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THE HYBRONAUT AND THE UMWELT: WEARABLE TECHNOLOGY AS ARTISTIC STRATEGY

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THE HYBRONAUT AND THE UMWELT: WEARABLE TECHNOLOGY AS ARTISTIC STRATEGY

By

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The Hybronaut and The Umwelt: Wearable Technology as Artistic Strategy

Abstract:

This dissertation explores the use of irony in networked wearable technology art as a strategy to emphasise the complexity of conjunction between techno-organic human and the techno-organic world.

The research addresses the relationship between technologically enhanced human and networked *hybrid environment*, and speculates on the impact of technological enhancements to the subjective construction of *Umwelt* through ironic interventions. The project employs both artistic practice and critical theory.

The practice-based part of the dissertation is comprised of three wearable technology artworks produced during the study. These concrete artefacts employ irony as a means to expose the techno-organic relationship between humans and their environment under scrutiny. The works highlight the significance of technological modifications of the human for the formation of subjective worldview in an everyday *hybrid environment*.

The theoretical part navigates between the fields of art, design, technology, science and cultural studies concerning the impact of technology and networks on human experience and perception of the world.

In the background of this research is biologist Jakob von Uexküll's concept of the *Umwelt*, which is a subjective perception created by an organism through its active engagement with the everyday living environment. This dissertation focuses on the *Umwelt* that is formed in an interaction between *hybrid environment* and the technologically enhanced human, *the Hybronaut*.

Hybrid environment is a physical reality merged with technologically enabled virtual reality. *The Hybronaut* is an artistic strategy developed during the research based on four elements: wearable technology, network ability, irony and contextualised experience for the public.

Irony is one of the prominent characteristics of *the Hybronaut*. Irony functions as a way to produce multiple paradoxical perspectives that enable a critical inquiry into our subjective construction of *Umwelt*. The research indicates that ironic networked wearable technology art presents an opportunity to re-examine our perception concerning the human and his environment.

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AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award. The research contained herein is the sole work of the author.

The practical projects related to the thesis and developed during the period of study under the Planetary Collegium Doctoral Programme are detailed in the chapter VI of this document entitled 'Practice and Methodology'. A DVD that documents the practice work through videos is annexed to this manuscript.

During the time frame of the author's research, the author attended the required composite sessions of the Planetary Collegium, as listed below.

Composite sessions attended:
No. 1. 2006: Tucson, Arizona
No. 2. 2006: Plymouth, UK
No. 3. 2006: Sao Paulo, Brazil
No. 4. 2007: Montreal, Canada
No. 5. 2007: Milan, Italy
No. 6. 2007: Plymouth, UK
No. 7. 2008: Gijon, Spain
No. 8. 2008: Vienna, Austria
No. 9. 2008: Sao Paulo, Brazil

The author presented the research in conferences on an international basis and participated in various exhibitions during the research and developed projects related to the thesis. The full list of publications, exhibitions, and other relevant material is detailed in Appendix 1. Complementary information about art projects, publications, lectures and conferences is also available online at: www.realitydisfunction.org

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Signed 

Date 24.4. 2012 Helsinki

0. Introduction

0.1. Terminology

The Umwelt:

The concept of *Umwelt* in biology was introduced by Jakob von Uexküll in 1934 (Uexküll 1934). The *Umwelt* is a subjective perception of the world, which can be imagined as a soap bubble that surrounds each individual and contains signifying markers relevant only to the world of that specific individual. The *Umwelt* is formed in an interaction between an organism and its surrounding world and is guided by the organism's design, its physiology, and its needs.

The Hybronaut:

The term is coined by the author (Beloff 2008a). The *Hybronaut* is a human whose existence is profoundly based on the hybrid environment and various kinds of relationships, physical and networked, which are constructed within this environment. The *Hybronaut* enables first-hand experience within the hybrid environment via the use of physically constructed wearable equipment that is available for public use. To become the *Hybronaut* is to use the constructed networked wearable equipment, which offers new perspectives regarding the user's perception of the world through ironic interventions.

Hybrid environment:

In reference to Adriana de Souza e Silva's term *hybrid space*, which she defines as a mixture of social actions that take place simultaneously in digital and physical spaces (de Souza e Silva 2006a; de Souza e Silva 2006b), the author's term *hybrid environment* also includes various other, non-social aspects of an environment. *Hybrid environment* is the merger of physical reality with a virtual technologically enabled reality, which is used specifically to reference the connection between the technologically enhanced, networked human and his or her environment, which is also networked and enhanced by technology.

Techno-organic:

The term references the merger of technological and organic materials. In this dissertation it is used in reference to such things as the merger of human & technology and environment & technology.

Wearable technology art:

A general term coined by Susan E. Ryan (Ryan 2008) to discuss the art & design approaches in the field of wearable technology. In this dissertation the term is used in a more narrow sense to reference works which typically emerge from the field of visual arts, but which clearly differ from the general aims present in the field.

Irony:

The dissertation follows the definition of *irony* by Norman D. Knox, who describes *irony* as a situation where the first meaning presents itself as the apparent truth, but gradually the context of the first meaning reveals a contradicting second meaning and the first original meaning seems suddenly limited or false (Knox 1973). In an ironic situation the observer is directed to distrust the first literal meaning and to interpret a new, typically contradictory, meaning.

0.2. Research Question

In this dissertation, the concept of subjective perception resulting from an organism's active engagement with the world is referred to as the *Umwelt*, a term defined by biologist Jakob von Uexküll. According to Uexküll, the *Umwelt* forms a basis for understanding the tightly coupled relationship between an organism and its environment. Uexküll argues that it is the organism's physiological abilities which define its *Umwelt* –the perception of the world – and it is the organism's aim to apply this perception to its very survival.

Alternatively, the *Umwelt* in this thesis, although drawing from Uexküll's theory, proposes a formation of contemporary *Umwelt* between a technologically enhanced human and his techno-organic *hybrid environment*. Similarly to Uexküll's formulation, in this case the *Umwelt* arises as an actively formed subjective perception between the organism and its habitat. But in addition to the organism's new self-defined design and boundaries, it has also made changes in its environment, such as enhancements made by networked technology. Rather than adhering to its perceptions for its biological survival, as proposed by Uexküll, the technologically enhanced human strives for a continuous presence in a networked hybrid environment. In sum, the research investigates the modification of the technologically enhanced human and the impacts of its subjective perception and, thereby, its *Umwelt*.

To achieve this aim, the thesis applies an artistic perspective to a developed case study in order to examine the formation of the *Umwelt* of a particular human, who is enhanced with specific networked wearable technology, forming what this thesis calls the *Hybronaut*. This case study is a paradigm example of conceptual and experimental approaches typically emerging within the arts. In order to explore the thesis issues, this research analyses aspects which shape the formation of subjective perception in the interaction between the *Hybronaut* and the *hybrid environment*, including the elements that define the existence and condition of the *Hybronaut*.

The original contribution to knowledge by this dissertation is that ironic networked wearable technology art enables critical inquiry into our subjective construction of *Umwelt* in the hybrid environment, opening up opportunities for alternative interpretations and revealing new insights into the situation. The research is based on practice and theory, each in ways that reflect the other; it navigates between the fields of art, design, technology, and science and the impacts of technological networks on human experience and perception of the world.

The research question of this dissertation is: **What kind of artistic strategy reveals new insights into our subjectively constructed Umwelt in the hybrid environment?**

Firstly, the research indicates that networked wearable technology art adds the faculty of networking to augment human biology, situating the user continuously in the hybrid *environment*. Secondly, the research has identified irony as a strategy in networked wearable technology art, which can offer multiple paradoxical perspectives to reveal hidden aspects of the *hybrid environment* and enrich our subjective *Umwelt*. Irony is used as a strategy in the practice-based part of this dissertation. Thirdly, the research presents the *Hybronaut* as an art-based figure and a concept developed by the author during the research.

The *Hybronaut* is an artistic strategy, which is based on: wearable technology, networkability, irony and a contextualised experience for the public. The constructed figure of the *Hybronaut* shows on the one hand that networked wearable technology art can be a strategy to

emphasise the complex relationship between the techno-organic human and the techno-organic world. On the other, it shows that irony is one of the prominent characteristics that define the condition of being the *Hybronaut*. Irony functions as a strategy to produce multiple paradoxical viewpoints that allow potential for new interpretations of our subjective construction of *Umwelt*.

The *Hybronaut* consists of three concretely constructed case studies, wearable technology art works produced during 2006-2012, which comprise the practice-based part of the dissertation. These case studies exemplify how irony is able to expose the techno-organic relationship between humans and their environment under scrutiny. The objective of the artworks is to provoke technological modifications of human experience, turning human beings into *Hybronauts*, and to produce perceptive jumps in the *Hybronaut's* subjective experience of the *Umwelt*.

0.3. Objectives

This research takes Uexküll's concept of *Umwelt* as an inspiration and adapts it to a technologically enhanced human being and his habitat, the *hybrid environment*.

The research question has generated the following objectives that clarify the aims of the research in more detail.

Objective 1: *To provoke technological modifications of human experience.*

The research is experimenting with non-standard technological situations that are based on the technological enhancement of the human and his relationship to the hybrid environment. Methodologically, the non-standard technological situations are created as artistic interventions with networked wearable technology devices, constructed by the author, aimed at being used in everyday circumstances. The first-hand experience of the situation is offered for the users of the wearable equipment. For example, the author's artwork the *Appendix* is a networked tail designed and constructed for a human. Although this technological device will become part of the users' physiological body, the control of its movement is triggered by natural phenomenon and by a

human-constructed artificial system. This networked wearable device is both part of the user's body and part of the environment. The work has potential to impact the user's experience of the situation.

Objective 2: *To experiment how technological wearability affects human perception and relation to technology and to the world.*

Wearability as a feature evokes different relations to technology e.g. in comparison to mobile phones, being commonly featured and perceived as instruments for communication and accessing data. When the device is worn on the body there is less expectation to use it as an instrument, but it becomes more rigorously a part of the user's body and part of his *Umwelt*. The author's work *Appendix* is constructed as a new technological member of the user's body. The user is not expected to *use* and control it, however it will impact his perception and relation to the world. Another work by the author, *Heart-Donor*, creates a concrete and visible social network, which physically enfolds the user into its realm in a hybrid environment. While the third work, *Empty Space,* works in a different way by using the human body as a vehicle for its mobility. In this work the human is subordinate to the work's requirements.

Objective 3: *To disrupt the ordinary situation concerning wearable and mobile technology and through this revealing new aspects of our subjective perception of the world.*

The disruption and alteration of users' and observers' expectations, regarding the traditional uses of technology, is methodologically achieved by ironic art strategies that result in a conspicuous visual appearance of the artworks. The chosen aesthetic is the first step towards intervening in the normal situation. The second step is the function of irony. In these works, irony amplifies the relationship between human beings and their environment and creates paradoxical situations, which have potential to reveal new insights through generating multiple perspectives.

From a user's perspective, the shift from an ordinary to an extraordinary situation is additionally impacted by the visual peculiarity of the works, which affects the user's identity on

the street. All the three works create a very different kind of identity for the user. Again the ironic enhancement of the human opens new insights into identity and its construction in the *hybrid environment*. For example, the previously mentioned aspect of *Empty Space*, which utilises the human for its own needs, creates an ironic situation with skepticism towards the motivations behind the work. The users have to find their own satisfactory interpretation for the situation and decide who is in the service of whom.

***Objective 4**: To provoke awareness about one's presence in the hybrid environment and its impact on the formation of subjective Umwelt.*

The basic situation addressed is, that the *hybrid environment* and human beings unfold together as humans exist continuously in the networked hybrid environment. The employment of wearable technology in the author's artworks enables the human being to gain a networking feature, and this sensorial change is the base activity in this research.

The *Heart-Donor* work investigates the concept and meaning of presence in *hybrid environment*. It creates a situation where the user is continuously present in the *hybrid environment* and can visually observe his self-assigned network of friends swapping between the offline- and online-status of presence. One's *Umwelt* is formed in a unique situation within the *hybrid environment* where the various physical and technological relations are the defining factors. Regarding the *Appendix*, this work is instead based on connections to non-human elements, which potentially affect the user's formation of identity and the subjective *Umwelt*.

These four objectives together are achieved by the action of the *Hybronaut,* which is the nexus of the methodology of the practice-based research. The *Hybronaut* is compiled of networked wearable technology devices constructed by the author. In order to become the *Hybronaut,* it is necessary to use the networked wearable equipment. This equipment places the user into a continuous *hybrid environment*. The *Hybronaut* is an experimental artistic intervention, which uses

irony as a strategy to reveal new viewpoints on the subjective construction of the Umwelt by enhanced human beings in the *hybrid environment*.

0.4. Methodology

This research was initiated in practice by construction of wearable technology devices. These wearable artefacts functioned as the site where questions and challenges were identified and concretely experimented with. They also provided a certain framework through which the larger field of wearable technology could be reflected upon. The research methodology was based on two simultaneous facets; one contained the practice-based methodology of constructing the actual wearable artefacts and formation of theoretical framework, which paralleled the practice-based research[1].

The major part of the research was carried out through practical methods of developing new ideas and realising new works. This process of practical construction was influenced by the theoretical research and findings on the way, as well as vice versa, the written analytical work was impacted by the practice, which contained the making of the works and their use.

The practice-based research method included construction of wearable artefacts and experimenting with the use of them (described in detail in section VII). The approach has been open and exploratory as referenced in chapter V.1.1. The actual method for construction of the artefacts has been largely based on intuitive and culturally embedded choices for creating ironic characteristics and aesthetics for the works, by and large the practice-based work follows familiar methods from contemporary visual- and media-arts and design. The practice-based work and research has been framed by the context of technology; it has focused specifically on technologically enhanced mobile human and hybrid environment (sections IV, V, VI). One of the

[1] Comparable practice-based approaches and methodologies are present e.g. in Carlos Augusto Moreira da Nóbrega's dissertation *Art and Technology: coherence, connectedness, and the integrative field*, 2009, Plymouth University (Nobrega 2009) and in Geoffrey Thomas's dissertation *Ambivalent Animal*, 2010, Georgia Institute of Technology (Thomas 2010).

methods used in the research has been collaboration with other artists and scientists; this is introduced in chapter VII.2.1.

The analytical research method has been largely context-led in its thorough investigation of a wide array of wearable technology projects, their background motivations and framework, which led to recognition of projects that seem to differ in their aesthetics and functional purpose from other works in the field (described in chapter III.1.). These projects (which include the author's works) seemed not to follow the same criteria as the rest of the field, but there were signs of distinct questions behind the projects. This indicated that current specification of the wearable technology field is not adequate; these kinds of projects and the questions they raise are not covered by the currently existing general literature in the field. The analytical research was focused specifically on these kinds of works, typically emerging from the arts, and their shared characteristics.

0.5. Scope and Limitations

The field of wearable technology has produced notable amounts of research on the field of wearable computing with a focus on engineering aspects and/or software development[2]. Increasing amounts of research is also carried out that focuses on design, craft and material-led solutions[3]. However, there is very little PhD-level research or publications that investigate approaches and motivations in the context of the wearable technology field that are emerging from a conceptual and art-related basis[4]. As previously mentioned, during the research, projects

[2] For example: Thad Starner's dissertation *Wearable Computing and Contextual Awarness* 1999, Massachusetts Institute of Technology (Starner 1999), Gerd Kortuem's dissertation *A Methodology And Software Platform For Building Wearable Communities 2002*, University of Oregon (Kortuem 2002), Tiiti Kellomäki's dissertation *Effects of the Human Body on Single-Layer Wearable Antennas* 2012, Tampere University of Technology (Kellomäki 2012), Michel Chedid's *Wearable Systems in Harsh Environments: Realizing New Architectural Concepts* 2010, Linköping University (Chedid 2010) among many others.

[3] For example: Maggie Orth's dissertation *Sculpted Computational Objects, with Smart and Active Computing Materials* 2001, Massachusetts Institute of Technology (Orth 2001), Lucy Dunne's dissertation *Minimally Invasive Wearable Sensing of Body Position and Movement Through Body-Garment Interactions*, 2007, University College Dublin (Dunne 2007), Anna Valgårda's dissertation *Computational Composites: Understanding the Materiality of Computational Technology,* 2009, IT University of Copenhagen (Valgårda 2009) among many others.

[4] For example Danielle Wilde's dissertation *Swing That Thing: moving to move; The poetics of embodied engagement* 2011, Monash University, is partly in this direction although it is framed into HCI and interaction design research (Wilde 2011). Researcher Dr. Susan Ryan has written few articles about political, social and cultural context of various

with this kind of conceptual approaches formed their own sub-category with their own characteristics and aims (described in chapter III.1.). The questions posed by these distinct works are typically related to topics such as human enhancement, human-technology relations or social and political aspects of technologically enhanced society. One of the prominent questions in all of the works is the perception of the world, which is at an increasing rate changing to become a techno-organic and hybrid environment. These emerging questions, which are also present in the author's artistic works, led the author to investigate the evolving relationship between the technologically enhanced human and hybrid environment through the concept of the *Umwelt*.

The limitation in this research and its methodology is subjectivity that which can be claimed to be inherently present in art making. In this research, some degree of subjectivity is present in the aesthetical choices made in the practice-based work of constructing the wearable artefacts. Some of the aesthetic choices evident in the works were made with the idea in mind of deliberately creating ironic characteristics in each work. However, irony is rooted on one's immediate cultural setting and background (Hutcheon 1998). What may appear ironic to someone may appear completely differently to someone else. Even, if the author has intended these realised wearable works as ironic and therefore opening up to multiple perspectives, this applies only to persons with a similar cultural background and setting as the author's.

Also the concept of *Umwelt* is defined as one's subjectively constructed perception of the world. Uexküll's *Umwelt* is species-specific, in other words, members of same species should share similar *Umwelt*. This dissertation is experimenting with the formation of the *Umwelt* in a technologically enhanced hybrid environment, which is obviously limited to people who exist in this kind of networked technological infrastructure in their everyday life. In other words, the author's works only function in a cultural environment where the networked hybrid environment is already a familiar concept and supports the perception of one's individual hybrid *Umwelt*.

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wearable works (also including non-technological works) within the arts and design (found in the full bibliography; appendix 4).

Nevertheless, the author sees the subjective practice of art making as a qualified starting point for research of a speculative nature, which seeks to investigate the world with an open, non-instrumental perspective. The subjective perspective is always, nevertheless, formed within a cultural setting and is thus subject to the impact of culture, as well as simultaneously reflecting the surrounding world and culture at large.

0.6. Chapter Layout and Case Studies

Section I of the dissertation introduces the concept of the *Umwelt* and its originating context in biosemiotics. The concept of Umwelt marks the topic of the dissertation as the formation of the relationship between an organism and its environment and their mutual dependency.

Similarly to the *Umwelt,* which is always considered as a subjectively formed perception, irony is also defined as a subjective viewpoint of the world. Irony is used in the practice-based part of the dissertation as a way of amplifying the research focus point, the relationship between an enhanced human and its networked world, and to place it under scrutiny. Irony is presented in the end of the first section as method, which enables the introduction of alternative perspectives of the situation.

The prerequisites for the research and the developed concept of the *Hybronaut* are introduced in sections II and III. The starting point is identified as the development in the 1940s of the field of the cybernetics and its influence on the arts. The new ideas in the arts during the 1960s, e.g. conceptual art and the influence of technology on the arts, continued the development which started with the cybernetics. These ideas are present today in art created at the intersection with science and technology, such as wearable technology art. Sections II presents aspects which are seen in particular relation to this research, such as art as a system, real-time art, presence and networks in the arts, the use of the human body in the arts and irony as a feature of art. Section III is a profound presentation of the field of wearable technology, especially in the area of art & design.

Section IV investigates the relation between human and technology from a design perspective. Firstly, it points to the aspect of the increasing transparency of technology in our everyday life and investigates the relationship between the human and technology through the theories of Ihde and Verbeek (Ihde 1990; Ihde 2002; Ihde 2003; Ihde 2009; Verbeek 2008; Verbeek 2009). Critical aspects on design are introduced through Flusser's ideas on how design determines our behaviour and perception of the world. The *critical design* concept, developed by Dunne & Raby, is used as an example of a way of distinguishing specific kinds of wearable technology works from others (Dunne & Raby 2001). Secondly, the chapter argues that our thinking regarding the human body is based on the perception of an entity compiled of many separate parts, which has supported the development of human enhancement and human extension with external and internal modifications and devices. The development of the cyborg in science is given as a historical example. In relation to cognitive enhancements, the research speculates on the issue of wearable technology art, which rejects the commonly desired objective of invisibility, but intentionally chooses conspicuous visual aesthetics. The key thinkers in transhumanism and the post-human concept of Hayles are introduced as areas which deal with ethical, political, practical and philosophical aspects of human enhancement (Hayles 1999). Thirdly, the last two sections introduce artists working with concepts and practice of human enhancement.

The section V articulates the concept of the *Hybronaut* in detail. It investigates art that is based on experience and looks at a formation of identity in hybrid enviornment; the both aspects that are inherently related to the *Hybronaut*. The identity of the *Hybronaut* is emerging within a network of relationships with other humans, non-humans, things and technology. The Hybronaut can be seen from two simultaneous perspectives: as the single individual within a hybrid environment from which various connections and relations expand, or as a simple node in a large networked aggregate. Uexküll's underlying suggestion of the biological survival of an organism as a determining factor of its Umwelt is no longer valid when it concerns the *Hybronaut*

(Uexküll 1934). The survival of the *Hybronaut* is related to his or her ability to be connected and online. The *Hybronaut* is modified for survival in a hybrid environment.

In section VI, the research moves on to investigate the relationship and connection between the human and his environment as a techno-organic compilation. It examines the technologically enhanced environment and the concept of network and further expands the idea of network towards the *Hybronaut* and his *Umwelt*.

Art and artworks are emphasised throughout sections I-VI with described examples that relate to the topics under discussion.

The section VII presents practice-based part of the dissertation, which is comprised of three case-study works: *Heart- Donor* 2007, *Empty Space* 2009 and *Appendix* 2011, which are introduced in detail in the section. The section also discusses the working methods, such as collaboration and actual practical construction of the works, as well as their use and reception by the audience, which is further expanded to include a discussion on performance and participatory aspects of wearable technology.

The author realized the work *Heart Donor in 2007.* This work investigates the idea of one's social network as a diverse and ironic spatial concept, which can be visually worn on a body. In the work the Hybronaut is seen as the central point from which various connections emanate. The work explicitly expresses existence in the hybrid environment, which has become the vital condition of the Hybronaut. This is perceivable also in the work's chosen aesthetic; it is a vest-shaped piece of clothing, which is ironically constructed to imitate the shape of a life jacket.

The *Empty Space,* which was realized in 2009*,* work deals with the idea of loss and presence in the hybrid environment, which can be seen as a composite of material and immaterial aspects of the world. The work is a constructed material monument that can be dedicated online to the loss of something. In other words, it is a wearable, material artefact that is designed to commemorate a material object or a cause that has become immaterial. The constructed wearable object is a transparent polycarbonate capsule, which is made as a vacuum – presenting an actual physical

empty space. The work is constructed solely as an object for a hybrid environment and designed as a wearable parasite, which uses the human as a vehicle to move from place to place. Again, irony is used in the absurd aesthetics of the work; in the literal play of concepts of materiality and immateriality and in the way this technological object extends its abilities by being a parasite of a human.

In the work *Appendix*, 2011, the author has aimed at creating an actual new organ for a human. It is constructed as a tail, which has various human and non-human connections. These connections impact upon the movements of the tail. In this work, the connections are chosen with the intention of their having no obvious meaning for the user. For example, the direction of the tail movements is determined by the direction of the Helsinki city transport tramway in real time. This certain kind of non-intentionality of the connections rejects the rational approach to technology as a purposeful tool, but treats technology as an environment and material for the creation of new, networked organs. The absurdity and purposelessness of the connections creates an ironic situation that allows for new interpretations of the situation and its meaning for the users. The work experiments with the construction of the *Hybronaut* and identity forming in the *hybrid environment* as a complex structure of various relations.

All these three works equip the human with a networked faculty, which enables his or her continuous existence in the hybrid environment. The works propose various coincidental viewpoints: from serious themes dealing with human and technology to absurd performance aspects of actually using the works in real life circumstances. The combination of context, constructed functionality and designed appearances of the *Hybronaut* equipment causes the observer, or the user of the work, to doubt its literal meaning and interpret a new meaning for the work.

Through construction and experimentation with the practice-based case study works, the dissertation reaches the conclusion that irony as a strategy in networked wearable technology art has an ability to amplify the relationship between humans and their environment, and it offers an

opportunity for the examination of current and future changes concerning the human and his environment. Irony produces multiple paradoxical perspectives that enable a critical inquiry of our subjective construction of *Umwelt*.

I. Starting point: Umwelt

This chapter introduces the concept of *Umwelt*, which serves as an inspiration for the research, showing how organisms are irrevocably connected to their surrounding environment. *Umwelt* is a basis for a developed perception of a merger between a human body and technology, and their conjoined relationship with the surrounding techno-organic environment.

I.1 Uexküll's Umwelt

> "High on his tower, as far as possible from the earth, sits a human being. He has so transformed his eyes, with the aid of gigantic optical instruments, that they have become fit to penetrate the universe up to its most distant stars. In his *Umwelt,* suns and planets circle in festive procession. Fleet-footed light takes millions of years to travel through his *Umwelt* space.
>
> And yet this whole *Umwelt* is only a tiny sector of nature, tailored to the faculties of a human subject" (Uexküll 1934, p. 76-77).

Jakob von Uexküll's term *Umwelt* refers to a concept about the subjective world of an organism. The world can be imagined as a soap bubble that surrounds each individual and contains signifying markers relevant only to the world of that specific individual. This soap bubble, or *Umwelt,* is created by the individual organism in a process of forming a perception of reality, which is guided by the organism's design, physiology, and needs. Uexküll realised that every species has its own constructed *Umwelt* because each species reacts in a distinctive way to the same signals it receives from the physical world.

According to Uexküll, the physiology and design of an organism impacts its *Umwelt*. For example, it has been proven that fighting fish do not recognise their own reflection if it is shown eighteen times per second, but they do recognize their reflection if it is shown at a speed of thirty times per second. This experiment demonstrates that in the world of fighting fish, "who feed on

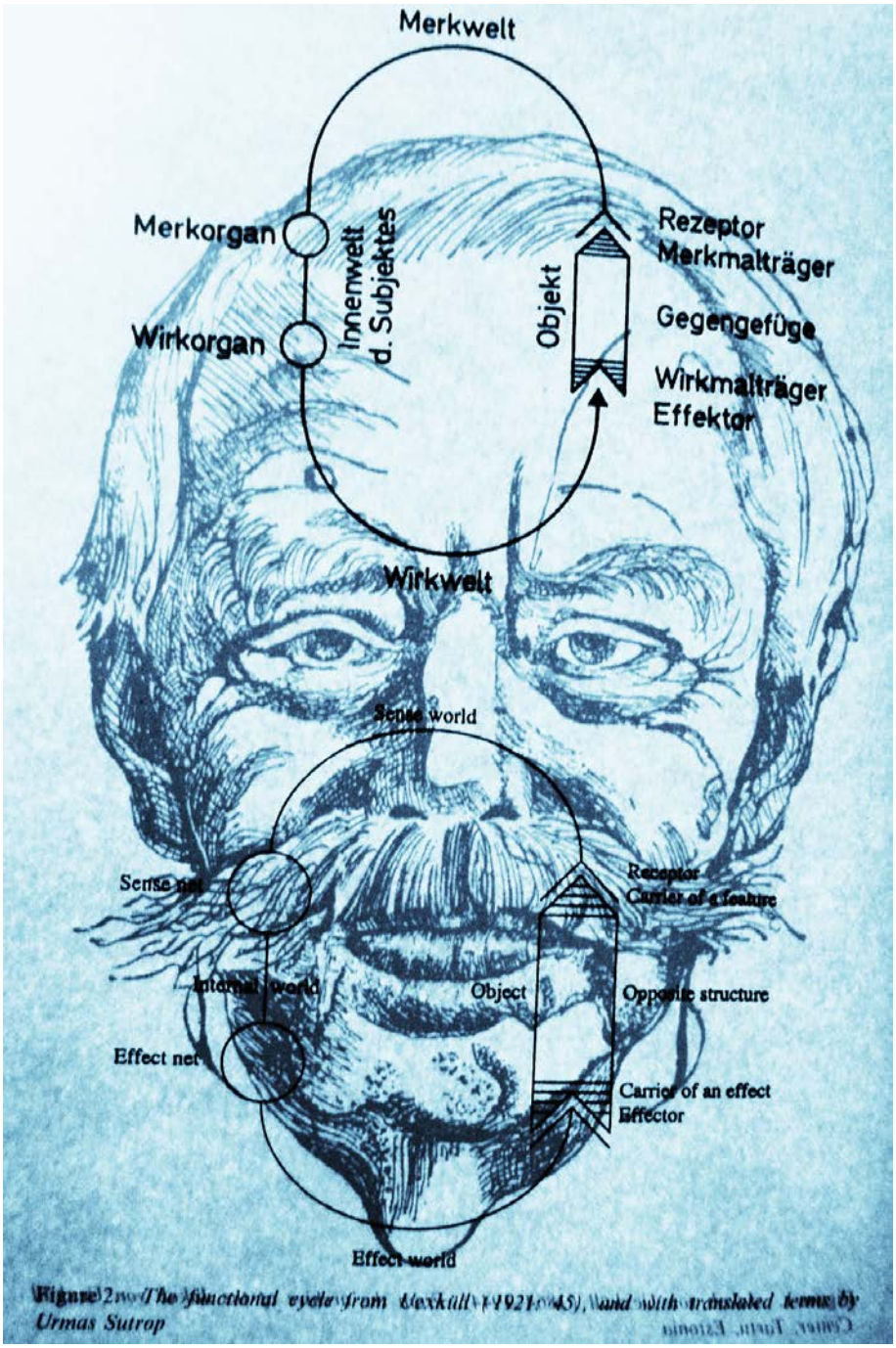
fast-moving prey, all motor processes—as in the case of slow-motion photography—appear at reduced speed" (Uexküll 1934, p. 28). The *Umwelt* of a fighting fish is based on its need to capture food for its very survival. Uexküll's point of view was that biology should study organisms as active subjects of their environments, rather than as objects of an environment, and focus on an organism's abilities to integrate into varied and complex environments. Thus, biology should "deal with holistic units and to maintain a broader scope than physiology in order to grasp the interactive unity of the organism and the world sensed by it" (Rüting 2004, p. 4). In theory, Uexküll emphasised the fact that each individual organism is actively creating its own *Umwelt;* what it perceives as a surrounding world.

