Proxemics 101: Understanding Personal Space Across Cultures."

    The MIT Press Reader. Accessed March 26, 2020.

      https://thereader.mitpress.mit.edu/understanding-personal-space-proxemics/

Krikortz, Erik. *Color by Numbers*. 2006.

      https://www.youtube.com/watch?v=8oS0zwL0G6Y

Media Lab Prado, and Lummo. *Lummo Blocks*. 2010.

      https://vimeo.com/24763639

Naimark, Michael. *Displacements*. 1980.

      https://www.youtube.com/watch?v=bMDr_CFFgWE

NAVA. "Types of Public Art." National Association for the Visual Arts | Australia. Accessed April 10,

    2020. https://visualarts.net.au/code-of-practice/32-types-public-art/

Obermaier, Klaus. *Dancing House*. 2014.

      https://www.youtube.com/watch?v=rCjt6TGrJbs.

Olson, Marisa, and Abe Linkoln. *Abe and Mo Sing the Blues*. 2006.

      http://linkoln.net/abeandmosingtheblogs/

Ruskar, Ramesh, Henry Fuchs, and Deepak Bandyopadhyay. *Dynamic Shader Lamps*, n.d.

      https://www.youtube.com/watch?v=wv7lUeRToqk

Tate. "Community Art — Art Term." Tate. Accessed April 9, 2020.

      https://www.tate.org.uk/art/art-terms/c/community-art

Unferkoffler, John, Daniel Chak, Gustavo Santos, and Hiroshi Ishii. "I/O Bulb and Luminus Room," 1998.

      https://vimeo.com/126754071.

UNESCO Centre du patrimoine mondial. "Colloque international 'Quel destin pour l'Art Public?'," Last

    modified May 19, 2011. http://whc.unesco.org/fr/actualites/746/

University of Waterloo. "Urban Realities Laboratory: Publications." Accessed April 1, 2020.

      www.uwaterloo.ca/urban-realities-laboratory/research-projects/publications.

Ushev, Theodore, and Iregular. *Diagonales*. 2014. https://vimeo.com/95222161.

VicHealth. "Creative Connections: Promoting Mental Health and Wellbeing through Community Arts

    Participation", 2002, Accessed May 19, 2020.

      https://www.vichealth.vic.gov.au/media-and- resources/publications/creative-connections

Werner, Andre, Buro Staubach, and ART+COM. *The Jew of Malta*. 2002.

      https://vimeo.com/184095418.

FILMOGRAPHY

Hirschbiegel, Oliver. *Mörderische Entscheidung*. Das Erste, ZDF, 1991.

    https://www.youtube.com/watch?v=nF5RT5_wIew.

Paik, Naim June. "Good Morning Mr. Orwell!" New York: WNET tv, 1984.

    https://www.youtube.com/watch?time_continue=149&v=0oUdI-KFCyU&feature=emb_title

Tambellini, Aldo, Otto Piene, Nam June Paik and Allan Karpow. "The Medium Is the Medium." Boston:

    WGBH, 1969. https://www.youtube.com/watch?v=UIpZ3n6F_dc

Table of figures

83

APPENDIX

Tutorials

Subject	URL
Light tracking in Processing	www.youtube.com/watch?v=jTu3HVr5fEA&list=PL632BB8C3F7E776BA&index=134&t=0s
Kinect and Processing	www.youtube.com/watch?v=FBmxc4EyVjs https://shiffman.net/p5/kinect/
Spout and Processing	www.youtube.com/watch?v=RdcEeH_tfRM
Spout and Unity	www.youtube.com/watch?v=iIwcqgAPVWI
TouchDesigner and playlists	www.vimeo.com/113322864
Audio analysis in TD	www.youtube.com/watch?v=K7fRKMCBnd0 www.youtube.com/watch?v=Z7be2ROpdAc www.youtube.com/watch?v=cpZZZqXZC3w
Data and TouchDesigner	www.matthewragan.com/2015/03/29/thp-494-598-make-it-with-data-touchdesigner/ www.youtube.com/watch?v=8GGCu9KMM14&list=PLqP54jFlI7s0IUq66BhdhJ092KenwhA6h&index=23&t=0s www.youtube.com/watch?v=GXu77VkLNRM&list=PLqP54jFlI7s0IUq66BhdhJ092KenwhA6h&index=24&t=0s
TouchDesigner projection mapping	www.youtube.com/watch?v=1QyFy6aJM4U&list=PLqP54jFlI7s0IUq66BhdhJ092KenwhA6h&index=4&t=0s
Kinect and TD	www.youtube.com/watch?v=r-EOtQhdJxg&list=PLqP54jFlI7s0IUq66BhdhJ092KenwhA6h&index=19&t=0s
Kinect and particle attractors	www.youtube.com/watch?v=JONepJ0_wnI&list=PLqP54jFlI7s0IUq66BhdhJ092KenwhA6h&index=21&t=0s
Twitter and Processing	www.youtube.com/watch?v=gwS6irtGK-c&list=PLqP54jFlI7s2fwwgWDurZxQqJjGfhtbbJ&index=5&t=0s www.youtube.com/watch?v=iSgi6JqOWZU&list=PLqP54jFlI7s2fwwgWDurZxQqJjGfhtbbJ&index=6&t=0s www.twitter4j.org/en/api-support.html