Part of Uexküll's work can be seen as a precursor to cybernetics. In *Theoretische Biologie*[5] publication Uexküll was developing an idea concerning feedback loops in relation to the stretching of muscles inside living organisms. Earlier he had developed a more general feedback concept, which he called a *functional cycle (Funktionskreis*). This functional cycle investigated animal organisms as subjects that are continually integrating objects into their *Umwelt* through the process of closed loop interaction. Uexküll attempted to explain the regulation of animal movement and behaviour, and envisioned a multitude of different functional cycles corresponding to and suspending the animal within its *Umwelt.* "The functional cue effected on the object transforms the state of perception of this opposite structure, thus erasing the original cue. This change leads to the perception of a new cue which starts a new cycle of sign production, which is attuned according to feedback and reafferent or other signs within the internal world of the organism" (Rüting 2004, p. 6).

Uexküll's overall research ambition was to see meaning as the key concept of life. For him, life events could be explained as an interpretation of sign and meaning; a continuous dialogue between an interpreting subject and its *Umwelt* (Jämsä 2008). Although Uexküll was unaware of semiotics at the time, he developed his own unique approach to biology that was very close to Charles Peirce's concept of semiotics. Uexküll's approach was later named biosemiotics and he

[5] Uexküll 1920; *Theoretische Biologie* http://de.wikipedia.org/wiki/Theoretische_Biologie [accessed 9.11.2011]

came to be considered as the father of the field.



01. Figure: Image adapted by author–Jakob von Uexküll. Photo © 2012, Laura Beloff.

I.2 Biosemiotics; Introduction

It is currently agreed among biosemioticians that Uexküll's overall perception of life was somewhat outdated, even during his lifetime. However, his basic idea about the perceptual world of an organism -*Umwelt*- is still considered a fascinating and original idea (Barbieri 2008a). Uexküll saw that different species react differently to the same cue; e.g. a flower for a human is a

decorative element, whereas for an ant it can be a natural ladder to climb up and for a cow it is a part of its nutrition (Hoffmeyer 2008). Uexküll also realized that animals can react in many different ways to the same stimulus, which led him to see animals as interpreters of signals. The ability to interpret means that one is able to see signals as signs with meaning (Barbieri, 2008a). This formulation presents three basic elements: object, sign and interpreter, which are similar to Peirce's semiotic relations and which have become the base of biosemiotic thinking. Charles Peirce developed a view on semiotics on the basis of logic and philosophical pragmatism. According to Peirce, in the triangle of object, sign and interpreter, any elementary act of signification cannot involve fewer than three entities because there must necessarily be a process of interpretation between sign and meaning (Barbieri 2009). Even today, biosemiotics largely follows Peircean semiotics in perceiving the concept of sign as based on Peirce's interpretation. Marcello Barbieri claims that: "a semiotic system is a system made of two independent worlds that are connected by the conventional rules of a code" (Barbieri 2008b, p. 181).

In short, biosemiotics is semiotic methodology applied to biology and living systems. The field is currently divided into several subcategories which approach certain aspects differently and, to an extent, investigate their own specific areas. For example, Barbieri makes a distinction between two types of semiosis, one which is based on interpretation and the other based on coding. Animals interpret the world through representations whereas single cells cannot, thus they use coding instead (Barbieri 2009). This is one viewpoint amongst many in this currently growing academic field.

What Uexküll was aiming at early on was not to create a semiotic theory of sign and meaning, but to describe the animal's functions based on sign, meaning and interpretation and specifically to look at communication between an organism and its *Umwelt*.

This dissertation is interested in and specifically references Uexküll's general idea of the *Umwelt*, in which individual organisms actively create their own subjective perception of the world. The organism, in the case of this dissertation a human, is the focal point that is investigated

and scrutinised in this thesis study.

I.3 Human Umwelt meets Art

Uexküll posits that an organism actively creates its own environment -*Umwelt*- and includes in it only what is absolutely necessary for its survival; e.g. in the example of a fighting fish that recognises only what it needs for survival. In other words survival, or staying alive, in relation to an organism's environment, is also the defining factor for the organism's biological and physiological design, which will further impact the formation of its *Umwelt*.

However, when considering humans, the idea of the organism's design for survival only holds when biological survival is at stake. In western contemporary societies, staying alive or the basic biological survival of a human being is mainly solved through man-made social infrastructures that offer the prerequisites for life. Therefore, it is no longer necessary to consider the development of a human and his physiology from a traditional perspective of survival. Biological survival concerning the human is currently being replaced with the self-designated design of the human body.

This dissertation sees wearable technology as one of the prominent ways in which the human body is currently being tested, enhanced and redesigned. In parallel to a redesign process of a human (and his abilities), a transformation process of his subjectively created *Umwelt* occurs.

Uexküll's *Umwelt*-concept functions as an inspiration for the thesis research. It shows how organisms are connected to their surrounding environment, and that any physiological change in the organism may impact its subjectively constructed perception of the world. In this dissertation, the *Umwelt*-concept is extended to include the artificially constructed technological components in addition to the natural biological components. The research considers the world and the human as a techno-organic entity.

02. Figure: *Appendix* by Beloff, 2011. Photo © 2011, Laura Beloff.

I. 4. Irony and Multiple Perspectives

In a similar way to how Uexküll researched the relationship between an organism and its environment based on biology and semiotic interpretation, art which is connected to real-life processes typically investigates the same relationship between a human subject and the world. A human subject can be an observer or participant, or both, in relation to an artwork. In this dissertation, such relationship is examined as a techno-organic construct between the technologically enhanced human and his networked, technologically enhanced environment.

Also irony, similarly to the *Umwelt*, is based on a relationship between humans and the world (D. C. Muecke 1970). Uexküll concentrated on the subjectively formed relationship between an organism and its environment based on survival and an organism's physiological design. In turn, irony is typically based on the observational relationship between an organism (a human) and the world.

I.4.1. Irony

The concept of irony went through a radical transformation in the early nineteenth century in the western world, during which new meanings were developed. Earlier, irony was considered primarily as an intentional figure of speech, whereas by the turn of the century irony was additionally understood as an observable relationship between humans and the world. Things were seen or presented as ironic. Since then, irony has been understood in two ways, sometimes more instrumental, sometimes unintentional and observable (D. C. Muecke 1970). Norman D. Knox described irony as a situation in which multiple simultaneous meanings appear in conflict: "initially, one meaning, the appearance, presents itself as the obvious truth, but when the context of this meaning unfolds, in depth or in time, it surprisingly discloses a conflicting meaning, the reality, measured against which the first meaning now seems false or limited and, in its self-assurance, blind to its own situation. Irony 'lies', but it does so only as a dramatic means of bringing two meanings into open conflict" (Knox 1973, p. 627-628).

Even if irony is commonly associated with humour and playfulness, it is not something specific that will always make us smile. Irony is more a kind of a position in which a literal meaning is contradicted by the context of the work or event or by other elements of the work. This contradiction, when put in front of the observer or reader, makes her doubt the first literal meaning, and subsequently interpret a new, often contradictory, meaning to the work. In irony, one and the same perspective is able to produce conflicting views; the reader or observer is directed to distrust the literal meaning by some kind of inconsistency in the presented context, or in their relationship with the reality. This also means that irony is unable to separate itself from the discourse it challenges; irony is tightly rooted in time, location and in the immediate cultural setting (Hutcheon 1998). What one sees as ironic is not necessarily perceived in a similar way by others. Irony is a subjective viewpoint, which depends on one's cultural background and immediate situation. It is a subjectively created perception of the world in a very similar sense to

how Uexküll saw the formation of one's *Umwelt*.

Throughout this dissertation, examples of wearable technology works are given (the author's works and others' works), most of which present a certain degree of playfulness in relation to technology or its topic. The ironic approach, combined with the humourous appearances of these works opposes the existing ideals commonly related to commercially produced wearable or mobile devices.

I.4.2. Irony in The Author's Wearable Technology Artworks

The author's work *Empty Space* (Figure 03) presents the following incongruous aspects: first, the act of carrying a literal empty space (a vacuum) on one's back and the created peculiar aesthetics of the situation of carrying a medium-size transparent empty capsule in public. Second is the earnestly offered possibility for private individual dedications. And third, the professionally constructed technological functionality of the work and at the same time the total dependency of the work on people's actions and participation. The work challenges the audience's preconceptions and expectations, provoking new ways of thinking about technology and humans existing in a techno-organic environment.

Umwelt is about the relationship between an organism and the world. *Empty Space* pinpoints the same relationship by using irony and distinctive visual aesthetics to question the current state of that relationship. The organism, a human, in the current image is enhanced by a technological artefact, which becomes an inherent part of the *Empty Space* user's *Umwelt*. The work invites the user and observers to reconsider the evolving relationship between a human and the world, increasingly affected by technology and other human-initiated enhancements.

03. Figure: *Empty Space* by Beloff, 2009. Photo © 2009, Laura Beloff.

Humour and irony have been inherent elements of more or less all of the works by the author. The irony functions as an amplifying indicator for the evolving relationship between an enhanced human and technological, networked world, and furthermore as a way of questioning this relationship. The author's works utilise an existing technological infrastructure – the telecommunications network – and commercially available electronic components, but the functions and structure of the works differ drastically from commercially available mobile

devices. The works are based on a new physical and conceptual wiring, which forms new functions and new aesthetics, thus making it possible to include irony in the works.

The enhanced networked human who is formed by the works, points to the existing relationship between us, our mobile devices and the world. This relationship often left unnoted and has a tendency to evolve in the direction as pointed to by available devices and their possibilities. However, by using irony in the works, the author is marking this relationship as suspect. Irony enables one to create a situation which is in conflict with the prevailing viewpoint on mobile and wearable technology, and subsequently, irony can reveal multiple perspectives and alternative ways to see this situation.

The aesthetically motivated humorous elements in the works have been used to attract the public's attention, and their ironic attitude serves to invite questions from the observers and users of the works. This kind of use of irony to create questions, rather than to give answers, has always been one of the central features of the author's artistic practice. Irony is an intentionally chosen tactic by the author, making it possible to deal with the topic and the context of the work playfully, whilst simultaneously making crucial inquiries about it.

II. Prerequisites for Artistic Practice Dealing With Human, Body and Networks

This chapter introduces concepts of art and science starting from the developments in the 1940s in cybernetics, looking specifically at the impact of technology and science on artistic currents. The chapter is narrowed down to include characteristics and developments in the arts which relate to the author's research and artistic practice: the impact of cybernetics on art, art seen as a system, the development of real-time technologies with an impact on art, the concept of presence in culture, the impact of networks on art and the issue of the body in art.

II.1. Cybernetics Influencing Art

Officially, cybernetics was introduced to the world in 1948 when Norbert Wiener published *Cybernetics, or Control and Communication in the Animal and the Machine* (Wiener 1948). The term cybernetics was coined during the Macy Conferences (1946-1953[6]), which were one of the main forums in which many of the ideas concerning systems theory and cybernetics were discussed and debated (Hayles 1999). Participants included figures such as Ross Ashby, Gregory Bateson, Margaret Mead, Heinz von Foerster, Warren McCulloch, John von Neuman, Claude Shannon and Norbert Wiener, among others[7]. As Wiener's title suggests, cybernetics is the science of communication and control in animal and machine. It proposes a viewpoint to the study of humans and machines.

One of the main concerns of cybernetics is studying the organisation of systems. This organisation accounts for the way in which the components of a system interact with one another, and how this interaction determines and changes its structure. It explains the difference between the parts and the whole, without reference to their material forms. Cybernetics focused on immaterial flows of information rather than on material properties. The construction of

[6] http://en.wikipedia.org/wiki/Macy_conferences [accessed 9.2.2012]
[7] ibid.

information as a theoretical entity, as distinct from material, was the major theme of the first Macy Conference, which was followed by themes such as the construction of neural structures to be seen as information flows, and the construction of artefacts that translated information flows into observable operations (Hayles 1999).

In other words, cybernetics made information that was understood as disembodied medium, seem more important than materiality. It also formed an irrevocable correlation between the functions of organic (human) bodies and machine functions, through the development of a theory of regulation and control that would be applicable to living beings as well as to machines. The 20th century perspective concluded that life is inextricably linked to the processing and communication of information. These concepts that were developed in cybernetics permeate thinking in many fields, e.g. computer science, biology, sociology, politics, ecology and many others, including the arts.

This dissertation stems from the arts as practice-based research dealing with the integration of human and technology, as in the case of wearable technology, and this chapter therefore mainly investigates the impact of cybernetics on the arts.

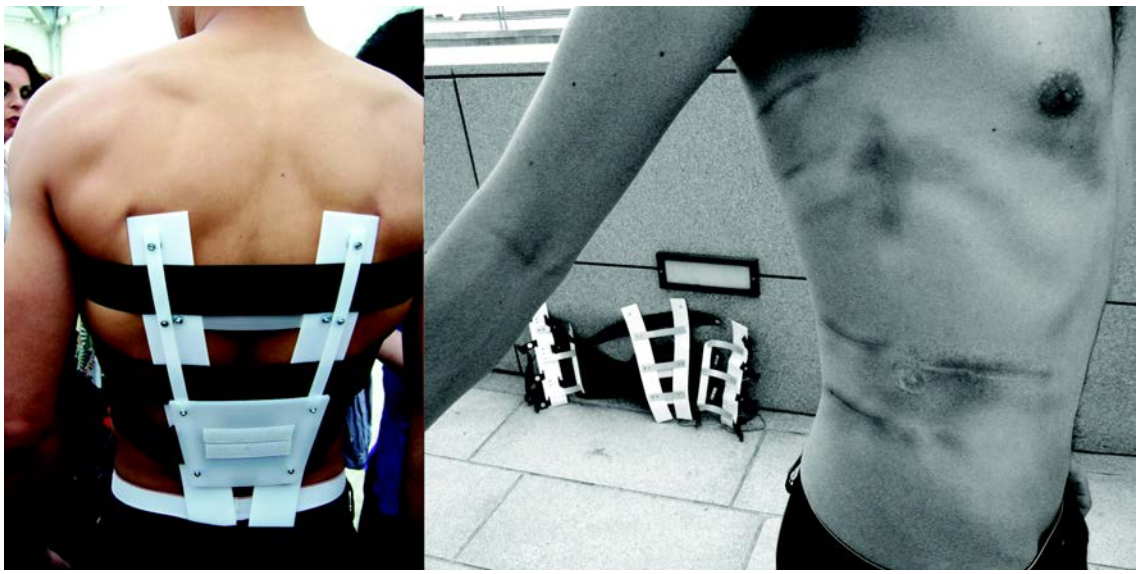
Cybernetics is based on an idea of feedback systems that help the system to maintain equilibrium. This is viewed similarly in humans and in machines; they both are viewed as information processors that tend towards homeostasis. "The idea behind cybernetics was not so much to think about machines as people, but to check if a man could function as a machine. In this context, it looked for discovering what connected humans, animals, and machines as information-processing devices" (de Souza e Silva 2004, p. 24). Cybernetics redefined the concept of the human to be seen primarily as an information-processing entity. This formed an image of the human as a system, which is constructed from distinct but connected parts that can be controlled individually.

This kind of viewpoint of a human can be detected in many wearable technology projects, particularly in wearable computing projects that are based on biofeedback. For example, smart shirts (of which there are many variations created by different companies[8]) typically detect the user's internal body functions, such as heart rate, respiration rate, temperature, activity and posture, as well as the user's geographical location. The detected data are subsequently transmitted wirelessly to a central observation system, which is alerted in the event of unexpected results. These shirts are usually designed for health or emergency monitoring for patients, athletes and soldiers. However, some of the wearable technology projects emerging within the arts are somewhat different in their treatment of a human. In these projects, the wearable device incorporates the user into a larger system and the user often becomes a component of this system. In other words, the user is no longer seen as an individual entity constructed of separate parts, but as a single part in a larger system. This is visible e.g. with Gordon Savicic's *Constraint City*[9] work, 2007 (Figure 04). *Constraint City* is a wearable corset-like device that detects closed wireless networks in a city; the stronger the restriction signal is, the tighter the corset on a user will automatically become. It is a constructed extension of a sense that is mediated through technology; the prominent wearable apparatus detects a spatially broadcasted technological signal that is otherwise imperceptible to the biological human senses. The system encapsulates the user into its realm; the user is no longer an outside observer but part of the system.

Similarly, in the author's work the *Appendix* (described in chapter V.1.1.), the user, who is also the observer of the system, is physically attached to a system, the functions of which are based on real-time information processing received from a networked hybrid environment. In works of this kind, the user is both within the system and a part of it.

[8] http://en.wikipedia.org/wiki/Smart_shirt
http://www.ecouterre.com/intelligent-t-shirt-monitors-hospital-patients-vital-signs-movements/ [accessed 17.2.2012]

[9] www.yugo.at/equilibre/



04. Figure: *Constraint City* by Gordon Savicic, 2007. Photo © Gordon Savicic.

The theory of second-order cybernetics emerged from the need to understand the observers impact on the results. Second-order cybernetics includes the observer (or user) as a part of the system, whose interaction with the system is seen to have an impact on the observations. Additionally, the observer himself is considered as a cybernetic system that is interacting with another parallel system. In the arts, this idea is most obvious in the interactive arts, where the user (and observer) of the work is expected to interact with them, which typically causes a visible or audible change.

Second-order cybernetics was developed during the 1970s; the work of Heinz von Foerster, Gordon Pask and Humberto Maturana among many others is strongly associated with it (Heylighen & Joslyn 2001). In a discussion with Stewart Brand, Gregory Bateson and Margaret Mead, cybernetics was described as a box with input and output and feedback taking place within it, and an engineer observing the system from outside; the second-order cybernetics diagram shows the same box with observers (Wiener, Bateson and Mead) outside it. However, all of the parts are now contained within a larger box with feedback taking place between the observers and the first box. As Bateson described it: "essentially your ecosystem, your organism-plus-environment, is to be considered as a single circuit" (Brand 1976, p.36).

A historical artwork, which was based on the idea of second-order cybernetics, is cyberneticist Gordon Pask's *Colloquy of Mobiles,* which he created for the *Cybernetic Serendipity* exhibition in 1968. He proposed it as an aesthetically potent environment, which shapes the viewers' experiences and allows them to participate. "It is a group of objects, the individual mobiles, that engage in discourse, that compete, co-operate and learn about one another" (Pask 1968, p. 34-35). The installation was a reactive, educable, computer-based system composed of five mobiles that were suspended from the ceiling. The rotating elements communicated with each other through light and sound. Visitors could participate in the ongoing discussion between the elements by using flashlights and mirrors (Rosen). In many artworks which are influenced by cybernetics, computational models are seen as underpinning *real world* phenomena. Pask's installation was reacting to its environment, to other parts of the machinery or to humans interacting with it and in response it affected the entire state of the installation. It was a system in which its observers (the visitors at the exhibition) became a part of the cybernetic system through their interaction with the work.

Humberto Maturana and Francisco Varela continued the work on second-order cybernetics with their idea of autopoiesis. According to Maturana & Varela's epistemology, the world is a set of informationally closed systems. The organisms respond to their environment in ways determined by their internal self-organisation (Hayles 1995). In the autopoietic perspective, there is no boundary between the system and its environment. In other words, we do not see a world as separate from us, but as what our internal, species-specific self-organisation allows us to see. A classic paper related to the topic is *What The Frog's Eye Tells The Frog's Brain*, which was written by cognitive scientist Jerome Lettvin with Humberto Maturana, Warren McCulloch and Walter Pitts in 1959. It proved that a frog does not see, or concern itself, with the stationary elements of the world around it, but its perception is organised in such a way as to enable it to clearly see small moving objects such as insects, which are its choice of food. The frog would starve to death surrounded by food if it was not moving, because its physiological structure allows it to recognize

only moving prey (Lettvin, Maturana, McCulloch & Pitts 1968). A frog's inner organisation determines its perception and interpretation of the world, therefore the world is subjectively constructed by an organism. There is a clear conceptual relationship between Uexküll's formulation of an organism's *Umwelt* (Uexküll 1934) and the autopoietic perspective. Both viewpoints see the world as a subjective reality constructed by an organism, impacted upon by an organism's physiological abilities and internal organisation.

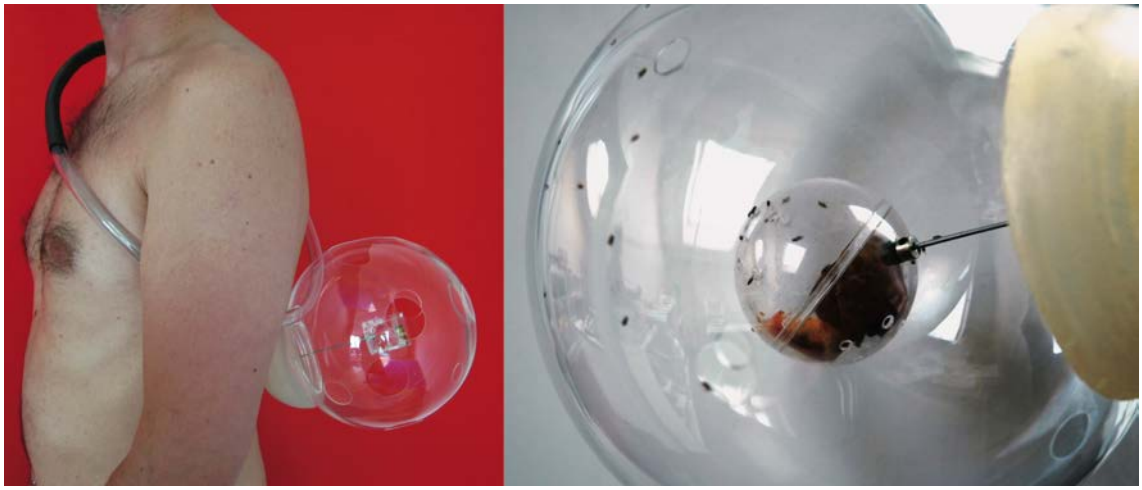
In Section I of this dissertation, introduced is Uexküll's concept of the *Umwelt* (Uexküll, 1934) from biosemiotics. Although cybernetics proposed a theory that concerned both the living and the non-living[10], it is typically applied to non-living artificial entities such as certain devices and machines, whereas biosemiotics focuses mainly on living organisms. However, several of Uexküll's ideas and concepts he developed within biosemiotics can be seen to bear relation to cybernetic principles that were developed decades later. For example, in 1905 Uexküll formulated one of the first definitions of the principle of negative feedback which occurs inside an organism, while he was studying the nerve and muscle physiology of marine invertebrate animals. Many scholars have demonstrated connections between cybernetics and biosemiotics, e.g. Alexei A. Sharov sees a synthesis between cybernetics and biosemiotics, in their constructions of agents that perform functions necessary for achieving their goals. This applies equally to living and non-living systems (Sharov 2010).

The *Cockroach Controlled Mobile Robot*[11] by Garnet Hertz, 2004, is an example of an artwork that addresses concepts stemming from cybernetics and which combines organic and technological components into a single system. It is a robot which translates the bodily movements of a living insect into the physical locomotion of a robot. A cockroach is carefully placed on a ping-pong ball on top of a three-wheeled robot, its crawling motions move the ball, which subsequently determines the direction and movement of the three-wheeled robot. The cockroach is provided with feedback on close obstacles in the form of light. In this techno-organic system, the

[10] Wiener's Cybernetics, or Control and Communication in the Animal and the Machine (Wiener, 1948)
[11] http://www.conceptlab.com/roachbot/ [accessed 21.2.2012]

cockroach's environment and species-specific *Umwelt* is replaced by a completely new one. One cannot help but wonder what kind of perception of the world the cockroach has within his new *Umwelt*, and how long it would take for the species to adapt to this kind of radical change[12].

Stelarc[13] (whose work is also discussed in the chapter IV.3) is a performance and robotic artist who has worked for decades with the human body and its merger with technology. Many of his works can be seen as experiments in second-order cybernetics in which he includes himself as a performer and an observer as a part of the system and vice versa; the machine becomes a part of himself. This is concrete e.g. in his work *Exoskeleton*, 1999, which is a large-scale six-legged robot that requires a human body to comprise part of its system. The human body controls the motion of the robot through magnetic sensors on the joints. Stelarc is extending his own nervous system into non-biological space (Clark 2003). With his experiments, Stelarc is testing the boundaries of the body through techno-organic constellations that affect behaviour and knowledge and form a new kind of subjectivity.



05. Figure: *Fruit Fly Farm* by Laura Beloff, 2006. Photo © Laura Beloff.

The author's projects presented in this dissertation are inherently techno-organic in their compilation of human body and wearable devices, together being considered as a single entity. The earlier work *Fruit Fly Farm* (Figure 05) includes another organic entity, the fruit fly

[12] There are many artists working with similar techno-organic constellations combining living creatures with technological cybernetic systems, e.g. Kenneth Rinaldo and Andy Gracie among others.
[13] http://stelarc.org [accessed 21.2.2012]

community, as part of the system. The work creates a connection between the audience, the user of the work and a non-human organism, the fruit fly community. All of these parts affect each other and form a system within the context of the hybrid environment.

In Stelarc's and in the author's work, one can understand the claim made by cybernetics that the boundaries of a human are constructed rather than biologically determined. In Stelarc's practice he – as a performer – is merged with cybernetic machines that transform his body's functions, and in the author's works, a new kind of environment emerges with the newly constructed faculties that subsequently impact upon one's subjective formation of *Umwelt*.

II.1.1. Art and Technology on Show In 1968

The summer of 1968 saw two major exhibitions investigating computers and the concepts of cybernetics in the arts in Europe; *Cybernetic Serendipity* at ICA in London and the *New Tendencies* exhibition in Zagreb.

"The principal idea was to examine the role of cybernetics in contemporary arts. The exhibition included robots, poetry, music and painting machines, as well as all sorts of works where chance was an important ingredient. It was an intellectual exercise that became a spectacular exhibition in the summer of 1968" (Reichardt 2005). The *Cybernetic Serendipity* exhibition was organised in three categories: computer generated work, cybernetic devices and environments, such as robots and painting machines, and machines demonstrating the use of computers and the history of cybernetics (Reichardt 1968). The curator, Jasia Reichardt, writes in the catalogue introduction that the *Cybernetic Serendipity* exhibition deals with possibilities rather than achievements. "There are no heroic claims to be made because computers have so far neither revolutionised music, nor art, nor poetry, in the same way that they have revolutionised science" (*Ibid.*, p. 5). Interestingly, she believed that the most important single revelation of the exhibition was the cross-disciplinary work it generated. It involved and attracted people who usually have very little to do with creative activity, who "started to make drawings which bear no practical

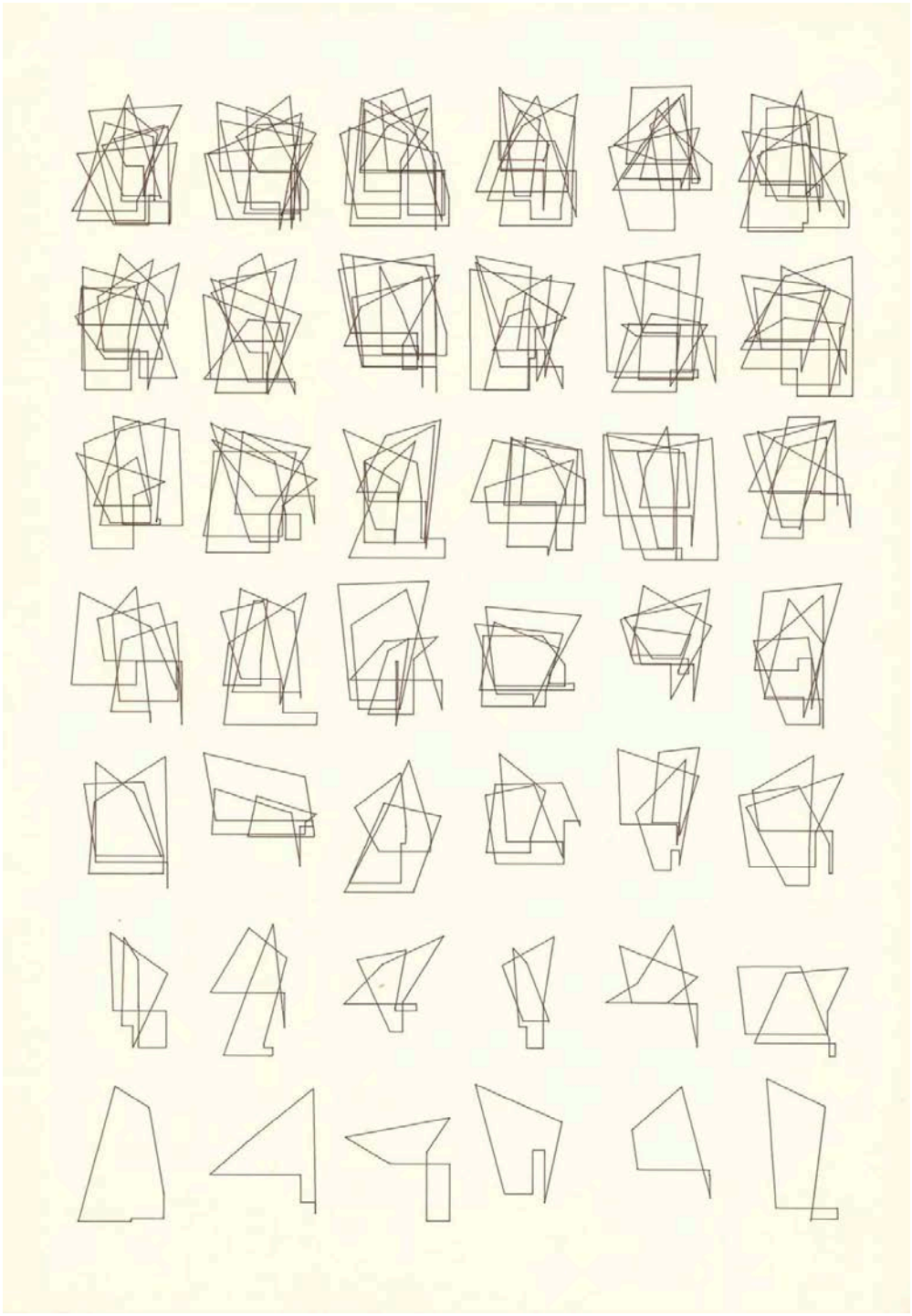
application, and for which the only real motives are the desire to explore, and the sheer pleasure of seeing a drawing materialise" (*Ibid.*, p. 5).

The exhibition included various kinds of computer graphics experiments, drawing and painting machines that were developed by both artists and scientists, often on the basis of given mathematical rules. For example, Georg Nees produced the various computer graphical works (Figure 06). For example, his *8-corner graphic* was made with the following instructions for the computer: "Distribute eight dots inside the figure-square and connect them with a closed straight edge line" (Nees 1968, p. 79). The result was a series of small computer-drawn shapes, which all presented a different solution for the instructions given.

It is worth pointing out that ideas in which one can see the impact of technology on society and general thinking, were also present within the more traditional arts. Sol LeWitt began his long series of wall drawings, which were conceived as sets of guidelines or simple diagrams to be executed directly onto the wall, in 1968. LeWitt's principle was that the work was usually executed by people other than the artist himself, according to the written instructions[14]. The instructions for *Wall Drawing* #69 from 1971 are as follows: "Lines not long, not straight, not touching, drawn at random using four colors, uniformly dispersed with maximum density, covering the entire surface of the wall" (Reas 2004).

At the same time as the now-famous *Cybernetic Serendipity* was on show in London, a lesser-known exhibition, the 4th *New Tendencies*, was being held in Zagreb. The 4th *New Tendencies* event included an exhibition and an international conference entitled *Computer and Visual Research*. The event focused on computers as a medium of artistic work, information theory, and technology that would define the future of civilisation (Monoskop 2011). E.g. the previously mentioned Georg Nees exhibited computer-generated drawings at both exhibitions, at *Cybernetic Serendipity* and the 4th *New Tendencies* in Zagreb, where he also participated in the conference (Rosen 2011). The 4th *New Tendencies* exhibition and conference added remarkable value to the research aspect of such artistic practice.

[14] http://en.wikipedia.org/wiki/Sol_LeWitt#Wall_drawings [accessed 20.2.2012]



06. Figure: *Ohne Titel* by Georg Nees. Software: ALGOL-Programm; Hardware: Siemens-Digitalrechner 2002; Output: ZUSE-Graphomat Z64. Photo: Courtesy of Kunsthalle Bremen - Der Kunstverein in Bremen, Kupferstichkabinett.

II.2. Art as a system

Hans Haacke wrote in 1968: “A 'sculpture' that physically reacts to its environment is no longer to be regarded as an object. The range of outside

> factors affecting it, as well as its own radius of action, reaches beyond the space it materially occupies. It thus merges with the environment in a relationship that is better understood as a 'system' of interdependent processes. These processes evolve without the viewer's empathy. He becomes a witness. A system is not imagined, it is real" (Lippard 1973, p. 37).

Charlie Gere points out that the first reference in English language to *art as a system*, which presented a perception of art in terms of communications and information theory, appeared in the catalogue accompanying the exhibition *This is Tomorrow* at the Whitechapel Gallery in London in 1956. The exhibition had twelve sections, the final section of which focused on communication research and systems theories. It presented collaborations between architect and artist within the framework of communications (Gere 2006). In the accompanying catalogue, there was also a reference to computers and other computing machinery as a potential means of making visual art. As Gere points out, this was highly prescient in 1956, considering that research into visual computing was very much in its infancy at the time (*Ibid*.). About a decade later the prediction became true, there were artists, several exhibitions and events exploring the possibilities of new technologies and ideas such as cybernetics: e.g. the aforementioned European exhibitions *Cybernetic Serendipity* and *New Tendencies* in 1968, as well as an exhibition at MOMA in New York, entitled *The Machine as seen at the End of the Mechanical Age*, and the *Some More Beginnings* exhibition at the Brooklyn Museum by EAT (*Ibid.*).

Experiments in Art and Technology – EAT – had already started collaboration two years earlier in 1966 with their famous event *Nine Evenings,* which was the first large-scale attempt by engineers, artists, and dancers for recognition of the fact that art and technology were no longer considered alien forces subverting each other (Burnham, 1968). During the early 1960s, artists such as Roy Ascott, Nam June Paik, Nicolas Schöffer, Gustav Metzger and David Medalla, among others, had individually begun investigations into the use of technology and its relating principles

in art, and addressing concepts stemming from the field of science and technology in their artworks. Ascott's interests in behaviour and cybernetics led him to develop *Change-Paintings* and *Analogue Structures* in 1959. These works were constructed as overlapping transparent panels of images or symbolic marks within a frame, which viewers could rearrange by sliding them. "I could see that the artwork was a system arising from a process, the system including the artist, the artwork, and the observer, coupled in a semantic relationship, where the aesthetic experience emerged from the interaction of these three elements" (Ascott 2008, p. 11).

Art that is affected by science and technology was introduced and fully developed by critic and theorist Jack Burnham during the late 1960s. In the last chapter of his book *Beyond Modern Sculpture*, Burnham focuses on *Robot and Cyborg Art*, on works that could be seen as systems and which were often shaped by science and technology. Burnham detected a problem of Kinetic Art in its non-responsiveness to a viewer: "[…] the result in every case was not communication but one-way stimulation for the human party involved" (Burnham 1968, p. 313). According to Burnham, a system is a fundamental concept of cybernetics and its value "[…] lies in its power to cope with kinetic situations, and particularly the connecting structures of evolving events. A property of all systems is *stability*, and its counterpart, *instability*" (*Ibid.*, p. 318). Burnham saw a change in art from fixed art object to dynamic systems, which were not made to last. In this viewpoint a strong emphasis was laid on an environment and communication between a system and that environment. "It becomes clear that with Object Art, physical presence is everything, while for Systems Art, 'information' is the key factor" (Burnham 1968, p. 365).

These ideas developed about modern sculpture were further expanded in two essays: *Systems Aesthetics*, first published in 1968, and *Real Time Systems* in 1969 in Artforum. In *Systems Aesthetics,* Jack Burnham claims: "We are now in transition from an object-oriented to a systems-oriented culture. Here change emanates, not from things, but from the way things are done" (Burnham 1974b, p. 17). Burnham's viewpoint was strongly influenced by cybernetics and systems biology through texts of Norbert Wiener, Claude Shannon and Ludwig von Bertalanffy,

who was the father of General Systems Theory, and many others. Burnham saw that the conceptual focus was the defining factor of a system, not its material limits. "Where the object almost always has a fixed shape and boundaries, the consistency of a system may be altered in time and space, its behaviour determined both by external conditions and its mechanisms of control" (*Ibid.*, p. 17).

In *Real Time Systems* Burnham continued to analyse art which functions as a system and art as information processed in real time. He posits that the major illusion of the art system is that art resides in specific objects, which he argues are only a material basis for the concept of *the work of art*. In this essay Burnham develops an analogy between the art system and the computer system and writes about artists who have begun to give real-time information to the public, "information with no hardware value, but with software significance for effecting awareness of events in the present" (Burnham 1974a, p. 30). Burnham was not only interested in works that operated as systems, but also in the role of the artist in an advanced technological culture. He claims that "With increasing aggressiveness, one of the artist's functions, I believe, is to specify how technology uses us" (*Ibid.,* p. 38).

In the late 1960s Burnham genuinely saw dynamic systems as the future of art. At the end of *Beyond Modern Sculpture* he writes: "The stabilised dynamic system will become not only a symbol of life but literally life in the artist's hands and the dominant medium of further aesthetic ventures" (Burnham 1968, p. 376).

II.2.1. From Conceptual Art to Les Immatériaux

During the same time, corresponding ideas were developed in other areas of art. Lucy Lippard & John Chandler described the art of the late 1960s and early 1970s as "an ultra-conceptual art that emphasises the thinking process almost exclusively" (Lippard 1973, p. 43). Their concept of the *dematerialisation of art* referred to a shift in the emphasis of an artwork from formalistic qualities to conceptual aspects and a wide variety of practices, from artists making

maps and instructions to happenings, writings, system-based installations and works on the streets. “The visual art at the moment seems to hover at a crossroads that may well turn out to be two roads to one place, though they appear to have come from two sources: art as idea and art as action. In the first case, matter is denied, as sensation has been converted into concept; in the second case, matter has been transformed into energy and time-motion" (*Ibid.)* In this text Lippard & Chandler argue that in the future, dematerialisation may cause the object to become obsolete. Lippard’s book *Six Years: The dematerialization of the art object 1966-1972* presents many artworks that are based on information, communication or systems, rather than formalistic material qualities. One example of this is a work by Vito Acconci, *Following piece,* 1969 (Figure 07), which was an activity carried out over 23 days for varying periods of time. “Choosing a person at random, in the street, any location, each day. Following him wherever he goes, however long or far he travels (The activity ends when he enters a private place –his home, office, etc.)” (Lippard 1973, p. 117). Many of these kinds of approaches to art we know today as *Conceptual Art*.

07. Figure: *Following Piece* by Vito Acconci, 1969. Photo © Acconci Studio.

Continuing on the trail of artists, art movements and events that have been influenced by science and technology; in 1985 an exhibition entitled *Les Immatériaux*, The Immaterials, was shown at the Pompidou Centre in Paris. The curator was philosopher Jean-François Lyotard, who had a few years earlier published *The Postmodern Condition*[15], which was a report on the state of knowledge in the Western world, commissioned by the government of Quebec. Charlie Gere writes that the report was a response to the world made possible by systems-based thinking and the technologies it had fostered; the report defined its field as knowledge in computerised societies (Gere 2006).

Lyotard's curatorial aim with *Les Immatériaux* was to establish a relationship between scientific and artistic modes of thought. The exhibition had two themes: the first one was "general interaction", which dealt with human sciences and liberal arts. According to Lyotard, technologies are forcing us to reconsider the position of the human being in relation to the universe, in relation to himself, in relation to his traditional purposes, his recognised abilities and his identity. Lyotard was observing a radical change between humans and their relationship and perception of reality. The second theme of the exhibition was "the immaterials". In an interview, Lyotard explains:

"…all of the progress that has been accomplished in the sciences, and perhaps in the arts as well, is strictly connected to an ever closer knowledge of what we generally call objects. (Which can also be a question of objects of thought.) And so analysis decomposes these objects and makes us perceive that, finally, there can only be considered to be objects at the level of a human point of view; at their constitution or structural level, they are only a question of complex agglomerates of tiny packets of energy, or of particles that can't possibly be grasped as such. Finally, there's no such thing as matter, and the only thing that exists is energy; we no longer have any such thing as materials, in the old sense of the word that implied an object that offered resistance to any kind of project that attempted to alienate it from its primary finalities" (Blistène & Lyotard 1985, p.34).

The exhibition at the Pompidou Centre was structured as a network of artistic, scientific

[15] Publishedin French 1979 and in English 1984.

and technological experiments. One of the features of the exhibition was a portable radio guide. Visitors could have their personal device with radio receiver. As they moved through the exhibition, various soundtracks of commentaries were transmitted to the devices based on their location.

This exhibition was related to the themes of art and systems, which had been articulated by Jack Burnham in the late 1960s, as well as tackling the question of the immateriality and dematerialisation of art, as proposed by Lucy Lippard in the early 1970s.

II.3. Real-time Art

08. Above *Dimi-A*, 1970, and below *Dimi-O*, 1971, by Erkki Kurenniemi. Photos: Courtesy of Finnish National Gallery, Central Art Archives / Erkki Kurenniemi Archive. Dimi-A photo © Mikko Ojanen / Erkki Kurenniemi Archive.

Erkki Kurenniemi is a Finnish artist, inventor, scientist and techno-visionary with "an idiosyncratic way of seeing the world and the universe, and assessing the impact of new technologies on the evolution of human beings" (Huhtamo [2003] 2011). In addition to creating 14 experimental short films during the 1960s, various computer graphics, electronic music recordings and theories about the mathematical foundations of harmonies, he designed and constructed several digital musical instruments (DIMI) in the early 1970s. Kurenniemi was interested in the various methods of controlling the digital instruments. For example, the *Dimi-O* from 1971 was based on the idea of optical control that could visually read the notes. The performer could additionally control the instrument with a traditional keyboard or through a video camera as an input device. An experiment was carried out with the *Dimi-O* instrument and a dancer, who could create music in real-time through the movements of her body as seen by the connected camera. Kurenniemi also developed instruments that were based on biofeedback as a control, e.g. *Dimi-S*, 1972, which was based on the electrical conductivity of skin and *Dimi-T*, 1973, which measured the electrical activity of a brain[16]. Present in these artworks are ideas such as cybernetics, real-time transmission of data and the use of technology as a basis for art practice, but they also anticipated interactive installation and performance art by years, as is pointed out by Huhtamo (*Ibid.*).

John Cage performed his work *4'33"* for the first time in 1952. It is composed for any instrument and the score instructs the performer not to play the instrument during the entire duration of the piece.[17] It is his famous so-called *silent piece*, which consists of the sounds of the environment that the listeners hear while it is performed.

Charlie Gere sees a connection between this work by Cage and the work of information theorist Claude Shannon, who laid the foundational stones of information theory. Shannon's research at the Bell Labs together with Warren Weaver is considered to be the foundation of modern telecommunications and resonated with Wiener's cybernetics in its viewpoint of seeing

[16] http://en.wikipedia.org/wiki/Erkki_Kurenniemi [accessed 22.2.2012]
[17] http://http://en.wikipedia.org/wiki/4'33" [accessed 23.2.2012]

information as the key component of communication technologies. Shannon was researching an efficient way of encoding information and how to deal with the problem of noise. Shannon understood noise as elements of the signal that are not part of the actual message being transmitted (Gere 2006). According to Gere, "Shannon's concept of communication is the exact inverse of Cage's strategy in *4'33"*, in that Cage seeks to show that, in Shannonian terms, noise *is* signal" (*Ibid., p.97*). Also, Norbert Wiener's theory of cybernetics incorporated similar thinking about information to what Shannon had proposed. They both saw information as connected to uncertainty. A message is compiled of individual elements, which make no sense on their own and until the message is complete, its meaning is uncertain (*Ibid.*).

John Cage was interested in uncertainty and chance in art and works, which could be considered as empty spaces that allow something to happen. John Cage became a highly influential figure for the development of experimental music practices, for performance art, for installation art and for art that employs technology and addresses new concepts emerging from new tools. In reference to Cage, Gere claims that art can cease to be objects but can be seen as active space where anything can happen and people communicate (*Ibid.*).

Artworks such as ones described above not only made use of concepts from the science and technology of the time, but they also brought changes to existing concepts in the arts. Over the last few decades, for example, practices with interactive and media-art have introduced the concept of real-time as a potential characteristic of an artwork, for instance, as well as challenging the concept of (human) presence through telematic and networked works.

According to Jack Burnham; "What a few artists are beginning to give the public is real-time information, information with no hardware value, but with software significance for effecting awareness of events in the present" (Burnham 1974a, p. 30). In the essay Burnham mentions SAGE, the first computer-based air defence system, Project Mercury, the first real-time digital support system for space flight, Telefile, the first online banking system, and SABRE, the first computerised airline reservation system, as examples of operational real-time systems which

gather and process data from environments (Burnham 1974a). Burnham related technological real-time systems, which had only recently been developed at the time, to artworks which were constructed as environments or systems involving their surroundings and context. His role models were artists such as Hans Haacke, whose work involved working with natural systems, e.g. air, wind, humidity, freezing and melting points, and a work that involved the incubation of chickens in a gallery; *Chickens Hatching*, 1969. These kinds of works Burnham understood as information processed in real-time. This line of thinking has been continued by Charlie Gere, who has theorised the role of art in the age of real-time systems and instantaneous communication within the history of media. According to Gere, the role of art in the age of real-time technologies is to keep our human relationship with time open in light of the potential of such technology to foreclose it (Gere 2006).

Gere, however, is somewhat sceptical of the recent engagement with real-time technologies of artists who, he feels, prefer working with static, unchanging objects that can be easily accommodated by a gallery or a museum. Nevertheless, real-time technologies have throughout the years provided the author with some of the primary characteristics present in her artistic production, e.g. the immediacy and presence of a hybrid environment.

II.4. Presence

An interesting take on the concept of presence is introduced by Hans Ulrich Gumbrecht, who makes a Western cultural distinction between *presence culture* and *meaning culture*. The latter is based on a Cartesian worldview, whereas the former tries to avoid the dichotomy between the body and the mind, and focuses on the impact of physicality and presence (Gumbrecht 2004).

Gumbrecht claims that over the last few centuries, Western culture has been dominated by *meaning culture*, which is based on the view of the human figure as a disembodied, purely intellectual entity. The primary function assigned to this figure is that of being an observer of the world because, in large part, the entity has been provided with sufficient cognitive faculties. In

meaning culture, therefore, the dominant human self-reference is the mind, with the implication that humans conceive themselves as eccentric in relation to the material world. In *presence culture*, conversely, the dominant self-reference is the body. Here, the human is part of a cosmology and actively present as part of the physical world. *Presence culture* is affected by the senses, while *meaning culture* is inherently related to interpretation. Although Gumbrecht sees contemporary culture as dominated by a meaning culture, he claims that effects produced by presence and meaning always appear together and they are always in tension with each other (*Ibid.*).

A concrete example of this is Gumbrecht's claim, with originating thinking referenced to Niklas Luhmann, that a specific feature of the art system is the possibility of experiencing meaning effects and presence effects in simultaneity. In the specific constellation of art, Gumbrecht argues, meaning will not make the presence effects disappear and the physical presence of an art object (a text, a voice, a canvas, a play) will not repress the meaning dimension.

Considering real-time technologies and their impact on the concept of presence, Gumbrecht remarks that the closer our contemporary communication technologies have come to fulfilling the dream of omnipresence – having experiences independent of the physical location – and the more definite the subsequent loss of our bodies and of the spatial dimension in our existence seems, "the greater the possibility becomes of reigniting the desire that attracts us to the things of the world and wraps us into their space"(*Ibid.*,p.139).

Along similar lines, looking at art, Jens Hauser sees information-centred new media art as being based more on the *meaning culture*, whereas for him bioart presents constellations based on presence effects (Hauser 2008b). Hauser's argument shows a shift away from the concept of the dematerialisation of art, which was one of the prevailing ideas in the development of conceptual art and art & technology during the 1960s, as is introduced in the previous chapter through the ideas of Jack Burnham and Lucy Lippard. These 1960s experimental works emphasised the importance of information and a concept over material qualities and physical objects, and it can therefore be said that interpretation and meaning effects were at the forefront of the artworks.

Gumbrecht proposed that the dominant self-reference in a presence culture is a body. One of the main characteristics of wearable technology artworks that they are in shifting degrees and ways connected to a (human) body and consequently have an inherent relationship with presence. In contrast to the early phases of media art, including experiments in virtual reality and telematic art practices, which celebrated freedom from the limitations of the physical body, it could be claimed that wearable technology art is re-considering the importance of the physical body and presence. As Hauser has claimed about bioart, the live encounter with organic materials has an impact on emotional factors that meaning does not convey (Hauser 2008b). In bioart, the presence effects have taken on a prominent role through the physical and material presence of the actual living artworks. This includes works involving the human body (Figure 09) as well as works shown in petri-dishes and various constructed systems employing organic materials.

09. Figure: Stelarc with his *Ear on Arm*. Photo © Markku Nousiainen 2012.

However, the treatment of presence varies between different approaches and artworks. Even if bioart typically uses organic living material as a medium, in many cases it is treated in the tradition of representational arts; the viewer is treated as an external observer - whereas in

practice, such as in wearable technology art or other human-body based works, the viewer is possibly also the user of the work and included as a component of the constructed system. These kinds of works often oscillate between *presence* and *meaning culture*. The shared presence of an organic body merged with a wearable artefact results in the first place in emotional impact, caused by the sheer physical presence of that body, and the secondary impact is in the interpretation of the work, which often involves understanding of technological structures and data transmission[18].

The wearable technology works (re)connect the world with the body that has regained its mobility and is now, possibly, networked. The firm relationship with the body and with physical presence differentiates (networked) wearable technology artworks, for example, from earlier telematic art practices, which seem to have been more focused on the connection of minds in the absence of the physical body.

II.5. Network and art

In October 1969 the first message was sent via the world's first packet switching network, the ARPANET. The well-known history of the Internet describes its initiation in the 1960s by the plan of the US Defense Department Advanced Research Projects Agency DARPA to prevent the Soviet Union from attacking and destroying the American communications system in the event of war (Castells, 1996). The network, which we now know as the Internet, was envisioned as early as 1960 by J. C. R. Licklider in his seminal paper *Man-Computer Symbiosis*: "It seems reasonable to envision, for a time 10 or 15 years hence, a 'thinking center' that will incorporate the functions of present-day libraries together with anticipated advances in information storage and retrieval and the symbiotic functions suggested earlier in this paper. The picture readily enlarges itself into a network of such centers, connected to one another by wide-band communication lines and to individual users by leased-wire services." (Licklider [1960] 2003, p.78). The 1960s saw the

[18] These ideas about meaning and presence effects in the arts and their relationship with specific art disciplines deserve a much more thorough investigation than is possible in the scope of this dissertation.

beginning of real-time computing which, combined with ideas from cybernetics and the development of communication networks, still underpins our contemporary communication and data processing systems.

Today we function in a society that is largely networked and increasingly based on mobile, portable and wireless technology. The mobility of technology, together with wireless networks, has created an instant and continuous connectedness, which many of us have casually accepted: we can be reached by anyone at any time, anywhere, and vice versa. It has become very clear that networks are everywhere and they are here to stay.

In the arts the impact of technological development, cybernetics, systems theory and information theory was seen with increasing interest to treat art not as an object but as a concept, which led artists to explore non-traditional media. For example, mail art anticipated the use of computer networking in telematic art (Shanken 2003). Mail art was pioneered in the mid-1950s by artist Ray Johnson. Its popularity grew during the 1960s until the 1980s and it is still today an active area of art. The initial network was named The New York Correspondence School, which Johnson was slowly building up as a network of correspondents who exchanged objects and messages through the postal system. With his initiative, Johnson wanted to challenge the (historical) temporality that informed modern art history and art production by placing the art within a communications system. Johnson claimed that mail art has no history, only a present[19]. In some of the mail art works, one can see that the emphasis of the work has been laid on the message as information, which is moving through a communications system. The actual content or meaning of the message itself was of less importance, but was often related to a specific time or location. This is seen for instance in the series *I got up* by On Kawara from 1969. One of the postcards in the series is addressed to Lucy Lippard and bears the stamped text: "Nov-5 1969 I got up at 12.17pm" (Lippard 1973).

[19] http://www.rayjohnson.org/Ray-Johnson-The-Present-of-Mail-Art/ [accessed 28.22012]
http://en.wikipedia.org/wiki/Mail_art [accessed 28.22012]

Fluxus is another example of art practices, which focused on networks and communication. It was an international network of artists, composers and designers, which bloomed through the 1960s to the late 1970s and is still today active to an extent. Fluxus is defined as a group of individuals that form an entity called Fluxus. Originally it was thought of as a means of information exchange, rather than an art movement defined by a specific style. During the late 1950s many artists, musicians and writers in different parts of the world began working in a way that rejected traditional cultural practices, but they had no knowledge of each other, nor any way of communicating and sharing ideas. In response to this came a magazine called Fluxus, which was started by George Maciunas and Dick Higgins (Smith 2005). Fluxus members shared a certain attitude towards art, life and culture. They rejected art as a professional and exclusionary praxis open to a selected few, and proposed art as an engagement open to all, which would make art into a social act due to its participatory and transformative nature. According to the Fluxus approach, the real significance of artworks was not the end product, but how the artworks model the process of intermedial thinking. "All Fluxus works, whether they be performances, publications, or multiples, are intended to be used and passed on as the viewer/participant comes to understand the work and even become a participant in the network. This model is based on a new social praxis that is shared and participatory. Art becomes not an object for contemplation or consumption, but a network, not, however, in the media or technological sense, but rather as a cognitive space and a communal structure" (Smith 2005, p. 134).

The development of telecommunications technology and emergence networks awakened the interest of artists wanting to test the possibilities of the new medium. At the beginning of the networked era, the interest was on the new immediacy of real-time computing and the technological possibility to connect remote locations.

The term coined to describe the convergence of computers and telecommunications is telematics. It was coined in 1978 by Inspector General Simon Nora and Finance Inspector Alain Minc, who were writing a report for the French Government that outlined developments in

computerisation and telecommunications in France at the time. In the coming together of computers and telecommunications they saw an impending telematic revolution, which would alter the entire nervous system of social organisation and open up radically new horizons (Shanken 2003). This led for example to the development of the French Minitel system[20], which was launched in 1982. It was a kind of pre-World Wide Web service on a national scale. According to France Telecom, in 2009 it still had 10 million active connections. However, in 2011 the France Telecom announced that it will close down the service in June 2012[21].

According to Roy Ascott, telematics "involves the technology of interaction among human beings and between the human mind and artificial systems of intelligence and perception. The individual user of networks is always potentially involved in a global net, and the world is always potentially in a state of interaction with the individual" (Ascott [1990] 2003, p. 232). Ascott has been the forefront figure of telematic art and one of the first artists to experiment with global-scale artistic collaborations over the network. Telematic art emphasises the immateriality of the process rather than the production of objects (Shanken 2003). According to Ascott, meaning in telematic art is the product of interaction between the observer and the system, which is in a state of endless flux and transformation. In this kind of approach, art is seen as residing in the cultural communications system rather than in the art object as fixed semantic configuration (Ascott [1990] 2003). In telematics Ascott saw potentialities for the emergence of a collective consciousness.

Another term pointing in the same direction was telepresence, which was coined by Marvin Minsky in his article *Telepresence* 1980, describing tele-operation systems used in remote object-manipulation applications (Minsky 1980). T. J. Campanella describes telepresence as "the mediated perception of 'temporally or spatially distant real environment' via telecommunications. Telepresence is reciprocal, involving both the observer and the observed. In other words, the

[20] http://en.wikipedia.org/wiki/Minitel [accessed 28.2.2012]
[21] http://online.wsj.com/article/SB10001424053111904772304576465573343018168.html [accessed 28.2.2012]

observer is telepresent in the remote environment, and the observed environment is telepresent in the physical space in which the observer is viewing the scene" (Campanella 1995, p.27).

An early artistic experiment using telecommunications as a medium was the *Satellite Arts Project*[22] by Kit Galloway and Sherrie Rabinowitz in 1977. The project was supported by NASA's satellites. The project consisted of two groups of dancers in different locations interacting with each other. The images from both locations were composited on a single screen (Chandler 2005).

In 1980, Kit Galloway and Sherrie Rabinowitz created the project *Hole in Space*, which was a satellite project connecting two storefronts, in New York and Los Angeles. On a November evening, the unsuspecting public walking on the streets of NY and LA had an unexpected encounter with each other. "Suddenly head-to-toe, life-sized, television images of the people on the opposite coast appeared. They could now see, hear, and speak with each other as if encountering each other on the same sidewalk. No signs, sponsor logos, or credits were posted – no explanation at all was offered. No self-view video monitors to distract from the phenomena of this life-size encounter. Self-view video monitors would have degraded the situation into a self-conscience videoconference" (Galloway & Rabinowitz 1980).

Other pioneering artworks using telecommunication technology include *The World in 24 Hours*, 1982, by Robert Adrian X and *La plissure du texte*, 1983, by Roy Ascott. Both works connected artists in remote geographical locations to a networked environment. Ascott's *La plissure du texte* was an evolving planetary fairy tale produced collectively by the participants at eleven different locations. It explored the potential of distributed authorship; each remote location represented a character in the story, who participated in contributing texts and ASCII-images as a part of the evolving fairy tale (Shanken 2003). Drucker writes of Ascott's telematic experiments that "the emphasis he placed on dynamic interactions stressed the human participant as an active component of information systems. Interactivity, [...] wasn't being conceived of as a simple menu of options for outcomes, but in the social relationships that produced meaningful experience" (Drucker 2005, p. 52). The telematic experiments can be seen as a continuation of

[22] http://www.1904.cc/timeline/tiki-index.php?page=Satellite+Arts+Project [accessed 29.2.2012]

the artistic moment of the remediation of the art object that had come to light during the 1960s. "Not only were new materials and media to be engaged, extending modern art's fascination with mass culture, but a serious thinking of the very idea of 'art' appeared on the edge of radical transformation" (*Ibid.*, p. 39).

During the 1990s, the telematic, telepresent and networked art beyond the Internet took many different forms and was explored by various artists, such as Paul Sermon, Eduardo Kac, Jane Prophet and Stelarc among many others. Today connectedness and the technological network are gradually becoming a standard characteristic, or at least a possibility, for any kind of artwork, and in the near future it will become a putative feature of artworks.

One can argue that the body has been one of the central concerns of technological art practices, with the examples of telematic art, virtual reality and wearable technology art. In telematic art, the aim has been to get rid of the body's physical constraints. Ascott considered telematics as the opportunity to connect with other minds, creating a collective consciousness and leaving the physical body behind or out of this image. For him, computer networking "responds to our deep psychological desire for transcendence – to reach the immaterial, the spiritual – the wish to be out of body, out of mind, to exceed the limitations of time and space, a kind of biotechnological theology" (Ascott [1989] 2003, p.223). Similar desires are also detectable in the 1990s virtual reality experiments and in the more recent development of online *metaverse* worlds; both practices have, in their own ways, aimed at diminishing the body and its physical limitations, whereas in wearable technology art, the physical body is of primary importance as the subject and also as the stage for the works. In the networked wearable technology projects, the networked virtual space is no longer seen as being separate from the physical reality, but as a new hybrid environment emerging from this merger, which also includes the presence and physicality of one's body. Considering the current development of wireless networks and wearable and body-embedded technologies from this perspective, one can argue that wearable technology is claiming back the importance of the physical body.

II.5.1. Internet Art

This research is concerned with networked wearable technology artworks, which have a specific relationship with telematic art practices through their emphasis on connections between physical things: people, objects, institutions, locations. However, it is worth briefly mentioning another art genre popular during the 1990s, which used the Internet as its material and its location: Internet art, also sometimes called net.art.

The history of net.art puts its starting point in 1994, with the creation of works such as the telephone intervention *kings X* by Heath Bunting[23], early works by Alexei Shulgin[24], Olia Lialina[25] and Robert F. Nideffer's early projects, such as ASCII Alphabet[26], 1995-96, that was to be experienced online, among many others. Internet art has been defined as art projects for which the Internet is both a sufficient and necessary condition of viewing, expressing and participating[27]. The majority of works done between 1994-1998 – during the height of Internet art –focused on and experimented with the medium and structure of the Internet. The net artists were questioning the structures and functions of the Internet and by so doing, showed that what most users accept to be natural is actually highly constructed. The main feature which categorises a work as Internet art is that the work, or part of it, is inherently built for the Internet and could not be achieved using any other medium. This meant that participating or viewing the work could only be done via a networked computer, but it also meant that it could be viewed from *any* networked terminal, whether it was a personal home computer, office computer or terminal in a public space. It was suddenly possible for the public to view an original piece of art whenever they wanted to, without the constraints of a museum or gallery. In the 1990s net artists primarily worked outside the field of institutionalised art discourse.

[23] http://www.irational.org/cybercafe/xrel.html [accessed 28.2.2012]
[24] http://www.easylife.org/ [accessed 28.2.2012]
[25] http://art.teleportacia.org/olia.html [accessed 28.2.2012]
[26] http://nideffer.net/proj/Terminals/t2/nideffer/intro.html [accessed 28.2.2012]
[27] http://en.wikipedia.org/wiki/Internet_art [accessed 28.2.2012]

II.6. Body, Art and Technology

An investigation of early art experiments, which used communication technology and computers, clearly shows that the human body has had quite a prominent role in them, even when the experiments have aimed at getting rid of the body. The logical explanation for this is that networked communication technologies have radically altered our understanding of the concepts of presence, space and location, which previously, almost without exception, were connected to physical presence. This shift has been dealt with by Paul Virilio, who is one of the leading critics and theorists of real-time networked technologies and their impact on our understanding of space. In a cynical tone Virilio questions: "How can we fail to see how much such radiotechnologies (digital signal, video signal, radio signal) will shortly turn on their heads not only the nature of human environment, our *territorial body*, but most importantly, the nature of the individual and their *animal body*? For staking out of the territory with heavy material infrastructure (roads, railroads) is now giving way to control of the immaterial, or practically immaterial, environment (satellites, fibre-optic cables), ending in the *body terminal* of man, of that interactive being who is both transmitter and receiver" (Virilio 1997, p. 11).

Over the centuries, science has underpinned an image of a fragmented body made of separate parts, organs and functions. This kind of objective and rational perspective of the body has made it easy to treat the body as a material, in both arts and sciences. In the arts this is seen, for example, in early body art and performance art (described below), which used the body as a material and, in a sense, aimed to transform our dependency on and fixed perception of it. The telematic art experiments described in the previous chapter treated the body as an obstacle and solved it by leaving the physical body behind and *travelling light* through the network. The recently developed *metaverse* worlds offer opportunities for a fluid data-body and for multiple virtual bodies and identities, which do not need to have any visible connection points to our physical bodies. In the *metaverse* worlds, the aesthetics of the body are completely malleable. However, the physicality of the material body is absent from these experiments. An interesting

point is that in the *metaverse* worlds of multiple users, the idea of a self is still nevertheless connected to a representational bodily entity, of whatever kind it may be. Whereas wearable technology art aims to equip the physical body with variable technological faculties and with new experiences that may permanently affect our perception of the body and its relation to the world. In all these examples, the limits and constraints of the human body are tested; how it could be different, better, variable, immaterial or be used as a material.

The body-centred art beyond theatre and dance, which we now know as performance art, emerged during the 1950s-1960s. Viennese Actionism is an example of body-based art movements. It is also known as one of the many efforts in the 1960s to develop action-based art that rejected object-centred and commodified art practices, alongside Fluxus, Happenings and Performance Art. The Viennese Actionists typically engaged in actions that involved social taboos, such as nakedness, destructiveness, religious or state symbols, violence and even genital mutilation. The use of the body as both the surface and site of art making was a common point of origin for the Actionists in their departures from conventional art practices. The main figures were Günter Brus, Otto Mühl, Hermann Nitsch and Rudolf Schwarzkogler[28] (Wegenstein 2006).

Artists Yoko Ono, Marina Abramovic and Valie Export have all played with the topic of sexuality and the idea of threat or violence towards women in their performances. Valie Export, with her *Tap and Touch Cinema*, 1968, gave the public the real thing – her naked breasts –instead of cinematic representations of women's bodies on large screen. However, the customer also had to encounter her direct and intimate gaze (Huhtamo 2005). Yoko Ono's *Cut Piece*, originally performed in 1964, was a performance in which she was sitting with scissors on front of her. The audience gradually cut the clothing from her body until she was naked (Pinkel 2003). *Rhythm 0*, 1974, was a six-hour performance by Marina Abramovic in which she offered an array of 72 instruments of pain and pleasure to be used on her body by the audience[29]. In these examples

[28] http://en.wikipedia.org/wiki/Viennese_Actionism [accessed 29.2.2012]
[29] http://en.wikipedia.org/wiki/Marina_Abramovic#Rhythm_0.2C_1974 [accessed 1.3.2012]

from the 1960s and the 1970s, it is very obvious that body was used as a material and as a site of action.

Happenings came into being in the American 1950s and can be defined as events without a predefined and fixed script. According to Allan Kaprow: "[…] they [Happenings] appear to go nowhere and do not make any particular literary point. In contrast to the arts of the past, they have no structured beginning, middle, or end" (Kelley 1993, p. 16). Kaprow created Happenings against a backdrop of being within everyday circumstances and locations that emphasised the non-separation between the play and the audience. Kaprow writes: "The fine arts traditionally demand for their appreciation physically passive observers, working with their minds to get at what their senses register. But the Happenings are an active art, requiring that creation and realization, artwork and appreciator, artwork and life be inseparable" (Kelley 1993, p. 59). Happenings fused the product with its creation process and with its environment (Wegenstein 2006). Whilst traditional theatre is based on predefined, framed situations, the Happening was produced simultaneously with its creation process and its environment, which was often an everyday place, such as a street. In the Happening the body became a part of a real-time and real-life process, which functioned as the final artwork.

The author's artistic works have a relationship with this kind of thinking. The works are offered for the concrete use of the public; there is no prewritten script or time limitations and no separation of the audience and the artwork. Rather than a traditional audience, these works require volunteers and participants, who can participate through a physical encounter with the work or via the telecommunications network. Downstream, there is no clear distinction between the presentation of the artwork and normal everyday circumstances. Optimally, the author's works are based on participatory experiences within the aesthetics of the everyday hybrid environment.

The development of networks, communication technology and programmable computers offering real-time characteristics has encouraged artists to create works with two-way (or more)

dialogues with an audience. This is also visible in the above-described examples; there is a clear rejection of a passive audience and there are expectations of audience participation. Similarly, participation is a prominent feature of the telematic and telepresence practices as previously described, and also almost all interactive artworks.

An example of interactive work, which deals with the body as its topic and which requires participation or interaction from the viewer, is Lynn Hershmann's *Deep Contact*, 1985-1990 (Figure 10). It is an interactive video-based work with a main character Marion, who exists on a screen. In the beginning Marion knocks on the screen and asks to be touched, continuing to do so until the participant touches specific parts of her body, which subsequently give the participant options. Hershman writes that "[…] a growing number of people feel an increasing need to participate personally in the discovery of values that affect and order their lives, to dissolve the division that separates them from control (freedom), and to replace longing, nostalgia, and emptiness with identity, purpose, and hope" (Hershman 2003, p. 194).

10. Figure: *Deep Contact* by Lynn Hershmann, 1985-1990. Photo © Lynn Hershmann.

There are not very many examples in architecture where human users become active and crucial part of the construction. The architects Diller + Scodifio constructed the Blur Building for the Swiss Expo 2002. It was a not solely an extravagant building in the midst of an artificially produced evolving fog-cloud, but also a fully holistic body concept. The visitors to the building were given wearable *braincoats* through which they partly experienced the building. These coats reacted to one another by comparing profiles and changing colour to indicate attraction or repulsion. "The architectural innovation of *Blur* lies not only in the fact that this is no longer a *building* – it is rather a *pure atmosphere*, as Diller + Scodifio themselves emphasise – but also in the fact that this 'habitable medium' no longer emphasises vision, but rather the proprioceptive *bodily* experience of inhabiting space" (Wegenstein 2006, p. 138).

The idea of the body and identity as a stable and fixed characteristic of oneself has long since disappeared. The contemporary body is a flattened body of simultaneities and coexisting possibilities and potentialities (Wegenstein 2006). What is striking in all these artistic examples starting from the 1960s and ending with today's wearable technology and body modification practices is that they all present us with a clear underlying desire for a more flexible, malleable and extendable body.

II.7. Irony in Art

Already introduced in the previous chapter, irony is a concept rooted in western culture with a centuries-old tradition and features in works by many scholars, such as Socrates. One example of ironic behaviour or performance from medieval Europe is the figure of a jester[30] or a narr. The well-known tradition in medieval royal courts was to employ entertainers, among them a court jester. He was a distinctively dressed figure who was allowed to speak about controversial issues and even make fun of the king. It was believed that the sharp eye and tongue of a jester disguised in humour often pointed to 'the truth' in the issues concerned. The jester was an entertainer, but also an adviser and a critic of the world. He was an appreciated figure with low

[30] http://en.wikipedia.org/wiki/Jester [accessed 23.3.2012]

social status, but more freedom to speak out on problematic issues (Otto 2001).

The concept of irony has evolved throughout the centuries. By the early 19th century, the concept of irony included both the intentional, instrumentally-used irony that had existed for longer, and unintentional irony, which was based on observations. This kind of observable irony was also representable in art (D. C. Muecke 1970). The early 19th century scholar and critic Friedrich Schlegel claimed that irony was paradoxical and dialectic. He saw as ironic the situation of a man as a finite being attempting to comprehend an infinite and incomprehensible reality (D. C. Muecke 1970; Knox 1973).

An example of irony represented by art and published in the public media is the mid-twentieth century cartoonists' viewpoint on the then recently emerged figure of a photographer in public. Their illustrations of photographers often depicted them working in public in such a way as to suggest that the photographer's head was under the hood of the large-format camera that was standing on a three-legged tripod and the human and the machine seemed to have fused together. For example, in the famous *Elephans Photographicus*[31] (Hankins & Silverman 1995) the cartoonist claims to have created an image of a new species, in which the camera and the hood replace the photographer's upper body and the single-eyed creature (the camera's outward pointing lens) is looking for a new prey. In these drawn images irony is located in the relationship between the human together with technology and the world. The pictures point to the simultaneous fears and desires of the public towards new technology, in which technology replaces parts of the human body with a specified functionality. They make a statement about technology improving the human and extending his abilities, but also about technology possibly replacing the human or his humanity. These images exemplify a situation in which human and technology are merging together and the human is learning to perceive the world through technology.

The use of irony in contemporary visual arts can be detected in many works. For example, the artist Maurizio Cattelan's works, which are often sculptural installations or performances, can

[31] Published in the journal Punch 44 (1863): 249.

be described as being at the same time comic and tragic, peculiar and familiar. Cattelan's works are clearly telling us something about our world, society and us, whilst simultaneously challenging the dominant structures of the contemporary value system (Arie 2004). Irony is claimed to be tightly connected to time, location and situation (Hutcheon 1998). This means that irony always has a connection to our existing reality, which is also true in the Cattelan's case. His works blur the distinction between art and reality in order to provoke a reaction. Cattelan uses references to existing reality, things that we are able to recognise immediately, such as the figure of the Pope in his installation *The Ninth Hour*, 1999[32]. Yet Cattelan does not use the representational sculpture of the Pope in its original or expected context, but creates a new meaning for it by subtly manipulating the context in the created imagery. In the work, the life-sized and life-like Pope has been struck down by a falling meteorite. The irony is produced in an almost classical sense, by intentionally saying one thing but meaning something else, and inviting the observer to interpret the meaning.

Media historian Wolfgang Ernst writes that technological media often aims at hiding their mechanisms in order to let the message appear in a pure form on well-established media, such as television or cinema. But *ironic media* display their own "artificiality, technical fictionality and artefactuality" (Ernst 2005, p. 598). In line with McLuhan's argument of the medium being the message (McLuhan 1964), Ernst argues that irony corresponds to an awareness of the medium at work with the message.

Irony is a frequent characteristic of artworks which utilise electronic media or technological devices. This is particularly visible e.g. in the previously mentioned Internet art of the 1990s, which experimented with the medium of the Internet. The artists were scrutinising the inherent structure and limits of the Internet and at the same time showed that it is a highly constructed medium. This ironic approach is present in many of the experiments in Internet art.

[32] "La Nona Ora", 1999.

11. Figure: *Upside-Down Glasses* by Carsten Höller, 1994-2004. Photo: Courtesy of Gallery Air De Paris.

The artist Carsten Höller's *Upside-Down Glasses*, 2001 (Figure 11), are wearable mechanical devices which manipulate the users' perception with various types of optical transformations, such as inversion, displacement, reversal, magnification or scrambling. Höller references his work to the famous scientific experiment from the 1890s by psychologist George Stratton, in which he experimented with the adaptability of brain and perception by wearing upside-down glasses several days in a row. But Höller's intention with his comparable work is to spread doubts. The users need to decide on perception on their own subjective viewpoint and to re-consider what reality is. In this work, the ironic perspectives are revealed in between the concepts of fiction and reality, which expose the artificiality of the situation.

Art which utilises technology, but which is constructed without any straightforward purposeful functionality, often results in an ironic or playful nature due to our strong expectations on rationality of technology. This enables observers to interpret the work, its use and its relation to the world in new ways. Device Art is a term used for a contemporary approach to Japanese Media Art. The works of Device Art are typically playful devices that involve hardware specially

designed to realise a particular concept. Even if these artworks have no direct useful purpose, the functional and visual design of a device is an essential part of the artwork (Kusahara 2007). These unexpected approaches offer opportunities to contemplate open possibilities and present different viewpoints on the relationship between art, science and technology. Professor Machiko Kusahara claims that artists visualise what is happening inside the black box of technology, whilst information technologies become more invisible and ubiquitous in our daily life. According to her, Japanese artists often take a playful and humorous approach in their artistic practice while still involving criticism. Artists are able to visualise what technology means to us, which can be a form of being critical without necessarily being negative towards technology. "It is important that an artist who understands the nature of media technologies creates a space where viewers – participants – can share such understanding through their own experiences" (Kusahara 2007, p. 289) These kinds of works, that create a balance between purposefulness and absurdity, point to possibilities of technology beyond purposeful functionality. The individual interpretation is created in a situation of an actual encounter with the works.

Ryota Kuwakubo's and Maywa Denki's the *Bitman*[33] is an example of the Japanese Device Art. The *Bitman* is a simple electronic device to be worn around the neck as a pendant. When the user shakes the device, the *Bitman* will start dancing on the screen of the device; the more one shakes the faster the *Bitman* will dance.

Irony and playfulness in art present an important chosen tactic and characteristic of a work, which has the ability to reveal multiple perspectives of the presented situation. In art that uses technology, irony typically points to awareness about the medium it uses and the situation this medium enables. Irony is an inherent feature of the author's practical research that has resulted in three works submitted as a part of this dissertation, as well as several earlier works that are referenced in the written part.

[33] http://www.cube-works.co.jp/works/index_sub_e.html?/works/meywadenki/index_e.html [accessed 24.3.2012]

III. The Contemporary and Historical Background of Wearable Technology in Art

This research began with a supposition that the author's practice is dealing with the wearable technology field, but from a very different perspective than approaches prevalent in the field. During the research process it became increasingly clear that in the background of the author's work, at influence were different questions and issues than what is typically discussed in the literature related to the field. These issues were related to, among others, the following themes: human enhancement and human design, the impact of technology on one's worldview, and perception of technology beyond instrumentality. Nevertheless this present study is associated with the field of wearable technology, which can be considered as the background source for the research. These developments have also impacted the emergence of the *Hybronaut* and the author's artistic practice. This chapter introduces the field of wearable technology, showing its relationship with historical traits in the arts, technology, fashion and science.

III.1. The Field of Wearable Technology

The wearable technology field, including terms and areas such as wearable computing and fashionable technology, has been evolving at the intersection of various disciplines including augmented reality, fashion, design, cognitive science, visual art, cybernetics and ergonomics. The field continues to investigate and develop wearable items that employ emergent mobile and wearable technology. For example, the research community in wearable computing[34] has been carrying out in-depth work in understanding and defining many key principles in the field. In this view, wearable computers are understood as a kind of extension of the body, which enables it to perform tasks that would not otherwise be possible, such as being in several places at once[35]. This is an example of one of the approaches which currently exist in the multifaceted field of wearable

[34] I make a distinction between the terms wearable technology and wearable computing. Wearable computing references specifically wearable devices with extensive computational abilities, whereas I use the term wearable technology to include a much wider array of wearable projects that employ technology. Wearable computing is therefore a subcategory of wearable technology.

[35] http://www.wearitatwork.com/home/discovering-ubiquity/ [accessed 15.12.2011]

technology. The field also contains other detectable approaches, each with their own distinct objectives. These approaches vary from developing solutions to engineering problems to form- and material-centred experiments in fashion and design, and subsequently to more conceptual approaches that often focus on the development of a single concept.

The author has identified the following three categories within the field, which are seen as distinct on the basis of their approach, anticipated goals and background motivation. However, this categorising is not meant to be restrictive, for instance many individual projects may have several different approaches and multiple goals, but these categories attempt to point out that there are various distinctive approaches and interests in the developing field, and that these three may be just a few of them.

12. Figure: *Currente Calamo* by Barbara Layne / Studio subTela, 2011. Photo © Hesam Khoshneviss.

1. An approach to wearable technology that aims to produce purposeful and justified functionality, including areas such as wearable computing. The focus is often on enabling the management of various tasks that would not be possible for a mobile human without a wearable device. The wearable device is treated as an instrument for achieving something. One example of this approach would be, for example, a commercial project, the Xybernaut wearable computer[36] of 2001, which claimed to bring wearable computing to enterprise and consumer customers at all levels, with open computing standards for communication, computing and networking.

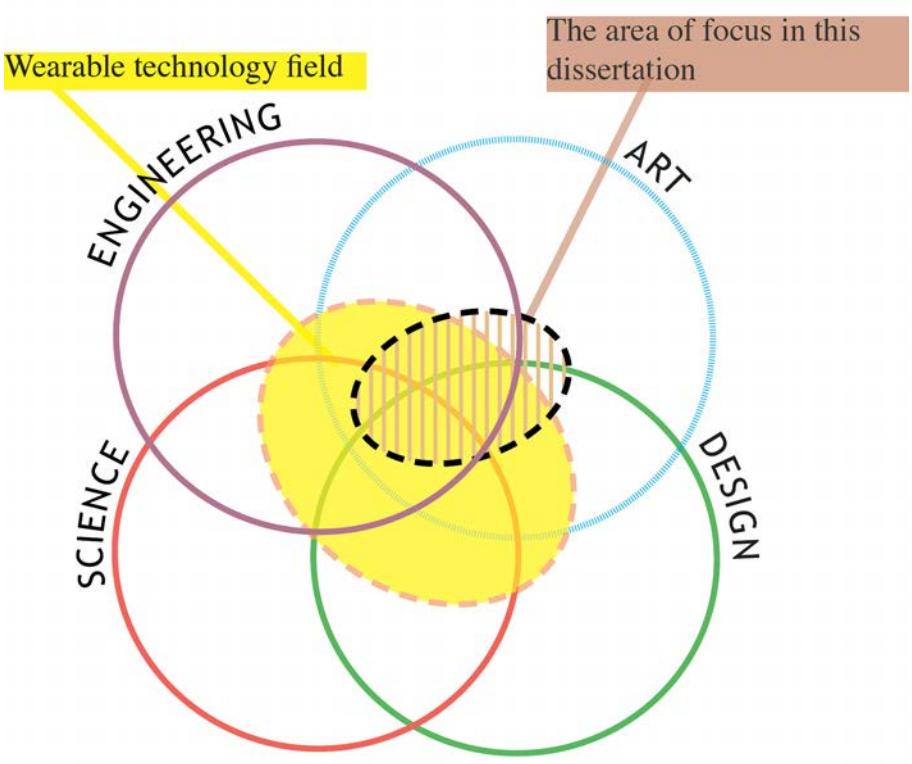
2. This approach includes wearable projects that are related to and often build on the traditions of fashion and textile, as well as related fields such as jewellery. The projects often focus on finding elegant, playful and durable solutions for the integration of hardware and various (e.g. soft) materials within the design objectives. As an example, a project by Barbara Laybe, the Currente Calamo from 2011 (Figure 12), which is series of garments with embedded, flexible LED arrays that function also as touch pad systems for direct writing and drawing.

3. The author's investigation of the field has revealed that there are projects that present us with unexpected characteristics that seem to deliberately lack the otherwise typical functional and rational approach towards technology. In this category, wearable technology projects often seem to oppose the general aims of the field. Instead of aiming to achieve the invisibility and transparency of technology and stylized appearances, these *wearables* are often theatrical and absurd in their enhancement of the body. Moreover, their functionality does not follow the expectations of rationality in technology, nor can they be seen as decorative elements, but appear to put forward critical and conceptual questions. Examples of this category would include such works as the author's projects and various other examples given throughout this thesis.

While the first category has a substantial body of academic publications starting from the 1990s, specifically in the area of wearable computing, and the second category has few

[36] http://www.znews.com/tech/news/2002011401technews.html , http://www.xybernaut.com/ [accessed 1.1.2012]

publications[37] (Lee 2005) with a focus on fashion and various DIY-style instruction manuals[38] for craft projects (Pakhchyan 2008), there is a clear lack of academic publications and theoretical research on the latter category. On the basis of the currently available publications on the field, the development of purposeful functionality and design of intuitive, transparent and fashionable interfaces would seem to be the sole direction of thinking surrounding wearable technology at the moment. However, as described above, there are works that belong to the third category. In addition to the author's publications, art historian Susan E. Ryan has published articles on the subject of wearable technology and conceptual clothing. For example, Ryan has coined the term Wearable Technology Art to discuss the artistic approaches to the field (Ryan 2008). But in general, surprisingly few of the analytical investigations into the field of wearable technology have focused on the conceptual side, taken a critical viewpoint into it or investigated deeper layers of themes related to the field. This dissertation has focused specifically on this last category and is, for its part, filling the existing gap.



13. Figure: Wearable technology field. Image © 2012, Laura Beloff.

[37] For example notably Fashioning the Future by Suzanne Lee. (Lee, 2005)
[38] For example, Fashioning Technology; A DIY Intro to Smart Crafting by Syuzi Pakhchyan (Pakhchyan, 2008)

III.1.1. Wearable Computing

The majority of publications about wearable technology and its history consider the field as a result of systematic developments in science and technology. The field is seen to manifest itself following the progress of technological development aiming at purposeful functionality, where the focus is often on designing instruments that extend human abilities or augment the environment for human interaction.

Research into wearable computing provides one side of the history of the field of wearable technology. Bradley Rhodes puts the starting point of wearable computers in the year 1268, with the earliest recorded mention of eyeglasses in the western world (Rhodes 1997a). Five centuries later, the pocket watch appeared in 1762, followed by the wristwatch in 1907. What these two technologies have in common is that the historical eyeglass and wristwatch were designed with the primary purpose of being functional aids for the mobile human body. This prevailing perspective sees wearable computing and wearable technology as technologies that are primarily aimed at assisting the human. Similar tendencies are also visible in the field of augmented reality, which is often seen as parallel to the field of wearable computing. The development of both fields, wearable computing and augmented reality, has been motivated by two primary goals: the need for people to access information whilst on the move and the need for people to better manage information (Barfield & Caudell 2001). A lot of research has been carried out in the area of so-called context-aware wearable computing[39], which combines body-worn computation, sensing and networking in a clothing-integrated design. This development has seen some of the functions becoming partially automated, e.g. using sensors to monitor the body's functions due to health concerns. For example, the LifeShirt vest[40], developed in 2007, featured heart monitoring through sensing the movement of the heart and lungs. The data was recorded and automatically sent to doctors, who could observe dangerous symptoms and adjust a patient's medication.

[39] http://www.media.mit.edu/wearables/mithril/index.html [accessed 11.1.2012]
[40] http://www.sciencedaily.com/releases/2007/05/070518160743.htm [accessed 11.1.2012]

Obviously, the military domain is one area in which these kinds of ambitions are highly valued. Mikko Malmivaara suggests the military as one of the main influencing factors in the development of wearable computing. According to Malmivaara, however, it was not the military that made "wearables" successful in the 1990s. It was the global availability of electronic components and related knowledge, as well as the crucial impact of the World Wide Web, which enabled easy and fast communication within peer networks (Malmivaara 2009). Downstream, developments in the extensive field of wearable technology have been influenced by various other research fields such as human-computer interaction (HCI), which includes psychology, cognitive science, ergonomics, human factors engineering and related interaction design that investigates the emerging practice of design focused on interactions with technological objects (Maze 2007).

The intensive research and development of wearable technologies in academia, in industry and in military for over the last decade have produced a wide variety of applications, projects, research papers and publications on this development. Investigation through a large number of articles written during the mid and late 1990s by a variety of researchers such as Bradley Rhodes, Steve Mann, and Steven Feiner, among others, has revealed a set of properties, or criteria, for wearable systems that seem to be agreed upon by a wide variety of researchers. The expected properties for wearable computers can be listed as following: portable while operational with negligible operational delays, controlled by the user with minimal need for manual input (hands-free), sensitive to the user's surrounding environment, always on, and able to attract the user's attention even when not actively in use (Rhodes 1997b; Feiner 1999; Mann 1996; Mann 1997).

Steve Mann has considered the wearable systems from a perspective that includes thoughts on their social impact. Mann has strongly emphasised the importance of control issues; privacy and individual freedom with the wearable device. He proposes wearable systems for use in everyday circumstances within the surrounding fabric of the individual. According to him; a wearable system should be situated physically in a way that allows the user and others to consider it part of the user (Mann 1996).

Although this list of criteria from the 1990s for wearable systems may have changed somewhat during recent years, more recent research and projects apparently agree with many of the characteristics listed above. For example, researcher Ana Viseu continues along the same lines as the others by writing in 2003, "Initially, wearable computers were considered tools that were designed to give wearers' instantaneous and constant access to information [...]. Nowadays, the ultimate goal of wearable computer developers is to make them proactive, i.e., responsive, communicative and 'aware'. A wearable computer should be able to recognize its 'owner', its 'location' and the 'activity' being undertaken" (Viseu 2003a, p. 79).

The prevailing aspect in all of these formulations and criteria for wearable computers is their seemingly inherent focus on functions – what a wearable device enables a user to do. As several articles refer to a comparison between a wearable and a desktop computer, one can ponder whether this development concentrating on differences and similarities in the workings of fixed-place computers to mobile and wearable computers has triggered a function-oriented approach to wearable computers as tools. It is obvious that this function-oriented development is strongly influenced by the rational aims of the military and health sectors as the major funding-bodies for the field. What is left unanswered is the question of why the function-oriented approach is presented in the articles almost as a fundamental need or desire of humans.

Additionally, regarding the clear direction of considering wearable computers in terms of purposeful functionalities, few researchers have articulated the importance of aesthetics or style in the commercialisation of wearable devices. Researchers such as Mann, Barfield and Caudell seem to agree that in order to become accepted by the general public, wearable technologies need to adapt to a sleek style and fashionable aesthetics or become invisible in use to be successful. This task has been actively taken up in recent years by researchers, artists and designers within the design, fashion and textile departments of various universities.

III.1.1.1 Augmented Reality and the First Wearable Computer

Well-known scientific experiments on transformations of the perceptual world were carried out by psychologist George Stratton during the 1890s. He was researching perceptual adaptations of human vision and brain. The human retina normally receives the image upside down and Stratton wanted to see what happens when the brain receives the image the right way up. His invention, the upside-down glasses, simply inverted the visual field of a user. Stratton tested the glasses on himself; on one occasion he wore the glasses continuously for eight days within his normal environment and daily routines. According to his report, on the fourth day things seemed to be upright rather than inverted, and on the fifth day he was able to function and move around his house quite normally. He also noted that after removing the glasses, it took several hours for his vision to return to normal (Stratton 1896)[41]. From this experiment Stratton concluded that the human brain is malleable and can adapt to one's visual clues. Since then, there have been several other researchers continuing Stratton's experiments; among others e.g. Huber Dolezal and Ivo Kohler, who was based in the Experimental Psychology department at the University of Innsbruck (Kohler 1964; Kohler 1962). All these kinds of analogue modifications of human perception by intervening in how one sees the world, can be seen as forerunners to the augmented reality experiments.

In the 1960s Ivan Sutherland developed a see-through head-mounted display, which could display graphical elements over the surrounding physical environment. The users were immersed in augmented reality with this computerised visor. Sutherland's main interest was in immersive technologies, such as virtual reality, which were related to his pioneering work on computer graphics. In 1965 he wrote: "The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal. With appropriate programming such a display could literally be the Wonderland into which Alice walked" (Sutherland 1965, p. 508). Modifying human perception

[41] Carsten Höller's *Upside-Down Glasses*, 2001 (described in chapter II.7., Figure 11) reference Stratton's experiments.

and the development of various wearable, often head-mounted displays, are closely linked to the development of wearable computers.

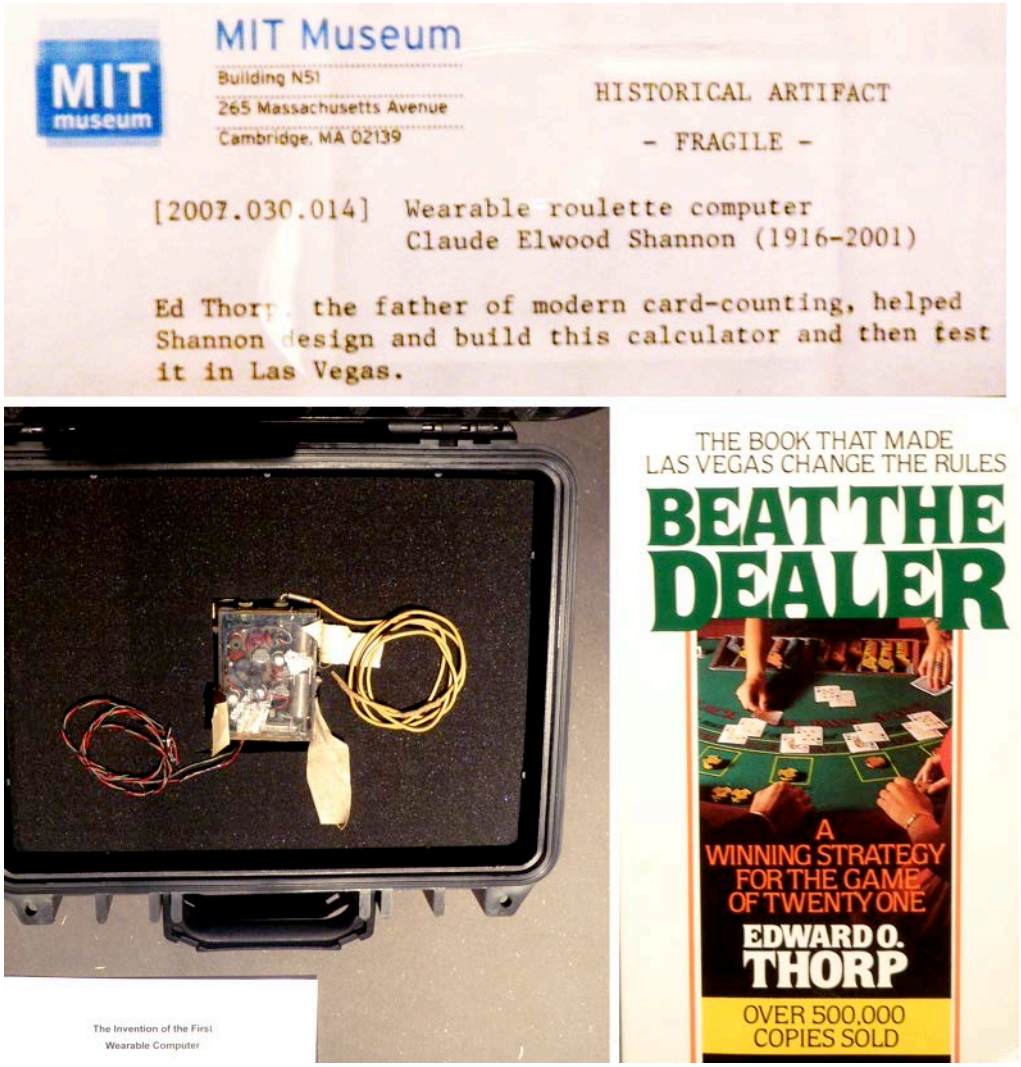
According to Steve Mann, it was George Stratton who introduced the concept of mediated reality[42] and presented his research with two important ideas: "1. the idea of constructing special eyeglasses to modify how he saw the world; and 2. the ecologically motivated approach to conducting his experiments within the domain of his everyday personal life" (Mann 2002).

Steve Mann is undoubtedly one of the main figures in the field of wearable computers. Starting in the late 1970s by building a wearable "photographer's assistant", Mann has developed numerous wearable systems up to the present day with features such as body mounted cameras, lighting equipment and head-mounted displays. He is also known for wearing *the WearComp* system for many years, through which he sees the world and even himself through a video lens. The system allows the eye to function as a camera and a display with graphic and text. "In this way, eye and camera, mind and computer, are joined. The user is at once in constant contact with the surrounding world, and in constant contact with a data processor tailored to personal specifications" (Mann & Niedzviecki 2001, p. 9-10). Mann claims that his wearable devices have allowed him to become a computer, a camera, a telephone, a videophone and himself in a same single entity. He sees *the WearComp* system in a McLuhanian sense rather as a second skin and not as a tool to be turned on and off. Mann's *WearComp* system differs from earlier personal technologies (e.g. eyeglasses, pacemakers, computerised training devices in shoes or garments) in that it is not designed for any specific task, but it is used within everyday life for whatever it seems suitable and its technology can be re-purposed at any time (Mann & Niedzviecki 2001). Mann's approach shows a clear difference also from many industrial applications in wearable computers, which are typically developed for a defined use in specific situations, such as for extreme sports and climates, for construction workers or health personnel. What is interesting about Mann's *WearComp* system is that it is designed for everyday life, to be worn all the time and everywhere.

[42] The term "mediated reality" is a general framework proposed to include a broad range of devices for modifying human perception or mixing perception with the various aspects of reality and virtuality.

It becomes part of a user and his abilities. This approach is similar to the author's approach of seeing technology as part of a human and his normal everyday life. Steve Mann investigates how technology might be used in this kind of situation. However, his research is still framed with the background idea of the usefulness and usability of technology on a mobile human. The author's wearable technology experiments investigate technology's meaning and relationship with us and how it affects our perception of the world when it becomes part of the user's intimate realm. The author constructs defined and restricted technological artefacts, which reject the requirement for utilitarian usefulness.

Steve Mann has been also a strong advocate of personal privacy issues, which have become a crucial issue in the age of the Internet and ubiquitous communication technologies. One of his primary attributes in constructing wearable systems has been that the device is controllable by the user rather than by any central system (Mann 1996; Mann 2001). The term *sousveillance* means inverse surveillance as a counter to organisational surveillance. In other words, it proposes giving the technologies of control to individuals, offering them the opportunity to observe those in authority. But it also refers to a situation in which the control of observations, control-technology and collected data lies with the individual who is being observed (Mann, Nolan & Wellman, 2003). A similar direction of thinking is also seen in his approach to research on human intelligence systems; instead of aiming to replace a human or construct a machine which can process information faster than a human brain, Mann is convinced that a user, the human, must be an integral part of the discourse loop. "The wearable computer allows for new ways to be, not just do" (Mann & Niedzviecki 2001, p. 31).



14. Figure: Shannon's and Thorp's *Wearable Computer* presented at Ars Electronica Center, Linz Austria. Photo © 2011, Erich Berger.

Even though Steve Mann has had a great impact on the development of wearable computing as an academic field, he was not the first inventor working on wearable computers and other portable and personal technologies. In the article *The Invention of the First Wearable Computer*, Edward O. Thorp desrcribes his collaboration with Claude Shannon in designing and constructing a roulette-predicting device, which is claimed to be the first wearable computer. The wearable version of the computer was complete and operational in June 1961. Although not exactly a computer, it was more like a timing device the size of a cigarette packet with twelve transistors, which was designed to be hidden in a shoe. Shannon and Thorp tested the device in a casino in Las

Vegas and it proved to be successful. The project was kept secret until 1966, when Thorp finally made public their roulette predicting system (Figure 14).

Based on the results from Shannon's and Thorp's experiment, a group of young scientists in the 1970s built an operational wearable computer for the same purpose – predicting roulette – using the next generation of hardware and technology (Thorp 1998). This version is now known as The Eudaemon Shoe. By 1978, the system was ready to be tested in Las Vegas and again proved successful, with an average profit of 44% for every dollar. This system was split between two wearable parts and two persons: an observer and a gambler. The observer would tap input signals with his foot, and the gambler would receive output signals underneath his shirt[43]. "[…] this shoe was not a general-purpose computer in the sense that the user could not change its functionality by writing a new program into it, while walking around. It was more like wearable technology than the wearable computing we know and use today […]" (Barfield et al. 2001, p. 478).

III.1.2. Fashion & Technology

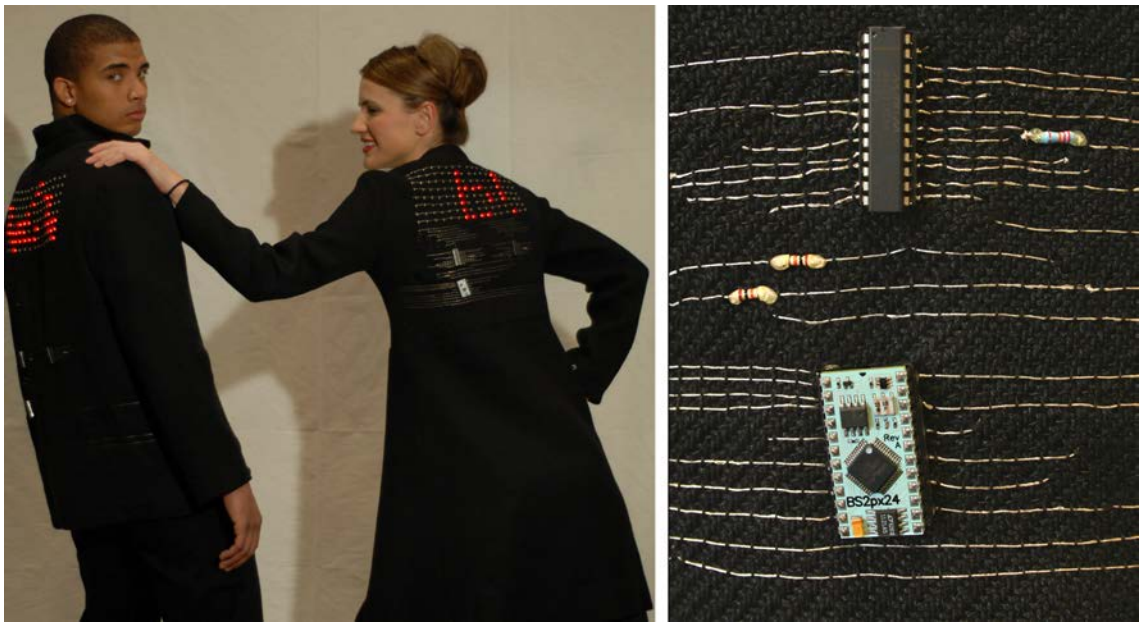
The interest in implementing hardware embedded in garments and soft materials was partly sparked by the desire of the wearable computing field to make wearable computing more fashionable and invisible in use. For example, Steve Mann is convinced that devices aimed at personal everyday use, such as hearing aids and personal eyeglasses, must have an unobtrusive or hidden appearance, or be designed to be sleek and fashionable (Mann 2002).

Although there have been several decades of efforts in constructing wearable computers and distributing hardware efficiently around the body, it took until the end of the 1990s for design and art universities to start to seriously investigate the area of wearable technology and combine electronics with fashion and textile-based artefacts.

In art and design initiatives, the focus is often on the design of elegant solutions integrating computational components into soft and washable materials, as well as on researching the new

[43] http://en.wikipedia.org/wiki/Eudaemons [accessed 11.12.2011]

characteristics of emergent materials and projects combining textile and electronics. The development takes place in two different directions: in the smart materials and material sciences, where the material itself is developed on a molecular level with new qualities such as colour-changing ability; and towards research into the possibilities to embed computing abilities into textile-based projects. Against the backdrop of many recent developments is an impact of military interest, with the military having been a major funder of the field. For example, in 2002 there was an idea about interactive camouflage, which would be able to change colour and pattern when soldier moves from one environment to another, from desert to a city, for instance (Cunningham 2002). These kinds of new possibilities for textiles have been enthusiastically welcomed by fashion and textile practitioners, who see in them new potentialities for clothing, which could display personal information and change colour according to one's mood, or time of the day (Berzowska 2004).



15. Figure: *Jacket Antics* by Barbara Layne / Studio subTela, 2007. Photos © Hesam Khoshneviss, Mikey Siegel.

Fashion is claimed to be a way to express one's identity and a way to unite one with a specific social class or ideological and political group, whilst segregating one from others (Simmel 1904), (Hebdige 1983). The approach to clothing as communication (Barthes 2005; Calefato

2006) points to the idea that clothing, fashion, or appearances, can be used as an aesthetic or political strategy. It is a way to utilise the physical space of a mobile body to manifest various meanings and values that correlate to a construction of an individual identity, which is created in relation to one's social environment. In wearable technology and electronic clothing, the concerns about identity and personal expression through wearable artefacts are very much a concern of the creators. "Designers of electronic textiles need to focus on personal expression and the social, cultural, and economic history of textiles instead of striving to replace (or 'augment') human experience" (Berzowska 2005, p.74). The clothing is developed within the traditions of textile and fashion, to become dynamic, able to change its shape or colour according to received inputs. In this context, clothing is seen as a second skin, which can transform and change one's identity and one's cultural context. (Berzowska 2004).

Designer Di Mainstone has developed a series of dresses with theatrical and fictional features. Her project *Skorpions* contain a set of kinetic electronic garments that change on the body in slow and organic motions. They are not interactive with the user, but have a life of their own with personality, fears and desires[44]. Mainstone's dresses are often created for performance purposes, for instance the dress *Sharewear* is designed as a performance executed by identical twins[45].

The approaches to wearable computing and its often cyborgian aesthetics have been criticised by textile and fashion experts as a top-down approach, whereby hardware is just placed into clothing in a manner that is not user-friendly, lacks comfort and wash-ability, and which has nothing to do with fashion and little to do with clothing (Lee 2005). "It is ironic that these wearable computers are in fact not very wearable - at least not in the same sense that a cashmere sweater is wearable. […] In order for the wearable computer to be more wearable, we need to be able to knit it onto the body and replace wires with conductive yarns" (Berzowska 2004).

[44] http://www.dimainstone.com/#skorpions [accessed 11.1.2012]
[45] http://www.dimainstone.com/#sharewear [accessed 11.1.2012]

Conversely, the approach developed during the last decade among textile practitioners can be described more as a bottom-up approach, which is investigating the above drawbacks and looking into ways of making the textile itself a part of an electronic circuit. It proposes a move away from hard components towards a merger with soft structures. "Electronic textile research aims to combine wearable computing with textiles and move towards the vision of a seamless integration of computation on the body" (Berzowska 2005, p. 63). However, this approach is also facing limitations with existing hardware components that are, for example, not made to be washable, but at the same time they are necessary for the desired functionality. The biggest obstacle for the whole field has always been, and still is, power consumption and the size and weight of batteries. The problematic power issues have generated some interesting experiments and research into kinetic energy, e.g. Joanna Berzowska's project *Captain Electric and Battery Boy* (Figure 16), which are prototypes developed for wearable power-generating artefacts[46]. These prototype clothes generate power through restricted movements of the user and the energy generated and stored is then used to actuate light and sound events on the body.

There are still relatively few commercially available products which employ wearable and embedded technology. In 2000, Levi's and Philips released the first jacket on the retail market with strategic pockets for mobile phone and for mp3 player. The devices were connected via the jacket to a central control module, which allowed the wearer to switch between them and control them separately[47]. Similar applications were later developed by many other companies, which offered for instance the possibility to connect one's music player to a soft textile control pad that was designed as a part of a jacket's sleeve[48]. However, even now, after over 10 years of research projects, there are still very few commercial products available that embed electronics into clothing. Instead, the number of portable gadgets for personal use has increased; additionally, the proliferation and development of mobile phones as multi-purpose devices have offered the most

[46] http://www.captain-electric.net/ [accessed 9.1.2012]
[47] http://fibretronic.com/news/Wearables%20Review [accessed 9.1.2012]
[48]http://www.apple.com/pr/library/2003/01/07Burton-and-Apple-Deliver-the-Burton-Amp-Jacket.html [accessed 11.1.2012]

of the basic functions, such as communication, gaming and music listening, in one small, neat and portable package. A company that has aimed to bring electronic clothing to the fashion market is the London-based CuteCircuit. They have developed e.g. the Hug Shirt in 2006, which allows people to hug over a distance through the connection of mobile phone and the Hug Shirt, which is embedded with electronics. In the CuteCircuit online shop one can purchase various shirts and dresses, which employ LED-technology that reacts to the user's movements.

16. Figure: *Captain Electric and Battery Boy* by Joanna Berzowska / XS Labs, 2009. Photo © Guillaume Pelletier.

Even though the history of textile and fashion is closely connected to technology and science, these historical traces are seldom visible in the actual fashion creations. Hussein Chalayan is one of the few figures who have brought these aspects and wearable technology to the haute couture scene with a great deal of media attention. The 2007 summer showpiece collection featured dresses that were designed to morph through three decades of fashion change. Through the use of embedded wearable technology, small motors and other electronics[49], the dresses magically transformed their shape on the catwalk. "Chalayan has always maintained that clothing for modern life should be a machine in itself – a dynamic interface between the body, its physical capabilities and the environment" (Quinn 2002, p. 34). Chalayan's work as a designer is mainly located in the realm of fashion and haute couture shows, yet his works clearly explore conceptual questions concerning the human future, the growing symbiosis between the body and the machine and new kinds of identities emerging from this situation. Chalayan shows us concretely how contemporary fashion and clothing can be used for making statements that cross boundaries and carry beyond the field of fashion.

A comparable historical example would be Paco Rabanne, who in the 1960s developed dresses from unconventional materials, such as aluminium and vinyl polychrome, which were constructed from small pieces chained together to form a flexible surface. In a similar way as Chalayan, Rabanne's creations were inspired by the signs of the times: the space race of the early 1960s, the glamour of flight travel, the aesthetics of plastic and Pop Art (Lee 2005).

Currently, almost all of the projects employing design and wearable technology are put into a category with a vague distinction from wearable computing. However, there are projects that clearly emphasise the traditions of fashion and textile in investigations of novel characteristics for materials and clothing artefacts. Additionally, there are projects that are emerging from the tradition of fine arts and media arts, which often lay greater emphasis on the conceptual and functional aspects and place less focus on material development.

[49] http://www.technologyreview.com/Infotech/17639/ [accessed 11.1.2012]

It is easy to criticise one approach in comparison to another. For example, many of the experiments emerging from the field of fashion and textile are often lacking the knowledge of media-art and its history, even though the works are referencing this area with their implementation of technology. These works run the risk of looking naive and simple when seen from the perspective of media-art or fine art. But when considering them from the perspective of the fashion, textile and design traditions, the viewpoint is quite different. The same applies when comparing works emerging from the arts to wearable computing projects; the artworks often seem simplified and aesthetically peculiar, whereas wearable computing projects seem justified and purposeful, even with their cyborgian aesthetics - that is if one looks at them from the wearable computing perspective.

The shared common interests of the different approaches to the wearable technology field are a human, a body and its relation to technology. Otherwise there are wide variety of interests and approaches, which influence the motivation for the work, focus and chosen aesthetics. This kind of multiplicity of perspectives should be understood as a valuable asset for the whole field of wearable technology.

17. Figure: Works by Di Mainstone, Barbara Layne, Margarete Jahrmann. Photo © 2009, Laura Beloff.

III.1.3. Wearable Art: Manifest and Ideology

In the above examples from Paco Rabanne to Hussein Chalayan, and to Di Mainstone's fictional dresses, the division between fashion and art starts to blur. In the contemporary art scene the division between art and fashion has many crossovers. There are also historical examples of

artists who have incorporated the language of fashion into their artistic expression or into political messages.

The Italian Futurists' aim was to extend the artistic realm to every aspect of life, from painting to architecture, food and fashion (Stern 2004). After the launch of Futurism through the publication of the Futurist Manifesto in 1909 by Filippo Tomasso Marinetti, many other manifestoes were written and published in the following years. One of them was the Futurist Manifesto on clothing in 1914, *Male Futurist Dress* written by Futurist painter Giacomo Balla, who is often regarded as the father of Futurist fashion (Balla 1914). Balla was looking for a new approach to clothing that would have qualities such as: dynamic, asymmetrical, nimble, simple as well as comfortable, hygienic, joyful, illuminating, wilful, flying and variable. The manifesto opposed the traditional, in Balla's view depressing approach to clothing (Stern 2004). The Futurists mainly concentrated on male clothing, which they wanted to change from rationality and they stabile state to express the new vocabulary of the time, such as: speed, dynamism, progress, modern technology, urbanism and freedom (Brand & Teunissen 2009). Balla thought that in the same way as there was a need to vary one's environment frequently, clothes should also be variable. He designed clothes that were transformable through the use of *modifiers,* which were pieces of cloth of a variety of materials, colours, sizes and even smells, which could be attached to any part of the dress with press-studs. The wearer of the dress was seen as a collaborator, who had the responsibility for controlling the changes in the dress (Stern 2004). In another manifesto, *The Futurist Reconstruction of the Universe*, Giacomo Balla and Fortunato Depero defended the idea of transformable clothes which could be made by using mechanical trimmings, surprises, tricks, disappearance of individuals. The idea extended to a dress which could metamorphose according to the wearer's mood, time or season (Stern 2004).

With its modifying characteristics, the clothing became the means for self-expression and the wearer was transformed into a performer. There is a record about the Futurist necktie, which Balla designed for himself. It consisted of a transparent celluloid box with a battery and an electric

light bulb, which could be switched on to emphasise important passages during his speeches (Brand & Teunissen 2009). This was possibly the first artist-made artefact, which used wearable technology.

In revolutionary Russia, fashion went through a change following the abolishment of the class system. Fashion was regarded as a way to show class difference and inherently related to the bourgeoisie; it was expected to disappear together with the social class which had produced it. Similarly, autonomous art was related to the elite and seen as representing an old society. Under the communist regime, the political climate made its impact on art and how artists approached art. Fashion was one of the areas in which this became very visible.

During the 1920s, several artists proposed new designs for clothes that would better fit with the values and ideals of the prevailing political climate that favoured the idea of a classless society. Many of the artists started designing uniform-like practical clothing from an anti-fashion perspective. For example, Vladimir Tatlin created "constructed" clothing, which was put together on the basis of a similar concept to a machine with the practical criteria of efficiency and effectiveness. Tatlin's clothing designs did not focus on aesthetics, but on practicality. His most revolutionary innovation was an overcoat based on a modular concept whereby the overcoat had two changeable linings, depending on the weather (Stern 2004).

In general, the aims for art and design at the time were strongly coloured by functionality and a desire to be in touch with real life. Any artistic or decorative addition was considered artificial and to disguise the true nature of things. The artist and designer Varvara Stepanova saw the evolution of clothing as being linked to industrial development, whereby practicality and functionality were the primary aims of clothing. Stepanova designed work clothes for specialised professions, e.g. well-known sport outfits for professional football teams. Stepanova argued in 1923 that "[…] fashion is replaced by clothes that can be worn everywhere, which have no independent value and are not an art product" (Stepanova 2004, p. 172). Nowadays, however, Stepanova's designs are considered mainly as an example of an experimental art & design project.

In both examples, the Russian avant-garde and the Futurists, clothing was no longer considered simply as a protective covering for the body, but as an important factor of everyday life that could convey a public message. The Futurists treated it as a performance and an extension of one's personality. The Russian avant-garde saw clothing primarily in the service of the ideology that was aiming to abolish the social class system and saw everyone as an equal part of the society.

III.1.4. Conceptual Clothing

C*onceptual clothing* could be defined as artistic expression in the form of clothing, whereby clothes are not created for functionality (and sometimes not even for wearing), but as conceptual thoughts in material form. To some extent this development can be considered to have been triggered by the fact that fashion has become a major social phenomenon alongside the vast clothing industry and consumption (Cottel & Schoettle 1986).

Conceptual clothing is a vaguely used term to reference either artworks in the form of clothing or fashion pieces that are based on a conceptual approach and which are commonly made to be exhibited rather than worn. In other words, the term *conceptual clothing* refers to works that emerge or are exhibited mainly within the context of art. *Conceptual clothing* appeared in 1986 as a title and a topic for an exhibition in the Ikon Gallery in Birmingham (UK), which was accompanied by a catalogue and several essays. The exhibition presented works by various artists and designers working with clothing as the subject matter or as a metaphor for human body (Cottel & Schoettle 1986). *Conceptual clothing* objects commonly focus on the form, aesthetics and politics around the body, fashion and their relation to world.

In this dissertation the term *conceptual clothing* is used to reference works that place greater emphasis on the conceptual than on the functional side. These kinds of works are related to wearable technology works which primary focus on the development of (artistic) concepts, but with the distinction that *conceptual clothing* works do not employ technology. All the works share

subsequent features: they are wearable in form and they differ considerably from the ordinary by being experimental and theatrical. These works are often responding to such stimuli as the political climate, social problems, the position of women, or are expressing a critique of the prevalent art world. There are many examples of these kinds of works from the 1960s until today.

For example, Valie Export's famous *Tap and Touch Cinema*, 1968 was a work that critically questioned the distinction between art and life, and women's role in society. It was constructed as a wearable artefact for a performance action taking place in the midst of everyday life in a city. The *Tap and Touch Cinema* was a small-scale "movie theatre" which Valie Export wore around her naked upper body, in such a way that her breasts could not be seen but they could be touched for maximum of 30 seconds by anyone reaching through the curtained front of the "theatre." She was performing on the streets, inviting the audience to touch her. This outdoor action was playing with the boundary between art and life, and also suggested cinema as a projection space for male fantasies[50].

Other examples include Hélio Oiticica's work *Parangolés*, 1964-1979 (described in detail in the chapter VI.1.), which were wearable capes that critically challenged the relationship between the audience and the artwork. Both of these works, *Tap and Touch Cinema* by Valie Export, and *Parangolés* by Hélio Oiticica, were public performances. Export was herself performing on the street, whereas Oiticica was offering the capes for audience participation and performance.

In the early 1970s, German artist Rebecca Horn created wearable works that were typically performed for a film camera. For example, the performance work *Finger Gloves* extended the wearer's fingers and allowed remote touch (Schwartzman 2010). *Touching the walls with both hands simultaneously*, 1974, was a work with similar extensions, but the fingers were extended to a specific dimension, enabling the wearer to reach opposite walls of a room with her fingers.[51] *The Unicorn* is one of Horn's most famous works dealing with body modification. In the filmed

[50] http://www.medienkunstnetz.de/works/tapp-und-tastkino/video/1/ [accessed 30.1.2012]
[51] http://en.wikipedia.org/wiki/Rebecca_Horn [accessed 31.1.2012]

performance, a woman walks through a landscape wearing a white horn protruding upwards from the head and straps that hold the horn in place.[52] In these above-mentioned works, among many others, Horn proposes new ways of perceiving and touching, and new gestures for a mobile body.

Other historical examples of artists who have created conceptual clothing include Birgit Jürgenssen, Yayoi Kusama, Joseph Beuys, and Andy Warhol among many others.

Recent years have seen a newly emerging interest in works that cross the boundaries between fashion and art and design.[53] A well-known contemporary artist working with conceptual clothing is Lucy Orta, whose practice is located in the intersection of art, politics, architecture and clothing. She has been especially involved with the idea of protective gear and survival related to social problems. Orta's works are often aimed at restoring and developing connections; they may take the shape of an intervention that is designed to bring individuals with different social backgrounds in touch with each other. For example, *Nexus Architecture (Collective Wear)*, 1998-2002 (Figure 18), deals, quite literally, with the idea of social network and social distinction. The work is constructed as clothing, which is worn by the participants, and in some cases the garments are also manufactured and designed in conjunction with the participants. The clothing created – overalls – comprise parts that connect a participant to another participant's overalls, which connects to the next one and so on, creating a network of connections. Paul Virilio writes: "Lucy's collective wear reminds me of collective body practices which exist in the world of survival. The survival of most animals depends on running with the pack. The concept of the pack is linked to animality. Lucy's collective wear represents a denunciation of man's return to the pack. At a time when we are told that men are free, emancipated, totally autonomous, she tells us that, on the contrary, there is a threat and that man is regrouping. We refer to this new phenomenon in terms of gangs, new tribes, commandos" (Virilio 1996).

[52] http://en.wikipedia.org/wiki/Rebecca_Horn [accessed 31.1.2012]

[53] For example, a recent exhibition (2010-2011) in London "Aware: Art Fashion Identity" exhibited conceptual clothing works by 30 designers and artists[53]. "Spectres: When Fashion Turns Back" was an exhibition and publication by the Victoria & Albert Museum in 2004, which investigated fashion and its display in cultural context (Breward 2004).

18. Figure: *Nexus Architecture* by Lucy Orta, 1998-2002. Photo © Studio Orta.

A historical work, which is comparable to Orta's *Nexus Architecture* is Brazilian artist Lygia Pape's work *Divisor*, 1968. It was a huge white fabric to be worn collectively by several individuals. The piece looked like a white landscape, where only the heads of people came outside the white surface. Both Orta's and Pape's works challenge the idea of an individual as a central

perspective and propose a viewpoint that prioritises the collective and community above the individual.

Examples of contemporary creators working with conceptual clothing in the intersection of fashion, art and design are Alicia Framis, Yinka Shonibare, Marina Abramovic, Yohji Yamamoto, Beverly Semmes, Ying Gao, Walter Van Beirendonck and Ana Rewakowicz among many others.

III.2. Wearable Technology Art

Until now, the field of wearable technology has been discussed primarily as one unified area, the conjunctive characteristics of which are technology and wearability. By focusing on a defined group of works within this field, which differ from others in their aims and criteria, the author is explicitly abandoning the idea of a unified area and shared common goals. This dissertation proposes to see a defined distinctive group of works as an area of its own with detectable historical traits and objectives.

Investigation into the field has revealed works that are firstly noticed due to their unexpected style and chosen aesthetics that do not follow the general expectations of wearable and mobile technology. Inevitably, one reaches the conclusion that the majority of these works clearly originate from a conceptual approach and have little to do with the objectives of purposeful and rational functions, which are typical expectations of the field.

In the existing literature on wearable technologies, there seems to be a lack of attention on the works that have taken a different approach, with their own – the often self-defined – values and aims that are typical features in the field of the arts. Likewise, the field of fine art does not seem to have noticed a traceable line of *wearable (technology) artworks* over several decades, although many individual artworks have received a lot of attention in other contexts.

Susan Ryan has coined the term *wearable technology art* to describe art and design practices which incorporate ideas about "dress (garments and/or fashion), technology, art, and social mobility, from both aesthetic, and critical, points of view" (Ryan 2008, p. 7). This is a fairly wide

definition, which includes all the practices emerging from the creative field, whereas the author sees divisions and differences emerging on the basis of project aims and background motivations, which are often visible in the final project and its development. For example, projects that focus on the new possibilities of materials and their crafting and design aspects are often visibly very different from projects related to liberal arts (including media arts) that typically concentrate on developing concepts, experiences and artistic expression. These kinds of projects that focus on the development of concepts and experiences are the focus of this dissertation. They typically emerge within the fields of art & design, although there are exceptions.

In all wearable works, historical and contemporary, the human is in the focal point. The works are based on the human body, its abilities and its relationship with the environment and other people.

The following chapters present both historical and contemporary artworks and artists following the same trajectory: wearable technology works, which are specifically focused on the creation of concepts, comments and experiences.

III.2.1 Electric Dress and Other Works from History

Investigation into wearable works in the history of art shows that there is a linear trajectory of works that leads up to the contemporary works, including wearable technology projects. There are several examples in history of visual artists whose work included designs for clothing as well as other media, e.g. already mentioned futurist Giacomo Balla (1871-1958), and Sonia Delaunay (1885-1979), both of whom worked in parallel on painting and fashion (Stern 2004), whereas fashion designer Elsa Schiaparelli's (1890-1973) creations were fashion pieces inspired by surrealist art.

The changes in the political and art climate during the 1960s influenced the appearance of various experimental art forms, which were centred around the human (body), such as events, body art, performance, art & technology, video, as well as works in wearable form.

19. Figure: *Electric Dress* by Atsuko Tanaka shown in Documenta XII Photo © 2007, Laura Beloff.

One of the first wearable works created as an artwork which utilised technology is the famous *Electric Dress*, 1957 (Figure 19), created by Japanese artist Atsuko Tanaka. It was a costume made of a compilation of cables and electric light bulbs painted in nine colours that turned on and off in a slow sequence. The *Electric Dress* was created as a part of her performance *Stage Clothes* for the *Gutai Art on Stage*- event. Tanaka was a member of the Japanese experimental Gutai group, which was one of the world's first groups to experiment with cross-disciplinary art practices dealing with space, time and material (Eiblmayr 2002). In the Gutai manifesto by Jiro Yoshihara, Gutai art is described as "art felt with the entire body" and "art that could only be touched" (Yoshihara 1956).

The wearability, the use of technology and references to science and technology are features that connect these historical works to contemporary ones. In many of the experiments from the 1960s, the prevailing perception of the world was challenged and new perspectives were sought, for example, by manipulating the visual image of the environment via mechanical or

technological devices. One of the interests, among others, was human perception as a physical and conceptual phenomenon.

Artists such as Alfons Schilling (chapter IV.1.4.) and Lygia Clark (chapter V.2.), Walter Pichler and Haus-Rucker-Co, as well as an early work by Krystof Wodiczko, all dealt with perception and experience of the surrounding environment.

The artist group Haus-Rucker-Co from the 1960s focused on mediated reality experiments with architectural constructions and objects. For example, their work *Environment Transformers*, 1968, consists of helmet-like wearable appliances that change the wearer's sensory impressions visually and acoustically. "The processes of seeing and hearing are drawn out of their habitual apathy, separated into their individual functions and put together again as special experiences."[54]

The artist Walter Pichler sketched out several wearable concepts in the late 1960s and constructed the works *Small Room*, 1967, and *TV-Helmet* (Portable Living Room), 1967. They were exceptional-looking white plastic helmets, which cover the entire head of the user and featured the embedded technology of the time on the inside. These works can only be understood as cultural products with no apparent or purposeful function. Pichler has said that these two works were meant to be cynical and critically humorous as they addressed the theme of television and isolation cells, revealing isolation in a very overdrawn way. His practice was influenced by the theories of Oswald Wiener, specifically the bio-adapter, in which Wiener proposes a kind of ultimate cyber-suit for a human (Wiener 1998).

In 1969, while still living in Poland, Krystof Wodiczko constructed his *Personal Instrument*, which was designed to be used on the street. It was a wearable instrument with a microphone placed on the forehead that received sound from the environment and transmitted it to the electro-acoustic filters located in two soundproof earphones. These filters were controlled by two photoreceptors, one fastened to the palm of each hand. The device transformed the acoustic environment in real-time through the manipulation of hand gestures. According to Wodiczko, it was a socio-political statement creating private play with public sound. "The street presentation of

[54] http://ortner.at/ [accessed 25.2.2012]

the Personal Instrument in use was an attempt to create a public monument to a private human being in a monumental public space, in "state socialism" of the early 1970s […]"(Wodiczko 1999, p. 141).

All the above-described examples addressed and manipulated the human senses and human body through technology. One can see the impact of science at the time in these examples; the developments of ideas on human augmentation, space travel, computing and gradual proliferation of various technologies in everyday life. These ideas led to the further development of wearable technology as a field of its own.

20. Figure: *Audio Ballerinas* by Benoît Maubrey, 1989 > Photo © Benoît Maubrey; European Land Art Biennale, Cottbus 1991.

III.2.2 Contemporary Approaches

The contemporary wearable technology works and those which emerged later can be seen in a continuum to works which started to appear during the 1950s and 1960s and has continued

over the decades to this day. These experimental works are primarily individual pieces by different individual artists and just a few more insistent creators who produced a body of work or several experiments on wearable technology.

Benoit Maubrey began developing and constructing various audio uniforms and costumes in the early 1980's. He started by transforming second-hand jackets by attaching small loudspeakers with pre-recorded sounds played from portable cassette recorders, and developed into a variety of audio uniforms that were designed for a specific group of workers. For example, in 1986 Maubrey developed audio uniforms for steelworkers, performed during the Ars Electronica Festival in Linz, Austria. The late 1980s saw the birth of what later became a large body of work called the *Audio Ballerinas* (Figure 20), which is a group of dancers wearing plexiglass tutus with embedded electronics and loudspeakers. The dancers use light sensors that enable them to produce sounds through the interaction of their movements and the surrounding light. The *Audio Ballerinas* are still a major project of Benoit Maubrey, and has seen many different versions throughout the years.[55]

21. Figure: *LapStrap Istanbul (Sirkülasyon)* by Steffi Weissmann, 2010. Photo © Georg Klein.

[55] http://www.benoitmaubrey.com [accessed 2.2.2012]

An equivalent to Maubrey's performative audio clothing is a *LapStrap* performance, 2010, by Steffi Weissmann, which includes an audio belt with speakers, for performance. Another version of the same work is called *LapStrap Istanbul (Sirkülasyon)* (Figure 21), which has a peculiar aesthetic character. The speakers are attached to ten plastic water bottles, which are connected to the rear side of the audio belt worn by the artist.[56]

Artist Stephan Schulz created a work, *Tin Drum*, 2007 (Figure 22), which is a wearable physical drumming machine that reads GPS data and translates it into drumming patterns. This work combines the virtual layer with a physical world intervention in order to create a connection between the two and to use new technology as a catalyst for social interaction through a performative act.[57]

22. Figure: *Tin Drum* by Stephan Schulz, 2007. Photo © Stephan Schulz.

These works by Maubrey and Weissmann deal with the human as a mobile audio source unit on a street. It is no longer a question of the natural human voice, but technological manipulation and modification of sounds that are produced, played and manipulated in real-time on a physical human body. Schulz's work physically produces an audio representation of

[56] http://www.steffiweismann.de/toplevel-frameset-e.html [accessed 2.2.2012]
[57] http://www.stephanschulz.ca/sts/?/projects/tin-drum/ [accessed 20.3.2012]

immaterial technological data that references the relationship between the geographical location of a human body and its virtual data based counterpart.

When one considers the articulated aims of wearable computing, for example that of enabling humans to access and manage information while being mobile (Barfield & Caudell 2001), and compares them to these above-mentioned works that enable the manipulation of sound information while being mobile, one cannot help but wonder about the similarities in their approaches and the vast differences in their end results. Instead of proposing useful functions, which often aim to improve the abilities of the human (body), these kinds of works (by Maubrey, Weissmann and Schulz) seem to intentionally contradict the goals of rationality and purposefulness.

Even though many of the contemporary wearable technology art projects differ greatly from each other, one can still trace certain common characteristics between them. Some of the traceable shared characteristics are: often an ironic attitude, peculiar functional structures and a sense of exaggeration in their appearance. The previously mentioned *LapStrap Istanbul* has a striking visuality that additionally creates an ironic perspective through its absurdity.

An ironic attitude is present in the *Constraint City* project by Savicic (chapter II.1), as well as in the works by the author (described in the chapter VI.). Irony was also a component in the staged intervention [58] by the Yes Men in Tampere, Finland, 2001. In the *Textiles of the Future*-conference, one member of the Yes Men activist group was giving a (fake) lecture, during which he tore open his business suit to reveal a shimmering golden leotard with a phallus almost one metre in length, that had an embedded monitor on the top of it. This garment was presented to the astonished audience as a serious management solution for monitoring the workers.

Like the golden leotard by the Yes Men, many of the projects have a sense of exaggeration in their visual and aesthetic choices. Although every project has its unique aesthetics, they are distinctive as a group when compared to the typically sleek and unobtrusive design of commercially aimed wearable devices. These projects utilise strong visual elements to attract

[58] http://theyesmen.org/hijinks/tampere-0 [accessed 25.1.2012]

public attention in the first place, and secondly, the visual elements often construct an associative link between the public and the conceptual aspects of the project.

For example, the author's project *The Head* (chapter VI.2.2.) requires the users to be visibly carrying a life-sized head with them anywhere they might go. This object strongly affects the user's *street identity* and his encounter with the public in everyday circumstances. The user needs to adapt mentally to this situation to be able to experience the project.

Usability and wearability are not criteria emphasised in these projects. They are not necessarily designed to be convenient to wear, but their unconventional characteristics often entail physical adaptiveness on the part of the users. For example, Krzysztof Wodiczko's fairly large-scale wearable work *Dis-Armor* uses its visual impact to attract an audience, but at the same time the wearable device is designed for troubled youths who find it difficult to express their feelings in face-to-face situations. The robotic-looking armour is designed to cover the user's face, which appears in the form of a video image (of the user's eyes) on a large screen located on the user's back. The user can talk to another person by standing with his back towards that person (Smith & Topham 2005). This device will obviously require both physical and mental adaptiveness from its users.

The Belgian artist Lawrence Malstaf's piece *Compass*, 2005 deals with spatiality with an ironic attitude. *Compass* is a large-scale orientation machine to be worn as a large ring around the waist. As the wearer walks around the room, his movements are manipulated by the mechanical parts of the device. The device has a programmed invisible map and a route, which the wearer is directed to follow, but can naturally choose whether to resist it or allow himself to be guided. The work creates invisible, yet tactile architecture.[59]

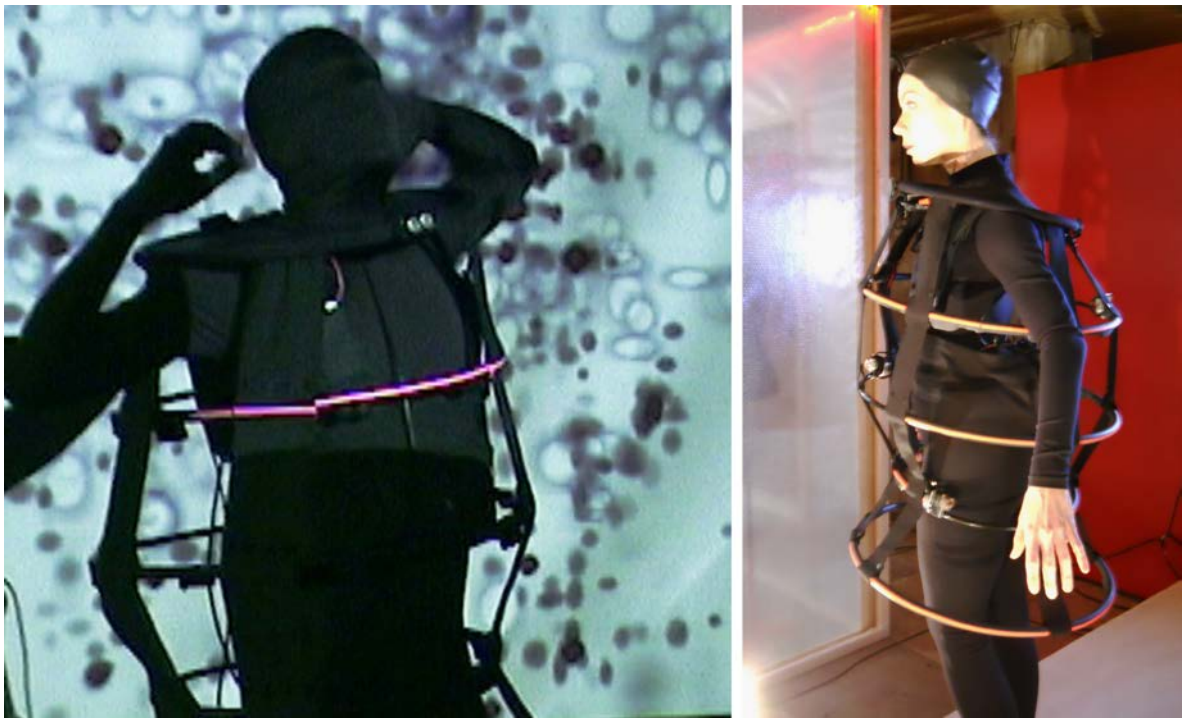
The artist and researcher Luisa Paraguai's wearable technology project *Vestis* (Figure 23) playfully deals with the idea of wearability and bodily spatiality. *Vestis* is a wearable skeleton-like

[59] http://www.fortlaan17.com/artists/lawrence-malstaf/works/ [accessed 3.2.2012]

structure that expands and shrinks independently, creating an evolving spatial dimension around the wearer's body.[60]

The clear rejection of rational functionality is one of the characteristics that set these kinds of above-described works apart from other projects in the field of wearable technology. While these works can have advanced technical functions, their distinctive style and unexpected features point to the significance of other criteria that seem to take precedence over the objectives of purposeful functionality.

Since they do not follow general assumptions and expectations, they offer possibilities for a re-interpretation of the purpose and meaning of technological applications and devices. These works offer the users questions and possibilities to go beyond the traditional assumptions and expectations about the purposeful functionality of wearable technology. They offer us a glimpse of how technology conditions our behaviour and influences our thinking.



23. Figure: *Vestis* by Luisa Paraguai, 2005. Performer Dani Gatti. Photo © Luisa Paraguai.

[60] http://luisaparaguai.art.br/ [accessed 3.2.2012]

IV. Aspects of Design between Human and Technology

This chapter aims to bring forth the figure of the *Hybronaut*. It presents viewpoints on body-technology relations, human enhancement and the evolution of the human as a self-designated design.

Our attitudes towards the body are in flux, which can be seen for example in the acceptance of ever more radical modifications of the appearances and functions of the body. The signs of changing attitudes can also be seen in visual culture; e.g. in evolving representations of the body in media, in the appearance of body-focused works within the arts, in the fashion scene's treatment of the body and in theoretical articulations concerning the body and the future of the human species. Design and art are to an increasing degree connected to the research concerning the future potentialities of the human and developments in human enhancement. This has become an emerging area which, due to advancements in technologies, such as wearable technology, as well as biotechnologies, genetic engineering, cognitive science and thinking, developed around the post-human and in transhumanism, has become a shared focus of interest for artists and scientists. This chapter investigates the physical body and its connection to technology. It establishes a viewpoint whereby the body and wearable technology are becoming a merged entity. This dissertation is emerging from artistic research and practice and therefore examples of artistic works are spread throughout the chapter.

24. Figure: Paper-cut model for *the Hybronaut*. Photo © 2008, Laura Beloff

IV.1. Designing Devices

IV.1.1. Technological Transparency

The recent direction of digital technologies has been heading towards invisibility and ubiquity, in which technology is embedded into everyday things. The increasingly encrypted objects that are nestled within technology and which act in parallel and in sync to humans, form a perspective which conditions our reality, behaviour and perception of the world. This development is comparable to the enhancement of our bodies and the use of body-related technology, such as wearable technology.

The assigned attribute of a wearable computer[61] has been, for example, the autonomous awareness of its location and situation without the need for external control by a user (Rhodes 1997b; Mann 2001). This feature resonates well with Mark Weiser's proposal for ubiquitous computing, in which he argues that when technology is successful, it will become intuitive to our use. The intuitiveness of our physical gestures will subsequently transform the technological device to become invisible to us (Weiser & Brown 1996; Clark 2003). The Theorist Lisa Gitelman argues that this kind of invisibility appears when specific technology becomes widely accepted into use by large numbers of people. The process of extensive usage will result in the transformation of a technological device into a self-evident commodity (Gitelman 2006).

Lisa Gitelman compares the acceptance of media technologies with scientific instruments and their employment in society. When scientists invent a new instrument, they have to demonstrate the use and meaning of the instrument. If they are successful, other scientists start using the instrument and its general acceptance will gradually make it a transparent fact of scientific practice (Gitelman 2006). Media technologies work in a similar manner; technology and its protocols become transparent with a general acceptance of their

[61] Here I specifically refer to wearable computers, which I consider as a sub-category of the wider term wearable technology that also includes technologies without necessarily a use of computing ability.

use. Gradually we will become unaware of our use of technology, its defined aims and underlying structures, although it will keep influencing us, and the context within which we use it. Gitelman references Marshall McLuhan: "the success of all media depends at some level on inattention or 'blindness' to the media technologies themselves (and all of their supporting protocols) in favour of attention to the phenomena, 'the content' that they represent for users' edification or enjoyment" (*Ibid.*, p. 6). Gitelman's investigations show how the widespread use and general acceptance of technology by society influences its transformation into invisible media. Accordingly, the cognitive scientist Andy Clark claims that some technologies are more successful in becoming intuitive and subsequently invisible in use than others. He describes as *opaque* those technologies that require constant attention from a user and intervene with normal everyday activities, whereas Clark claims that intuitive, *transparent technologies* can become an extension of a man (Clark 2003).

Based on the investigations by the author, many wearable technology artworks do not necessarily aim to produce the described transparency, which is caused by the acceptance of specific technology as a common everyday practice in the first place, and secondly, by the intuitiveness of a device in use.

For example, Gordon Savicic's work *Constraint City*, 2007, (described in chapter II.1.), a wearable technological corset which detects closed wireless networks, focuses less on developing a purposeful functionality achieved through technology than on the enhancement of a perception and experience of the world via technology. In the work, technology is seen as an intimate part of our body within everyday life and, simultaneously, it is constructed in a way that keeps reminding the user of its presence. It becomes clear that transparency is not the aim of this work; which instead takes on a more intricate nature.

Nevertheless, there are many other wearable technology projects, e.g. within wearable computing research, which very successfully aim to create the intuitive transparency Clark and Gitelman describe. However, the author's interests and questions in this dissertation are

directed to those projects which seem not to follow the aims typically laid down by research in wearable computing, e.g. the described transparency and intuitiveness, but seem to follow their own criteria.

IV.1.2. Body - Technology

Increasingly, the natural or biological body is being remodelled through the application of body-related technologies, such as wearable technology. The concept of the cyborg proposed in the 1960s as a merger of biological and technological, has by now become a familiar figure in western culture. In our everyday life we encounter technologies and various technological devices, which have become such a fundamental part of our everyday activities that we no longer notice them; they have become transparent to us. The body and numerous body-related technologies have formed an inseparable pair in contemporary life.

The focus of the tangible computing field[62] is encountering the world through physical artefacts that are often placed in everyday life. Paul Dourish argues that both, tangible computing and social computing[63], are based on the idea of embodiment, which is "the common way in which we encounter physical and social reality in the everyday world. Embodied phenomena are ones we encounter directly rather than abstractly." (Dourish 2001, p. 113). One of the central concerns of phenomenology is embodiment, which refers to an idea that we exist and act in the immediate physical world.

Philosopher Don Ihde has been investigating technological and scientific practices that are focused on the human body and its various relations to technology and to the physical world. His phenomenological approach is based on the work of phenomenologists Edmund Husserl, Martin Heidegger, Maurice Merleau-Ponty and the pragmatist approach to phenomenology by John Dewey.

[62] http://edutechwiki.unige.ch/en/Tangible_computing [accessed 24.3.2012]
[63] Social computing is a general term for an area of computer science that is concerned with the intersection of social behavior and computational systems. http://en.wikipedia.org/wiki/Social_computing [accessed 24.3.2011]

Ihde has distinguished four different relations humans can have with technological artefacts. In the *embodiment relation*, the technological artefact is embodied by the user in such a way that it becomes transparent to the user. An example of this is eyeglasses. In the *hermeneutic relation*, technology is used to create representations of the world that are readable by human senses. For example, a thermometer measures the temperature of the air, which is given as readable data and interpreted by a human. The *alterity relation* is a situation in which technology is seen as *other* that humans interact with. Examples of this are taking money out of an ATM machine, or Virtual Reality in which humans relate to a simulated world (Ihde 1990; Jørgenssen 2003; Verbeek 2008). In the *background relation*, technologies are in the background, but create a context for our perception, e.g. various automated tasks, such as humming from air conditioning (Ihde 1990; Verbeek 2008).[64]

Most of these relations are present to different degrees in our everyday technological devices, also including wearable technology devices. Typically, a wearable device may be *aware* of its situation and location and will generate data even without the user's actions. This data can be based e.g. on geographical location, conditions of the surrounding environment or biofeedback data of the user's physiological symptoms. This would be a typical example of *background relation*, in which technology, or the device, functions in the background and creates a context and technological environment for the user.

Investigation into wearable technology has revealed that behind various interests, in the field looms the idea of technology becoming an embodied part of a human and possibly an extension of his abilities. In a sense, wearable technology presents a direction that combines Ihde's *background relation* with *embodiment relation*; the technology is an embedded

[64] It should be mentioned here that Ihde's conception of the body has also been the target of criticism. For example, Robb Eason has criticized as misleading the general suggestion by phenomenology that there is something like the body. According to him, bodies are always particular bodies with particular histories, bodies are gendered, they have ethnicity, and they are motivated by different political ends (Eason 2003). This criticism is relevant and directed to ways of theorising about the body. However, when investigating the body with a more practice-based perspective (as in this dissertation), Ihde's formulation of various body-technology relations make sense as they investigate how humans experience the world through a technological artefact. In the focus of Ihde's conception appears to be precisely this relationship between the body and technology and not the (emphasised) body with its cultural and political location.

part of the user and at the same time, it sets the technological background for the user's actions.

IV.1.3. Intentionality

According to P. P. Verbeek, the body-technology relations described by Ihde make the relationship between human intentionality and technology visible. By human intentionality, Verbeek means that humans can never be understood in isolation from reality and their living environment. Verbeek argues that humans "cannot simply 'think', but they always think *something*; they cannot simply 'see', but they always see *something*." Humans are always directed towards their environment and reality (Verbeek 2008, p. 388). In Ihde's definitions of various relations, this kind of human intentionality is mediated by a technological device (Verbeek 2008).

Verbeek further develops Ihde's proposition of four different human-technology relations by suggesting a fifth category, which would come before *embodiment relation* on Ihde's list. This would be the *cyborg relation*, in which "the human and the technological actually merge rather than 'merely' being embodied" (Verbeek 2008, p. 391). In this situation, a human is embedded with technological parts: pacemakers, artificial valves, microchips, antidepressants, etc. There is no longer a relation between human and non-human entities, but a new merged entity appears, which forms its own unique relation to the world. The experiences are no longer mediated through technological devices, but technology has become an essential part of the human and his experience. "Technologies used, like telescopes and hearing aids, help to constitute us as different human beings, whereas technologies incorporated constitute a new hybrid being […]" (Verbeek 2008, p. 392). This kind of merged entity presents hybrid intentionality towards the world, which according to Verbeek is *beyond the human* (Verbeek 2008).

Although the current wearable technology projects are not incorporated within a user's body, the aim for a merger of human and technology is present in all of them in various degrees. Wearable technology intends to become a part of a user beyond being a tool. The author's project aimed at children, *Tratti*, 2007[65] (Figure 25), is designed as a wearable device in which the surrounding visual world is used as a constantly changing real-time score for generated sounds. In this work, both humans and technology perceive the same surrounding environment. The wearable technological device is simultaneously translating the visible information into audio. In this situation, the experience of the surrounding physical reality is mixed with continuous output from technological device. The device is attached to the front of the user's body and its functionality is dependent on the user's mobility. Every movement of the body will generate a different sound. The meaning of the work is created in the interaction between the human-technology merger and the world. In *Tratti*, technology is no longer a tool, but has become a part of the user and his reality.

25. Figure: *Tratti* by Beloff & Pichlmair, 2006-2008. Photo © Laura Beloff.

IV.1.4. Instruments of Knowledge in Science and the Arts

[65] http://tratti.attacksyour.net/

An instrument is a device for recording, measuring or controlling, or it is a means by which something is done; an agency[66]. Instruments in science typically have a defined objective, a task that is accomplished by means of using the specific instrument. The objective of this task is often connected to obtaining valid scientific data.

However, the way in which knowledge is obtained in science has changed radically due to the century-long development and advancement of scientific instruments. Don Ihde claims that before the 20th century, the invention of lenses and their gradual improvement dominated early modern astronomical science. For example, it was possible to identify Galileo's telescopic moon with the moon one could see with non-telescopic human sight. But Galileo claimed that his telescopic vision through the lens was *better* than naked eye vision. Galileo's experiments led to a point where the eye was no longer the main point of reference for visual phenomena. Gal & Chen-Morris write that for Galileo the telescope did not just improve the human sense, but replaced it. This meant that the human eye was to be considered nothing more than an unreliable instrument (Gal & Chen-Morris 2010). The accurate data obtained through scientific instruments overtook the reliability of human senses.

Even if Galileo's early experiments with lenses introduced the idea of technologically mediated vision, the boundaries of this were still determined by a human's body and his physical abilities. The lenses were able to optically enhance what was also otherwise perceivable to the natural human senses. Like Ihde claims, the scientific knowledge obtained was still within the limits of the optical (Ihde 2002).

So-called postmodern astronomy began in the 20th century with the invention of radar and radio astronomy, and the discoveries made with them, such as the background radiation of the universe. These technological developments and discoveries opened up a completely new perspective for astronomy that was no longer constrained by the existing abilities of a human body. The instruments used in contemporary astronomical practice,

[66] http://www.thefreedictionary.com/instrument [last accessed 20.8.2012]

such as instruments sensitive to gamma and to radio wave emissions, detect phenomena that would be otherwise invisible to the natural human senses. This kind of scientific knowledge is only obtainable through the mediation of technology. Ihde describes this kind of science, in which only instrumentally mediated evidence is possible, as instrumentally real (Ihde 2009).

As the human senses are considered to be unreliable, the scientific data has been increasingly obtained through the use of validated scientific instruments. Traditionally we consider instruments as tools, which are external to the human body. But, for example, wearable technology marks out a direction where a human's physical abilities are extended and enhanced through technology and instruments become parts of the human body. Instead of having external instruments, which generate legitimate scientific data, they could be partly replaced by extended human abilities. This would naturally require new observation and interpretation skills from a human and may influence criteria for obtaining legitimate scientific data.

Similarly as the sciences utilise instruments also the arts have various kinds of instruments in use. There are various artistic practices, which focus on constructing instruments, and devices, and experimenting with them. Examples of this can be found across various art disciplines, but it is typical for interactive, participatory and process-based art practices e.g. within the areas of new media-art, art and science and wearable technology art. Typically the arts that focus on instruments also imply a shift from a representational reflection of the world to ideas of an active construction of the world. The designed and constructed instruments acquire knowledge and test assumptions through experiments that include the instrument and a user in an actual physical experience. For example, *The Artvertiser* project by Julian Oliver, Damien Stewart and Arturo Castro, 2010[67] is an artwork in a form of an instrument that impacts the user's perception of the immediate surroundings when looking

[67] http://theartvertiser.com/ [accessed 19.2.2012]

through the device. The project targets the visual aspects of public space, which in the cities has been invaded by commercial billboard advertising. *The Artvertiser* is executed as a small handheld device, the function of which is to replace the existing billboard advertisements with different (artistic) messages when the cityscape is observed through *The Artvertiser* device.

Alfons Schilling is an historical example of an artist whose practice included research and experiments, for which he constructed his own instruments within his artistic research and practice. Schilling began his long-term investigations on perception during the 1970s and constructed a body of work called *Seeing Machines*. His experiments were constructed as head-worn objects, or instruments, in a variety of shapes and sizes, which transformed the viewers' perception through first-hand experience. He argued that human eyes were not spatial reference points, but temporal (Schuler 2009). Schilling aimed to see something nobody has ever seen before: he believed that new realities could be revealed by an extended perception (Schilling 1975; Reder 1987). Romana Schuler writes of Schilling's vision machines that the viewer/user is not only hindered in mobility by the heavy construction of the wearable machines but also by the impressive visual effects produced by the optical manipulation of the user's perception. "Similar to experimental enquiries in scientific laboratories Schilling's vision machines create artificial perceptual disturbances in the viewer's visual-motoric realm" (Schuler 2009, p. 76).

The variety instruments and devices created in the field of the arts often focus on producing an experience for users without a strictly defined single aim. This kind of created artistic experience presents a potential for revealing new knowledge, which would not be attainable without this device. Similarly to how Don Ihde makes his claim about technologically mediated scientific knowledge that is obtained through instruments (Ihde 2009), the knowledge that is generated by artistically guided experiences using instruments is also technologically mediated.

IV.1.5. Design and Decisions

> "If I hold a revolver against my temple and pull the trigger, I have decided to take my own life. This would appear to be the height of freedom: I am able to free myself from any predicament by pulling the trigger. But in reality, with this pulling of trigger I set in motion a process that is pre-programmed in the revolver. I have not, as it were, made a 'free' decision, but I have made a decision within the limits of the revolver programme" (Flusser 1999, p. 93).

An investigation into contemporary technological artefacts and devices that are commercially available, such as mobile phones and other portable small-scale devices, reveals that the majority of them are designed with a functional approach. Technology is directed at embedding purposeful and useful functionality into these small devices used by humans in their everyday lives. It also points out that our expectations of technology are based on the idea of functionality and purpose. It is important to realise that all these technological devices and apparatuses are products of our culture and that their designed functionalities and defined limitations present aspects and values of our culture.

Vilem Flusser defined the term *apparatus* as a complex plaything with its own programme. While fully automated apparatuses function without human intervention, many apparatuses require a human being, whom Flusser defined as a functionary. A functionary is a person who plays with an apparatus and acts as a function of the apparatus (Flusser 2000). In Flusser's investigations into photography, he defines a camera as a plaything (as opposed to a tool) and the photographer as a player (as opposed to a worker); not *Homo faber* but *Homo ludens*. Flusser perceives the photographer as a figure firmly bound up with the camera. "This is a new kind of function in which human beings are neither the constant nor the variable but in which human beings and apparatus merge into unity" (*Ibid*, p. 27). These kinds of functionaries

cannot change what is pre-programmed into the device, they can only challenge the cultural norms and principles through the use of the programme. To be able to modify the actual programme, they would need to be able to access the metaprogramme and initiate a change on that level. Which, according to Flusser, would be problematic, because "every program functions as a function of a metaprogram, and the programmers of a program are functionaries of this metaprogram" (*Ibid*, p. 29). There is always the next level of metaprogramme, to which the previous layers are subordinate; a camera to the photographic industry to the industrial complex to socio-economic apparatus, and so on. Flusser sees the technological devices as feeding into a large and complex entity, where the power no longer lies with the owners of objects, but with the ones who design and develop programmes for these objects.

Flusser's revolver quoted in the above excerpt is not commonly thought of as a wearable technology, yet it has several characteristics similar to what is generally considered *wearable*: it is technical, wearable (or portable), it is designed to be used by an individual, and can be considered, to a certain extent, as an extension of human abilities. The difference from a current definition of the objectives of wearable computing (Barfield & Caudell 2001) is that it does not fulfil the articulated aim of wearable computing for mobile information access and transfer. However, in Flusser's example of a revolver, it is quite obvious that the user of the revolver becomes a function of the apparatus, a functionary. The choices he can make are: who or what to shoot or not to shoot. But he cannot change the pre-defined premise that this is what guns are designed to do. Similar aspects, although not necessarily equally obvious, are also present with contemporary devices that have multiple functions and computing abilities, such as wearable computers or various mobile devices. In these devices it is not solely the design of the hardware that creates the limitations, but the programmed software, which is designed with specified functions and limitations for predefined purposes.

In general, Flusser's criticism points to design and to the preprogrammed nature of designed technological artefacts, in which the users typically have no choice other than to

function within the allowed, pre-defined limits. But design itself can also be used as practice-based criticism e.g. to question the impact of technology on culture and society, and to challenge our existing values.

The author's investigation has revealed that there are works within wearable technology that seem to be created deliberately with very restricted technological functions, in order to emphasise the conceptual meaning of the work over the technological inventions. In these works, the multi-layered meaning is often created as a carefully crafted combination of technological functions and user-participation. These kinds of works are often designed to be dependent on the users' actions, and without the participants the works are not able to perform – at least not in the intended way. In brief, defined functions and purposely designed limitations in the technological abilities of a work combined with a strong conceptual idea and structure that includes devices, environment and participation are some of the means used in creating significant works in the field. For example, the previously mentioned work *The Artvertiser* by Julian Oliver, Damien Stewart and Arturo Castro, 2010 (described in the chapter IV.1.4) manifests a clear political agenda.

The author's work *The Head: wearable sculpture*, 2006[68] (detailed description in the appendix 2) is an external eye and ear, which appear to be independently observing the world as a kind of second head of the wearer. However, *The Head* is dependent on the public's participation. The work is constructed as an open public channel for people to trigger the eye and ear through a mobile network, which enables it to *see and to hear*. In a way, it is extending a wearer's body and his presence, but not his physiological abilities. The extension of the user is directed towards a network and its connections to the wearer.

These kinds of works are comparable to what Flusser perceives as apparatuses that work on a symbolic level. Instead of changing the world the way tools do by taking objects from the natural world and forming them into something else, the apparatuses based on a symbolic level aim to change the meaning of the world.

[68] http://www.realitydisfunction.org/head/ [accessed 19.2.2012]

IV.1.6. Critical Design

Designers Anthony Dunne and Fiona Raby introduced a concept of critical design into their practice and theory. "Critical design, or design that asks carefully crafted questions and makes us think, is just as difficult and just as important as design that solves problems and finds answers" (Dunne & Raby 2001, p. 58). They argue that the field of design can be divided into two very broad categories: affirmative design and critical design. Affirmative design "reinforces how things are now, it conforms to cultural, social, technical and economic expectation" (*Ibid*), whereas critical design "rejects how things are now as being the only possibility, it provides a critique of the prevailing situation through designs that embody alternative social, cultural, technical or economic values" (*Ibid*). Design is a cultural product that, similarly to art, or any other form of culture, is based on the prevalent values and the worldview of that culture, which it either confirms or contradicts.

Design which deals with technology, has an especially strong connotation with functionality and much of it belongs under the affirmative design category defined by Dunne and Raby. Design involving technology is for the most part used for creating purposeful functionality in devices with very practical aims. According to researcher Johan Redström, our practice with technology "though phenomenological, sociological and other studies have challenged and expanded our understanding of technology, practice seems to be dominated by an instrumental perspective. Central to our understanding of technology still lie notions of use, the idea that technology is the means for achieving certain ends, often by amplifying the power of our actions" (Redström 2005, p. 22). Redström claims that the focus on functions in design is problematic because it easily reinforces predefined ways of using and interpreting the artefacts. He is calling for a different perception of technology, one in which technology can be understood as a raw substance in a similar way to any other material, which supports a creation of ambiguous and intentionally vague technological artefacts (Redström 2005).

Wearable technology is an area in which our understanding, use and expectations of technology are challenged on a very intimate level. In the current situation, the majority of widely available wearable and mobile technology devices and various research projects follow the guidelines of affirmative design; they respond to our typical expectations about the use and practicality of technology. But among these wearable technology projects, there are some projects that appear instead to be based on the idea of critical design and which could be described as *para-functional* devices, a term defined by Anthony Dunne (Dunne 2005).

Dunne describes *para-functionality* as a form of design in which designed functions are used for inviting observations on how technological products condition our behaviour. A para-functional device, or gadget, suggests that its "design is within the realms of utility but attempts to go beyond conventional definitions of functionalism to include the poetic" (Dunne 2005, p. 43).

In a very similar sense, the author sees wearable technology art in some way as *props for real life*, which are located in the ambiguous space between fiction and everyday life, imagination and reality. Through the works, people can participate in the proposed stories and offered experiences and see for themselves what currently is, what could be and what may come in the future. The ironic nuance present in the works allows alternative viewpoints that challenge standardised perceptions of technology and shows that there are more ways of relating to it.

IV.2. Human Design

During the Enlightenment period, many of the historical practices in medicine, as well as in the arts, were focused on making visible the non-visible aspects of the world. This included the interior of the body and its functions (Stafford 1993). Medical investigations and practices in human science, which focused on impartial and detailed aspects of the body, have reinforced the perception of the body as an entity of which all

parts can be analysed, observed and controlled independently of each other. The ideas of this historical movement, which begun in 18th century Europe, are still very evident today, for example in our perception and treatment of the body.

Cybernetics is a field, which is closely connected to investigations of the future possibilities of a human. In the late 1940s, cybernetics was a new emerging science, which proposed analogies between organisms and machines (Wiener 1948). "The cybernetic automaton's mirroring of the human body was not established on the basis of conventional mimicry, as in the case of androids and their internal parts, so much as on common understanding of the similarities that existed between the control mechanisms and communicational organizations of machine systems and living organisms" (Tomas 1995, p. 27). As much as cybernetics influenced the perception and development of machines, it also intensified our perception of the human body as an entity compiled of separate body parts: organs, fluids, functions and mental states.

Today, similar perception is visible for instance in our amplified body awareness, which is present in our cultural habits such as consumption of specified nutritional supplements and individual monitoring of separate aspects of the body, such as weight, blood pressure, fat and sugar levels, among others. This kind of viewpoint, which sees the body as a compilation of individual parts, keeps saturating our understanding of and attitude towards the body and its environment and also influences practices in human enhancement and extension.

The idea of the body, which is compiled of many individual parts, is also palpable in wearable technology works. The body is enhanced with external devices that are designated for specific, purposeful tasks. The body is seen as an extendable entity into which one can plug in new (technological) abilities to create a new techno-organic compilation.

IV.2.1. Space Travel and Human Adaptation; Cyborg

The suggestion in Manfred Clynes's and Nathan S. Kline's proposal for lunar exploration, which is distinctive from earlier approaches was, that instead of aiming to transport the terrestrial environment into space with an astronaut, the aim should be to enhance the astronaut in a way that would enable him to adapt to lunar circumstances. "Altering man's bodily functions to meet the requirements of extraterrestrial environments would be more logical than providing an earthly environment for him in space [...] Artefact-organism systems which would extend man's unconscious, self-regulatory controls are one possibility" (Clynes & Kline [1960] 1995, p. 30). During the 1960s, Manfred Clynes was working on the body's nervous system and its cybernetic control, and Nathan Kline was interested in the application of drugs for the treatment of mental patients. Underlying the proposal was the intense period of rivalry between the Soviet Union and the United States over space exploration[69].

Clynes & Kline named this proposed artefact-organism *a cyborg*: the term was compiled from the words *cybernetic* and *organism*. "For the exogenously extended organizational complex functioning as an integrated homeostatic system unconsciously, we propose the term 'Cyborg'. The Cyborg deliberately incorporates exogenous components extending the self-regulatory control function of the organism in order to adapt it to new environments" (Clynes & Kline [1960] 1995, p. 31). At the time, however, the term *cyborg* was more eagerly adopted by science-fiction authors than by scientists (Gray 2001).

The world's first cyborg was a rat with an osmotic pump embedded under its skin. The pump was automated to permit continuous injections of chemicals into the organism when needed. Clynes and Kline claim that a cyborg's self-regulation should be designed in such a way that it functions without conscious acts in order to cooperate with the body's own autonomous homeostatic controls. "The purpose of the Cyborg, as well as our own homeostatic systems, is to provide an organizational system in which such robot-like

[69] The first human spaceflight was in 1961, when the Soviet cosmonaut Yuri Gagarin made one orbit around the Earth. The first man landed on the Moon in 1969 with United States spaceflight Apollo 11. http://en.wikipedia.org/wiki/Apollo_program, http://en.wikipedia.org/wiki/Spaceflight [accessed 13.9.2011]

problems are taken care of automatically and unconsciously, leaving man free to explore, to create, to think and to feel" (Clynes & Kline [1960] 1995, p. 31). Based on the *Cyborgs and Space* article, the initial idea of the cyborg focused on extending and modifying the involuntary functionality of an organism, or a man, based on the aim of survival in extraterrestrial environments. The proposed ideas for extended functionalities of a man primarily emphasised the aspects of physiological modification, with very few considerations for their relationship with psycho-physiological adaptation. Ten years later, Clynes developed a criticism of the original cyborg concept and the way it considered humans merely as components of a technological system. In the article *Cyborg II: Sentic Space Travel* that was written for the journal *Astronautics* in 1970 but which was rejected by the journal, Clynes focused on the emotional and sensual side of the cyborg, which, he argued, was left out of consideration in the original cyborg proposal (Gray 1995b).

Clynes's further ideas for cyborg development are referenced in an interview with C. H. Gray (Gray 1995). *The cyborg III* was based on the idea that a man makes use of molecular biology to improve himself without changing heredity, but by using designer molecules to affect the cyborg's emotional world. The concept for *the cyborg IV* went a step further and also proposed a modification of heredity. In the last version of the cyborg concept, *the cyborg V*, Clynes imagined that humans would become in some ways networked similarly to computers, which would allow knowledge to be disseminated without the effort of learning. *The cyborg V* was a brain of expanded functionality capable of existing without the body (*Ibid*). His last proposal suggested that humans, or minds, be perceived as components of a complex networked structure, which is simultaneously the environment.

This idea correlates with the author's perception of networked wearable technology and how the network constitutes part of the living environment. However, the author sees

this development as being situated in the midst of physical reality and physical bodies, whereas Clynes was describing disembodied minds connected through a network (*Ibid*).

The idea of enhancing the human artificially or technologically has a longer history than the term *cyborg*, which was introduced in the field of science in the 1960s. The field of arts and culture presents early examples that propose the idea of a merger of a man and a machine or other inanimate material: e.g. *Golem* is a figure in Jewish folklore, who was created entirely from inanimate matter to become an animate anthropomorphic being[70]. Mary Shelley presented her famous story of *Frankenstein*[71] in 1818 and Fritz Lang's *Metropolis*[72] was released in 1927. Also, the early mechanical automata can be seen in the same line of interests, such as J. Vaucanson's *The Flute Player* and *The Digesting Duck*[73] from the 1730s and W.von Kempelen's *Chess Player*[74], which was created in 1769.

In the 1980s and 1990s, interest in the concept of the cyborg and what it implied circulated to a variety of disciplines, such as engineering, medicine and social and cultural studies. However, according to C. H. Gray, possibly the most important site of cyborg production has been the imagination, where the most startling and insightful takes on cyborgs are created, which later appear in the movies, the arts and literature (Gray 1995). Even though the term "cyborg" was originally partially rejected by the actual science field, science-fiction literature quickly adopted the term and the idea of the integration of technology into natural and living systems.

In the late 1980s, the concept of cyborg generated a fair number of publications referenced under the title "the cyborg theory", which investigated the idea of the cyborg in relation to identity, gender and socially inscribed boundaries between the body and technology. Donna Haraway's *Cyborg Manifesto* is undeniably one of the most influential texts in the field of cyborg and gender studies (Haraway 1991). Haraway's cyborg emerged

[70] http://en.wikipedia.org/wiki/Golem [accessed 20.2.2012]
[71] http://en.wikipedia.org/wiki/Frankenstein [accessed 20.2.2012]
[72] http://en.wikipedia.org/wiki/Metropolis_film [accessed 20.2.2012]
[73] http://en.wikipedia.org/wiki/Vaucanson [accessed 20.2.2012]
[74] http://en.wikipedia.org/wiki/Von_kempelen [accessed 20.2.2012]

from the blurring of strict boundaries between human and animal, human and machine, and physical and non-physical that were impacted upon by the development of new technologies, such as communication science and biotechnology. In her view, the concept of the cyborg served as a possibility and a fresh platform on which fresh perspectives and practices could be proposed, which challenged the prevalent subject produced by the patriarchal society. In the cyborg, Haraway saw the possibility for a new kind of cyborg identity, through which humans could contemplate their relationship with nature and technology, society, family relations and gender (Siivonen 1996).

Even today, the constantly evolving conceptual figure of a cyborg can be seen as a placeholder onto which one can project and test new identities and reconfigurations that are brought about by the era of bio-, nano-, cogno- and information-technologies. These tests are carried out in various fields and through different methods, of which wearable technology art represents one possibility.

26. Figure: *NeuroBodyGame* by Rachel Zuanon & Geraldo Lima, 2010. Photo © Rodrigo Pessoa. *NeuroBodyGame* is a wearable computer embedded into a garment that allows the user to play games using their brain signals. (Figure 26)

IV.2.2. Body Enhancement

It seems that the body in its original *natural* state appears increasingly old-fashioned the further technologies develop and the smarter technology becomes. Various body enhancement technologies are one way to answer the demands projected onto the human

body. Current examples of body-altering technologies are e.g. chemical enhancers and anabolic steroids, silicone transplants and plastic surgery, artificial limbs and other prosthetic devices, technologies directed against ageing, regenerative medicine, genetic engineering and various external devices such as mobile phones and, notably, wearable computers. It is clear when looking at this list that contemporary body enhancement practices are no longer solely and necessarily concentrated on repair or replacement of defective bodily functions, but are increasingly focused on the redesign of the body based on one's desires. According to Linda F. Hogle, body enhancement and body modification can be seen also as "a manifestation of changing ways of thinking about biological and social life that is fundamentally transforming institutions, economies, and meanings" (Hogle 2005, p. 696).

Underlying the various body enhancement practices is a cultural assumption of what is considered to be *normal*, which is always related to one's cultural setting. Different cultural values create a different understanding of normality, and also influence the degree of acceptance of body enhancement. For example, contemporary prostheses, which are connected straight to the body's nervous system, are primarily experimented as improvements of an incomplete or injured body. They are not designed as additional technological functions to upgrade *a normal body*. Also, other *beneficial* prostheses such as heart implants, pagers or artificial organs are accepted as necessary to enable the normal functioning of the body without further questions. But many body modification practices, technological attachments and other improvements, which are not considered *necessary* for the normality or vital functions of the body, are still not yet fully accepted within society. The gradual changes in attitudes towards the acceptance of more radical body enhancement in the future are visible, for example, in the popularity of contemporary aesthetic practices, such as plastic surgery, body-piercing and tattooing. These physically alter the body but do

not change the existing functionality, or add new properties to the current body or its heredity.

Contemporary enhancement processes do not always start with the idea of deficiency, which is still common e.g. in the practice of medicine, but its aim may instead be focused on the invention, redesign or upgrading of human capabilities (Hogle 2005). It is clear that the dividing line between what is considered appropriate concerning body enhancement and what is not is becoming increasingly blurred due to development of nano-scale technologies, cognitive enhancers such as nootropic drugs, life extension therapies and other "invisible" enhancement techniques.

Many of today's body enhancement practices are focused on improving one specified aspect of a human; e.g. the perfection of beauty, a specific physiological function or an enhancement of physical or cognitive achievement. An area in which the enhancement of physical achievement has become almost an everyday practice is the world of professional sports, where doping-scandals are nearly a commonplace reality. According to scientist Helga Nowotny, developments in the field of athletics are "paradigmatic in that they reveal how rigid boundaries between artificial/technological and the natural are no longer tenable" (Nowotny & Testa 2010, p. 18). Nowotny argues that there exists a boundary between inside and outside concerning the enhancement of sporting achievement. The aspects that are produced within the body are accepted, whereas things coming from the outside are forbidden. For example, training at high altitudes, which is known to increase the production of red blood cells inside the body, is accepted, but blood transfusion coming from outside of the body, which would produce a similar result, is not allowed.

Paralympic runner Oscar Pistorius is an example of how the use of prostheses, carbon-fibre legs, are claimed to have upgraded the *normal* physical ability of a body. It has been debated, even in court, whether he is at an advantage or disadvantage compared to able-bodied runners with his artificial limbs after he was excluded from being accepted to

compete officially with able-bodied athletes in 2007. Nowotny claims that Pistorius is being punished for the visibility of his prostheses because they are displayed in public and emphasise his difference from *normal* sprinters. Nowotny continues by asking: "But what if it were possible to use stem cells to stimulate the growth of new legs that were also faster and better than the already twenty-five-year-old legs of his competitors? […] It is thought-provoking that society proud of its ideal of equality sees a threat to sports precisely when technology enables a handicapped person to overtake his non-handicapped competitors" (Nowotny & Testa 2010, p. 25).

It is clear that the advancements in genetic engineering and stem cell technologies will continue to complicate the current division between the natural and artificial concerning the body. At the atomic or molecular level, the division between natural and artificial disappears, even if the actual act of creation may still hold a possibility for this kind of division.

The scientist Helga Nowotny claims: "Replacing the cell nucleus with the genome taken from another cell of the same or a different species is a vivid illustration of what the molecular glance can do with the knowledge and technology it comprises. It also shows that the familiar distinction -between knowledge and application, between science and technology- are outdated. Under the hegemony of the molecular glance, knowledge has become action. Today the fact is that *understanding life means changing life*" (Nowotny & Testa 2010, p. 5).

Today's wearable technology art can be seen in parallel to research in science. For their part, artistic practices in wearable technology experiment, question, and propose concepts and ideas concerning the development of the future human. At the same time the molecular sciences investigate and test the practical possibilities for human enhancement on a molecular level. Both of these practices are embedded in action and in practical experimentation. From this parallel development, one can come to the conclusion that

possibly in the future, art practices concerning the human will happen on molecular level, at least to some degree. The contemporary wearable technology works can be seen as prototypes, which investigate various aspects related to human enhancement. But they also support the emotional and conceptual adaptation of the human to future changes and possibilities, including the shifting understanding of what is natural and what is artificial.

IV.2.3. Cognitive Enhancement

Cognitive enhancement is defined "as the amplification or extension of core capacities of the mind through improvement or augmentation of internal or external information processing systems" (Boström & Sandberg 2009, p. 311). Cognitive enhancement includes medical and psychological interventions and improvements of external technological and institutional structures that support cognition. Examples of conventional methods are education, various kinds of training and the use of external information processing devices; unconventional means of enhancing cognition include nootropic drugs, gene therapy and neural implants. According to Bostrom and Sandberg, the conventional methods, such as education, often produce more permanent neurological changes than e.g. temporary use of drugs (Boström & Sandberg 2009). A cognitively enhanced person "has benefited from an intervention that improves the performance of some cognitive subsystem without correcting some specific, identifiable pathology or dysfunction of that subsystem" (*Ibid.,* p. 314).

Humans have a capacity to incorporate external tools and supporting practices into their existence. According to cognitive scientist Andy Clark: "For what is special about human brains, and what best explains the distinctive features of human intelligence, is precisely their ability to enter into deep and complex relationships with non-biological constructs, props, and aids" (Clark 2003, p. 5). According to him, our tools are integral parts of the human problem-solving systems, which we identify as human intelligence. The human mind is a complex computational apparatus that includes various external cognitive aids, which can be as simple

as paper and pen, a pocket watch, an artist's sketchpad and various electronic devices such as mobile phones: almost anything can be an extension of the mind.

Wearable computers and other wearable devices that process data are typically developed from this kind of perspective of understanding them as extensions of the mind and cognition. One of the stated goals of wearable computing is to enable people to access and manage information while being mobile (Barfield & Caudell 2001). It has been claimed that a wearable computer embeds a human within an augmenting *shell*, in which the software becomes less of an external tool, and more of a mediating *exoself*. For example, *exoself*[75] software can be used for enhancing the user's memory or vision (Boström & Sandberg 2009).

One commonly referenced aim of wearable technology and wearable computing devices is a certain kind of transparency in the use of technology. Wearable technology is considered to be successful when it becomes transparent to the user, in other words when the user no longer notices it. For example, eyeglasses are an early and successful case of transparency in wearable technology; while using eyeglasses, the user is looking through the lenses without being aware of their existence. This kind of transparency of technological aids and devices causes them to become an intimate part of the user's cognitive abilities. This requires that the device feel natural for the user, which implies that the device is often designed to enhance the existing abilities of the user, but does not necessarily offer new capabilities. Clark argues that *transparent technologies* are so well integrated within our lives and biological capacities that the devices have become invisible in use. Whereas *opaque technologies*, according to Clark, keep obstructing and disturbing the user and require skills and capacities "that do not come naturally to the biological organism, and thus remains the focus of attention even during routine problem-solving activity" (Clark 2003, p. 38). In other words, according to Clark's definition, *transparent technologies* have the possibility to become a cognitive tool extending the abilities of

[75] http://www.aleph.se/Trans/Words/e.html [accessed 28.8.2010] Exoself: Systems linked to the self in a cooperative way, extending the mind and the body. Especially used about the systems supporting an uploaded personality, providing information, virtual reality and monitoring. [Greg Egan, Permutation City]

a man, but *opaque technologies* have no real potential to become an extension of a man because they are not intuitively functional. His argumentation follows similar thinking to Lisa Gitelman's argument about technology becoming transparent when its use becomes an accepted fact of scientific practice and technology is no longer paid any specific attention in relation to the produced (scientific) results (Gitelman 2006). In both cases, technology is perceived as a transparent cognitive extension of a man.

Whereas its opposite, *opaque technology*, references the way a *failed* design of a technological device keeps preventing the intuitive functionality and intimate connection that would make the device feel like an extension of the user, according to Clark. Cognitive science sees a benefit in the invisibility and smooth integration of technology.

The wearable technology works typically emerging within the arts do not follow the same criteria, but seem to aim almost in the opposite direction. Many of the works are intentionally created in a way that does not allow any disappearance of technology, but they deliberately direct a spotlight onto the use of technology and its evolving relationship with the human. This is often achieved by creating works with obtrusive aesthetics and characteristics. In short, wearable technology works with emphasised visual and functional characteristics are often intentionally created as *opaque technology*.

IV.2.4. Playfulness in Enhancements

Playfulness is not usually associated with the idea of body enhancements, which are most often conceived as repairing or improving the body to become *normal*. To be able to play or to be playful with real physical body parts is possible only within the physical and physiological limits that the current state of the human body allows. Aimee Mullins's case is an interesting example addressing this issue[76]. Mullins was born without fibula bones and had her legs amputated at a young age. Mullins has rejected the idea of seeing herself as a disabled person without legs; instead she has taken this feature as an advantage, at least to

[76] http://www.aimeemullins.com/ [accessed 7.3.2012]

some degree. Her prosthetic legs have become fashion accessories, which she cheerfully changes, depending on her mood and the situation. Her collection of legs contains a dozen pairs of different kinds of prosthetics, ranging from haute couture wooden legs created by fashion guru Alexander McQueen to transparent limbs used in Matthey Barney's *Cremaster Cycle*-movies and high-tech legs designed for a competitive runner. By choosing a specific pair of prosthetic legs, Mullins is also able to manipulate her physical body height by several centimetres. Mullins is a good example of evolving attitudes concerning the body and its enhancements, but it also points to the fact that this kind of playful attitude is acceptable and respected when it is adopted by a person with real physical abnormality.

A comparable example, worth mentioning, of this kind of playfulness can be found in the Internet. The Second Life *metaverse* (SL) is an online arena where a playful attitude towards the body, body-parts and appearance is an everyday practice. One specific area of creativity in SL is so-called avatar[77] attachments, which are body attachments specifically designed for avatar bodies. There are designers in SL who specialise in creating these and selling them online to others. Some of the SL avatar attachments feature ideas that experiment with the future possibilities of the human species and the human body. There are imaginative avatar attachments that function as vehicles, attachments that add extra elements to one's (avatar) body and there are prosthetics and various other kinds of body parts that replace existing body parts with new designs. These attachments enable quick and non-orthodox modifications of the (avatar) bodies; the body and its parts are made to be changeable according to one's mood and desired aesthetics.

Aimee Mullins's attitude in real life towards her prosthetic legs appears to be closely related to how one modifies his body or changes his body parts in SL in a very casual manner. There is an underlying suggestion in these practices that possibilities concerning a radical modification of the body, which are currently possible mainly in the online *metaverse* worlds, may become reality in the future.

[77] In Second Life metaverse, one can design and create an avatar as a representation of oneself.

The wearable technology field offers opportunities to experiment with some degree of body modification and extension in physical reality. The advantage of wearable technology in comparison to physical body alteration is its quick and easy changeability from one device to another, or from one appearance to another without physical operations. In addition, wearable technology is not limited by judgments of its appropriateness in the way some *real* physical body modifications are. Wearable technology offers multisided opportunities for playfulness and enables receptive and even radical experimentation with concepts, appearances and reflection on ideas. The possibilities for body enhancement in SL and in the physical wearable technology works with a playful approach towards the body, which treat the body as a site for experimentation, propose a fresh new attitude towards the body and enhancement practices that go beyond cosmetic modifications. This is seen especially in the wearable technology works emerging from the arts, which do not follow the general goals of invisibility and smoothness of technology.

Artist Krzysztof Wodiczko's wearable technology piece *The Ægis*[78], 2000, is composed of two wing-like screens enclosed in a backpack hanging from the shoulders of its wearer. The wearer of the work can trigger the wings to unfold and fold via oral commands. The wings will feature pre-recorded video images of the wearer's face. The wearer can engage in a dialogue between his three heads. The work presents a playful, but very challenging experience with a newly enhanced body, the parts of which can be controlled only to a certain degree. A dialogue between the *real* face and the two concurrently present video faces cannot be achieved without revealing one's own contradictions. As it states on the website of the work, perplexity can only be met with complexity[79].

[78] http://web.mit.edu/idg/aegis.html [accessed 13.3.2012]
[79] ibid.

27. Figure: Beloff in dialogue with *Geminoid* at Ars Electronica Festival, 2009. Photo © Oliver Frommel.

IV.2.5. Transhumanism and the Posthuman

The Mesopotamian epic of Gilgamesh is a tale about a wish to be immortal, and the Jewish folklore story of Golem features a human-shaped figure created from inanimate material. These early tales and many other stories from history present signs of a human desire to overcome limitations and expand the human boundaries. Today, these desires are coming closer than ever to fruition, due to the development in human enhancement practices.

The transhumanist movement and recent theoretical articulations concerning the so-called posthuman[80] are directing the discourse which addresses ethical, philosophical and

[80] On terminology: Transhumanism is philosophy with a doctrine and a cultural movement, whereas posthumanism is a more general term used in theoretical argumentations concerning the future of the human species without necessarily being affiliated to the aims of transhumanism. The use of the terms transhumanism and posthumanism varies from author to author. Transhumanist expert Natasha Vita-More has defined the difference between the terms in the following way: *Posthumanism* stems from a postmodernist perspective on the current state of human-machine integration and the future. As such, it claims that humans will be disembodied. Posthumanism may stem from Humanism, but it is more often distinguished by and through science fiction and the threat of the future. Posthumanism claims to be the human condition. As such, posthuman is a fait accompli wherein the future looks dystopic. *Transhumanism* stems from a broader philosophical and scientific discourse that looks to explore human potential as humans merge more with technology in a self-directed evolutionary transformation. Its historical antecedents include Aristotle, Nietzsche, Huxley and Teilhard de Chardin. Because Transhumanism focuses on "life

practical aspects concerning human enhancement and his future evolution. The debates in the field are situated at the intersection of science, technology, critical theory, art & design and philosophy. A prominent transhumanist thinker and scientist, Anders Sandberg, claims the following: "The goal of transhumanism is to make humanity grow to its full potential. We are no longer bound by biological evolution, we can choose our own path: the era of autoevolution has begun. The responsibility of our development is now ours alone, we can choose what we want to become and how we want to become it" (Sandberg) [81].

Transhumanism is an intellectual and cultural movement formalised during the 1980s that includes many notorious futurists, philosophers, theorists, scientists and artists. It is coloured by an optimistic prescience about human future and development possibilities offered by current and emerging technologies in nano-, bio-, information technologies and cognitive sciences (NBIC). Strategic philosopher Max More defines transhumanism in the following way: "Transhumanism is both a reason-based philosophy and a cultural movement that affirms the possibility and desirability of fundamentally improving the human condition by means of science and technology. Transhumanists seek the continuation and acceleration of the evolution of intelligent life beyond its currently human form and human limitations by means of science and technology, guided by life-promoting principles and values" (More 2011, p. 137).

Transhumanism considers the current state of the human species as an early phase in its continuing development, and supports the efforts to improve the human condition through applied reason. Within transhumanism there are a variety of different directions and interests that are sometimes contradictory to each other. However, the central concerns within the transhumanist discourse are: "the view of evolving human nature, the focus on biotechnological enhancement that will exceed ordinary human physical and

extension" and "life expansion" it is linked to a strong, historical prospect of radical life extension. Transhumanism aims to elevate the human condition. This is a continuous element of becoming, and a final state of evolution, wherein the future looks challenging. (Vita-More 2011) [Personal communication with the author, May 2011]

[81] http://www.aleph.se/Trans/Intro/vision.html [accessed 13.3.2012]

cognitive traits, a preoccupation with human happiness that can be perpetuated indefinitely, a deep concern for longevity and radical life extension, and a techno-utopia of human-machine fusion that constitutes practical immortality" (Tirosh-Samuelson 2011, p. 29). For example, concerning human enhancement, transhumanists argue specifically for the general rights of individuals to redesign themselves and their own descendants.

A posthuman is an enhanced human of the future, whose capacities revolutionise the abilities of the present-day human. Philosopher Nick Boström claims that a posthuman can be a synthetic artificial intelligence, an enhanced upload or a biological human body with various profound augmentations. To become a posthuman requires radical technological modifications to our bodies and brains. It is not enough to just change our self-conception and the way we think about ourselves (Boström 2003). This means that it is currently almost impossible for us to imagine a posthuman future, because all experiences, concerns and even the way the world is structured would differ drastically from what we can currently understand, due to the potential modifications of mind and body.

Professor Katherine Hayles approaches the posthuman as a question of embodiment of information. She understands the posthuman perspective emerging through the development of cybernetics, in which information lost its body and is considered separate from matter. The first phase of cybernetics introduced the construction of humans and machines as theoretically similar; the second wave of cybernetics introduced the concept of autopoiesis and the idea that reality is constructed subjectively by organisms. According to Hayles, the third wave in this development is investigation into Artificial Life (AL) and its focus on the construction of code-based, disembodied organisms (Hayles 1999). In her comparison of the aims and methods of AL and Artificial Intelligence (AI), she argues that the goal of AI has been to construct intelligence comparable to that of a human inside a machine, whereas AL has been aiming to "evolve intelligence within the machine through pathways found by the 'creatures' themselves" (Hayles 1999, p. 239). Hayles sees in the

development of AL the cradle of the posthuman. "In the AL paradigm, the machine becomes the model for understanding the human. Thus the human is transfigured into the posthuman" (*Ibid*.). The AL is located in a computational universe, which is based on the processing of information. This universe is developing in itself and autonomically creating intelligence and life. According to Hayles, the posthuman evolves in this computational universe separately from matter. The environment for the evolution is a replaceable and changeable computational device.

The optimistic approach to the future, which is typical of transhumanists, has also received criticism. For example, Katherine Hayles considers it problematic that, as she puts it, transhumanism lacks consideration of socioeconomic dynamics beyond the individual, for example in its pursuit of elimination of aging (Hayles 2011). Generally, the criticism tends to evolve around arguments which claim that transhumanism neglects the possible dangers and problems brought about by technological advancements and their projected application to humans, while other critics (e.g. Andrew Pickering) are worried about the transhumanist conception of what it is to be human.

Still, Hayles also agrees that it is primarily the transhumanists who are actively involved in the questions of technology and its co-evolution with human development and Andrew Pickering has claimed: "if transhumanism didn't exist, it would be necessary to invent it" (Pickering 2011, p. 189). It is clear that even if one does not agree with the transhumanists' approach, they make a crucial contribution to the current situation by debating with other researchers issues dealing with ethical, political, practical and philosophical aspects of practices in human enhancement.

IV.3 Human Enhancement in Art

The artist Marina Abramović's performance *Rhythm 2*, 1974, investigated whether a state of unconsciousness could be incorporated into a performance. In the first part of the performance, she took a pill prescribed for catatonia, a condition in which a person's muscles are immobilised and remain in a single position for hours at a time. Abramović's healthy body reacted violently to the drug, experiencing seizures and uncontrollable movements for the first half of the performance. While lacking any control over her bodily movements, her mind was lucid, and she observed what was occurring. Ten minutes after the effects of that drug had worn off, Abramović swallowed a pill for aggressive and depressed people that resulted in general immobility. Physically she was present, yet mentally she was completely removed.[82] This is an example of an artwork where artistic practice, which is using human body as an instrument, meets the practices of medical science. The human body is manipulated from within by taking a drug developed for medical use.

The last decade has seen a growing interest in the arts towards practices that are related to the sciences, scientific methods and themes. Artistic works in this area, often categorised as bioarts or art & science, have started to appropriate methods from sciences, such as tissue cultures, gene- and biotechnologies and processes of synthetic biology among others. A distinguishing feature of this kind of contemporary art is its exploration of the concepts of the natural and the artificial and its combination of organic and non-living matter. Curator Dmitry Bulatov sees in this kind of art a shift from interpretational practices to artistic strategies of "direct operational activity, where technology becomes immediately associated with the state of an organism" (Bulatov 2009, p. 015). This field also includes works that either take a more theoretical approach or address questions concerning the issues and impacts of developments in science through more traditional art disciplines. The projects cover a wide array of topics including works which focus on enhancement and future possibilities of the human.

[82] http://en.wikipedia.org/wiki/Marina_Abramovic/ [accessed 3.11.2011]

The performance and robotic artist Stelarc's[83] work is centred around the claim that the human body has become obsolete. His long career as an artist has been focused on extending the capacities and overcoming the limitations of a body, which is seen for example in his work the *Third Hand*, 1980 (Figure 28). The *Third Hand* is a robotic life-sized hand that is attached to Stelarc's right arm as an additional hand and the movements of which he can control through his abdominal muscles. "The Third Hand has come to stand for a body of work that explored intimate interface of technology and prosthetic augmentation- not as a replacement but rather as an addition to the body. A prosthesis not as a sign of lack, but rather a symptom of excess."[84]

28. Figure: Stelarc talking about the *Third Hand*. Photo © Markku Nousiainen, 2012.

In 2008 Stelarc began experimenting with the construction of an embedded ear on his left arm. The project *Ear on Arm* will contain (when fully finished) a miniature microphone placed inside this new ear. The microphone can hear the sounds in the close local environment and transmit them wirelessly to the Internet, making the ear into a

[83] http://stelarc.org/ [accessed 3.11.2011]
[84] http://stelarc.org/?catID=20265 [accessed 3.11.2011]

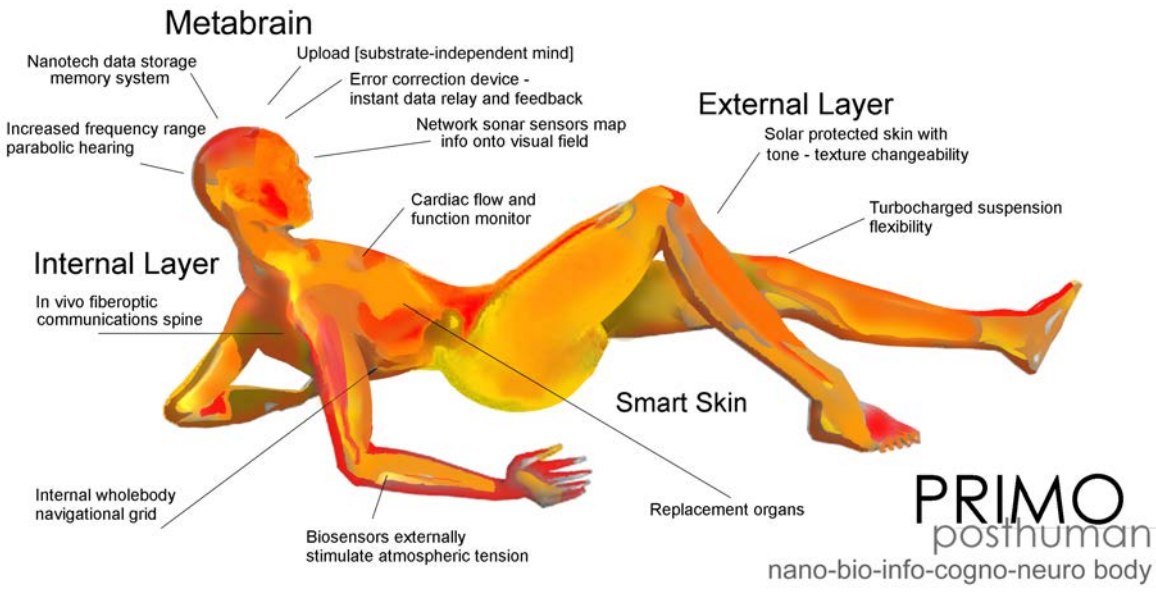
remote listening device for people in other places. Stelarc writes on his website: "This project has been about replicating a bodily structure, relocating it and now re-wiring it for alternate functions. It manifests both a desire to deconstruct our evolutionary architecture and to integrate microminiaturized electronics inside the body. We have evolved soft internal organs to better operate and interact with the world. Now we can engineer additional and external organs to better function in the technological and media terrain we now inhabit. It also sees the body as an extended operational system- extruding its awareness and experience."[85]

The self and the physical body have been long-term topics for the artist Orlan[86]. Her project *The Reincarnation of Saint-Orlan*, which was produced during the 1990s, used cosmetic surgery as a method for art. Several plastic surgery operations were carried out on Orlan's body, mainly to her face, through which the artist aimed at transforming herself into elements from famous paintings and sculptures of women. As a part of the project the surgeries were filmed and broadcast in various institutions worldwide. Additionally, Orlan had the surgery staff's costumes designed and made specifically for her surgery performances. Orlan has called her artistic practice a carnal art, which is defined on her website in a following way: "Carnal Art is self-portraiture in the classical sense, but realized through the possibility of technology. It swings between defiguration and refiguration. Its inscription in the flesh is a function of our age. The body has become a 'modified ready-made', no longer seen as the ideal it once represented; the body is not anymore this ideal ready-made it was satisfying to sign."[87]

In 2000, Natasha Vita-More[88] created the first version of the design for the *Primo Posthuman* (Figure 29), which became an evolving master plan for a future human and which saw an updated re-design in 2008. Vita-More, who is a transhumanist artist and thinker, has a

[85] http://stelarc.org/?catID=20265 [accessed 3.10.2011]
[86] http://www.orlan.net/ [accessed 3.9.2011]
[87] From Orlan's website: http://www.orlan.net/texts/ [accessed 3.9.2011]
[88] http://www.natasha.cc/ [accessed 3.9.2011]

long-term interest in body enhancement and radical life extension. According to her, the human is not adequately designed and sufficiently equipped to survive in the future, but our bodies require a radical redesign: "the physiological (cognitive and the somatic) state of human existence 'normality' ought to be a state of enhancement" (Vita-More 2009). While the concerns about ethics, individual's rights and control issues are some of the rudimentary questions being currently debated in the field of science and politics that concern body enhancement technologies, Vita-More is calling for artists and designers to take up the challenge to address these issues within the arts.[89]



29. Figure: *Primo Posthuman* by Natasha Vita-More, 2000-2008. Photo © Natasha Vita-More.

IV.3. 1. Human Enhancement by Wearable Technology

Although wearable technology artworks do not directly intervene with the organic body, their engagement with the human body is rooted in a similar idea of the possibilities of extending the human with new abilities and experiences.

[89] Natasha Vita-More is currently writing her dissertation on human enhancement and life expansion within the Planetary Collegium, Plymouth University. The areas of art which deal with human enhancement are e.g. bioart, art & science, robotics, media art and wearable technology art among others.

Many playful and smart experiments in combining textiles and garments with electronic components have been developed in the fields of fashion, textile and other arts & crafts. A close review of these works reveals that many of them are dealing with the enhancement of the existing human senses. These works typically construct what could be considered as a new sense organ, which is embedded into a garment. The sense organ is directed towards sensing the surrounding environment in a similar manner to the way in which humans sense the physical world around them. The detected aspects of the environment are transformed into playful visual signals on a garment, such as colour, light-pattern changes or audio signals, something a human sense can *read*. The detected data are mediated to human senses through a technologically constructed display. For example, detecting noise or air pollution levels, or the invisible presence of wireless networks.

In the work *Warning Signs*[90], by Nien Lam and Sue Ngo, air pollution is detected and translated into digital data, which is then subsequently connected to another medium that shows the data as visual signs. In this project, the combination of data and material is treated with a design perspective, making it visually intriguing (a T-shirt with a colour-changing lung-shaped pattern). A somewhat similar device has been developed by the company Sensaris, but with an engineering and commercialisation perspective.

[90] "*Warning Signs* is a visualization of the pollution that exists invisibly all around us. When the wearable device? senses carbon monoxide, the piece subtly changes color and pattern to indicate higher levels of carbon monoxide in the atmosphere to the wearer and those around him or her. The piece is designed to provoke conversation within its simple form and subtle reaction to the environment" [http://www.nienlam.com/2011/01/18/warning-signs/ [accessed 27.8.2011].

30. Figure: *Eco SensPod* by Sensaris, 2012. Photo © Sensaris.

The Eco SensPod's first version was worn on the wrist where it detected air quality and transfered the received data via Bluetooth to the user's mobile phone and then to a central server. The more recent versions (Figure 30) and the company's increasing variety of products collect many different kinds of data[91] and come in various forms. The difference between these two projects is that the *Warning Signs* clearly emphasises the material, aesthetic and emotional qualities, while the latter one emphasises the working functionality and the transfer of data. The core focus of these both devices is the human body exposed to environmental hazards, and its physical and cognitive limitations and specified functions that are to be enhanced. The approach towards the body is very practical and the application of technology is instrumental in it. Technology has a functional purpose through which it gains legitimacy.

As delineated in chapter III with a division of the field of wearable technology into various subsections, this dissertation focuses specifically on wearable technology artworks and

[91] http://sensarisupdated.bramblingdesign.com/ [accessed 15.4.2012]

approaches that seem to have a strong conceptual base instead of primacy for rationality and functionality.

Typically, in wearable technology artworks, the human and technology create a techno-organic entity, which is not based on representational qualities but on a concrete construction of an experience. The experience of wearable technology projects puts rigorous demands on the viewer, who is expected to wear the designed equipment[92]. These kinds of works do not follow the traditional division between the observer and the subject, but offer an immediate real-life experience, in which the user becomes a component in a techno-organic system. The author's project *Fruit Fly Farm*, 2006, includes a wearable, technologically networked fruit fly farm and a human as a single entity. In this work, the human experiences a co-presence with biological organisms and with other people within a *hybrid environment*, who can connect to the fruit fly farm via a mobile network. Presence and presentational qualities emerging from actual physical experience with the work are characteristic features of this and other wearable technology artworks.

Psychoplastics, 2010, by Stahl Stenslie[93] is an example of a wearable technology work which plays with the idea of tactile presence versus physical presence. In this work, a human is able to sense the presence of invisible sculptures in physical locations with the help of a lightweight tactile bodysuit. In other words, the suit is sensing the geo-positioned sculptures through geo-located data. The work is created specifically for the networked *hybrid environment* where the aspect of presence can have multiple meanings and connotations.

The author's project *Heart Donor*, 2007 (Figure 31), deals with the idea of presence in a techno-organic *hybrid environment*. The project takes its point of departure by rejecting the differentiation of virtual (technological) and physical layers of the world. The *Heart Donor* apparel -a vest resembling of life vest- is specifically constructed as an apparatus addressing our life in the *hybrid environment*. As concretely constructed apparel, *Heart Donor* encapsulates the

[92] E.g. the author's projects are meant for general public use.
[93] http://www.stenslie.net/?page_id=477 [accessed 4.7.2011]

user's body and locates him or her within the *hybrid environment*, where he or she can follow the presence of a selected network of individuals switching back and forth between the physical world and the *hybrid environment*. The *Heart-Donor* work is founded on the basis of the creation of emotional effects. It references the common habit of carrying passport-sized photos of close persons. The user of the *Heart-Donor* can collect 30 recordings of the heartbeats of friends and family as personal mementoes in the vest. Each recorded heartbeat will make a light, which is embedded on the vest, blink to the rhythm of the recording.

The project was carried out at the time when internet-based social media were becoming everyday practice and Skype[94] had become one of the most popular applications. The *Heart Donor* was focused on the question of one's presence in virtual and physical realities. If a person submitted his Skype name when recording the heartbeat, the *Heart Donor* vest could detect in real-time if this person is on Skype. The presence of individuals in the physical and *hybrid environment* is seen in changes of the colour of the blinking light. The wearer of the *Heart Donor* vest can observe people shifting their presence between the physical and virtual layers of the world independent of their geographical location, but the user of the *Heart Donor* vest resides continuously within the *hybrid environment*, where he not only becomes an observer of the techno-organic constellation of the world, but a part of it.

31. Figure: *Heart-Donor* by Beloff & Berger with Mitrunen, 2007. Photos © Anu Akkanen, Laura Beloff.

[94] Skype's first public beta-version was released in autumn 2003. [http://en.wikipedia.org/wiki/Skype]

Art that employs digital information technology has been described as immaterial and disembodied[95]. This claim has its roots in the early Artificial Life experiments that were based on complex algorithms that simulated the processes of life on a computer, and which have been of interest to scientists and artists researching and utilising digital media. When one carries out a broader examination of the field of new media art, it shows that current art using information technologies is often actually seeking to (re)connect to physical materials and body, to life and living. This is visible, for example, in many tactile or gestural interfaces and in works that incorporate the organic body and the environment into the work.

Wearable technology artworks are based on a combination of material and immaterial qualities and organic and artificial materials, which together form an active entity. This entity extends beyond the traditional physical dimensions of art objects by requiring the active participation of the audience (as wearers of the work) and occasionally by being located within everyday life. Wearable technology projects that are networked expand their material limits by positioning themselves in a *hybrid environment*.

On the level of practical experimentation, these works tackle questions of the future and the development of the human species, notably what it means to be a human in a techno-organic world. It appears that many works emerging from the field of art & design succeed in contemplating these challenging questions at a deep and rigorous conceptual level, regardless of whether they reach a professional level of technological sophistication. In the background of these projects are strong culturally influenced motivations intermingling with physiological and biological bases and needs. The questions concerning appearances, identity, the body and its extensions, potential body modifications, and about the future of the human are concretely investigated in the experimental works emerging within art and design disciplines. This kind of art no longer represents the world, but proposes and constructs the world, which is becoming increasingly techno-organic.

[95] This aspect is investigated in: Krysa, J. (2006) (ed). Curating Immateriality: The Work of a Curator in the Age of Networked Systems. DATA browser 03. Plymouth, Autonomedia, and: Munster, A. (2006), Materializing new media: embodiment in information aesthetics, Hanover Dartmouth College Press.

V. The Hybronaut

"As the tools and ideas of our art continue to evolve, so too shall we"[96]

(Vita-More [1983] 2003).

Wearable technology works are fundamentally concerned with the human and the development of the human intertwined with technology and impacted upon by advancements in sciences. Some of the works in the field also imply strong conceptual concerns, dealing with a kind of mental and practical extension of the human rather than an enhancement of existing properties. Here with the term *enhancement* the author is referring to existing human properties that are improved, whereas the term *extension* (of a human) is referencing a whole new dimension that is added to human abilities.

However, the various projects in the field of wearable technology, as well as the author's research, address directly or indirectly the future of the human species. This chapter introduces the author's concept of the *Hybronaut* in detail, as a developed networked figure and a concept within this practice-based research.

Etymology of the Hybronaut:

The term Hybronaut is coined from two words: hybrid + nautes; sailor. The term hybrid references a thing made from two different elements (Oxford Dictionary). For example a wearable device combined with a human, as in the Hybronaut. In the context of the Hybronaut, hybrid also references the hybrid environment, which is a crucial part of the Hybronaut concept. Nautes is referenced to naval by the Online Etymology Dictionary[97]*, as in astronaut or cosmonaut. Naval is from Latin navalis meaning*

[96] http://www.transhumanist.biz/transhumanistartsmanifesto.htm [accessed 15.6.2011]

[97] http://www.etymonline.com [accessed 13.3.2012]

'pertaining to a ship or ships'[98]*. Concerning the Hybronaut, it can be understood as an exploration vehicle. (The author 2012)*

V.1. A Concept and A Figure

The author's research concept, the *Hybronaut*, concentrates on examining possibilities of perceiving connectedness as a new faculty of a human body. The *Hybronaut* is an artistic experiment, realised through wearable technology equipment based on the merger of physical and virtual, organic and artificial. It investigates a techno-organic entity that combines human and technology located within the *hybrid environment*.

The *Hybronaut* emerged during the research. It was developed as a practice-led research vehicle connected to the author's artistic production. One of the initial reasons for its development was the necessity to combine the user and wearable equipment as a single entity and also as a single term, which would make it possible to focus on the situation between the constructed *Hybronaut* and the world, rather than investigating the user and the device separately. This approach sets the author's research apart from general research approaches in wearable technology, which typically concentrate on the relationship and interaction between a user and a wearable device[99].

The *Hybronaut* enables first-hand experience within the *hybrid environment* via the use of physically constructed wearable equipment that is made available for public use. This equipment enables a user to become the *Hybronaut* and explore the potentiality of the *hybrid environment* from the *Hybronaut*'s perspective. The *Hybronaut* is comparable to the figure of *flâneur*[100], whose

[98] http://oxforddictionaries.com/ [accessed 13.3.2012]

[99] This is visible, for example, in the papers: (Hasan & Hossein 2010), (Wilde 2011) or in the focus of research institutes: Wearable Technology Research Centre, University of Wales Newport (UK) http://www.newport.ac.uk/research/ResearchGroups/scwt/ , Hexagram (CA) based Studio subTela http://subtela.hexagram.ca/ and XS Labs http://www.xslabs.net/ [accessed 15.3.2012]

[100] Charles Baudelaire developed a derived meaning of flâneur—that of "a person who walks the city in order to experience it". A flâneur is a detached pedestrian observer of a metropolis, a 'gentleman stroller of city streets', first identified by Charles Baudelaire. The concept of the flâneur is important in the work of Walter Benjamin, in academic discussions on modernity, and has also become meaningful concept in architecture and urban planning. http://en.wikipedia.org/wiki/Flaneur [accessed 15.3.2012]

emergence was influenced by the changes in the surrounding environment, e.g. the material circumstances of the city. The flâneur is a concept firmly connected to the environment of a modern city, which the flâneur observes (Benjamin 1999). In a similar way, the *Hybronaut* is tied to his *hybrid environment* and influenced by its circumstances. The figure of the *Hybronaut* has emerged due to the technological development of wireless and mobile networks.

Researchers Timo Kopomaa and Anthony Townsend have articulated the occurrence of individual private spaces, which are formed by the connectedness enabled by mobile devices (Kopomaa 2002; Townsend 2001). Currently, these individual and invisible spaces become noticeable mainly when we are using mobile devices to perform predefined tasks, which the design of the devices allows us to do. At other times, the existence of our technologically networked world is largely imperceptible. The connection to this parallel *spatial* layer of the physical world is established and broken through a task-oriented use of the devices.

In comparison to the typical uses of wireless networked technology in mobile devices, the *Hybronaut* offers an alternative perspective into networked and wearable technology. The *Hybronaut* is only able to exist and emerge within a continuously connected world, within a *hybrid environment*. His equipment is specifically constructed for exploring, experiencing and observing the *hybrid environment* rather than being merely a tool for performing certain tasks.

An essential part of the *Hybronaut* is the actual wearable device, which is typically based on easily available technology, but differs in its use and connections from commercial applications employing similar technologies. The *Hybronaut* equipment is designed with a strong aesthetic appearance, which raises curiosity and fosters interaction and communication with the general public. One could claim that the *Hybronaut* is a user turned into a performer, who carries his own connected world with him and points his private explorations out to the public within a *hybrid environment*.

32. Figure: *Heart-Donor* by Beloff & Berger with Mitrunen , 2007. Photos © Anu Akkanen, Laura Beloff.

The *Hybronaut* is not founded on a goal-oriented trajectory with one clearly defined aim, even if all the individually constructed wearable devices (the equipment for the *Hybronaut*) have their own specific concepts. These series of devices enable the *Hybronaut* to experiment, observe and speculate: what will happen, what kinds of experiences are being formed and what unpredictable potential these situations offer. The *Hybronaut* is constructed concretely to experiment with situations in which technology has become inseparable from us and our environment. Through the emphasis on *being* rather than *doing*, the *Hybronaut* points to a way in which technology is commonly understood from a very instrumental perspective; it challenges the approaches which focus primarily on purposeful functionality. The *Hybronaut* pushes forward questions on the development of the human and proposes more speculative and conceptual, rather than purposeful and functional, ideas.

V.1.1. Open Experiments

Katherine Hayles's idea of a posthuman is the virtuality of disembodied information that can evolve separately from matter within a changeable environment as explained in the chapter IV.2.5. However, the recent development in the field of wearable technology seems to

strongly suggest that there is meaning and purpose in bodily matter as well as in its relation to the organism's substrate. This approach calls for the inclusion of a sentient body in the image of the future human. In wearable technology projects, the relationship between the physical environment and a bodily being is the foundation of a meaningful experience- although this experience is increasingly mediated through technology, and the organic body is increasingly enhanced or extended with technological features, as well as the fact that the environment has been transformed into a *hybrid environment*.

The experiments that are carried out with the help of the *Hybronaut* are based on conceptual ideas. They form mental and conceptual models, which provide opportunities to investigate these situations and their possibilities. Three of the experiments form the practice-based part of this dissertation; the *Heart-Donor*, the *Empty Space* and the *Appendix*, that are all introduced in detail in section VII[101]. As concrete and materially constructed situations they provide mental space for users, in which it is possible to gradually adapt to new possibilities, requirements and future changes. In a sense, the *Hybronaut* and the created situations can be seen as open experiments, kinds of prototypes and rehearsals for possible future circumstances.

The project *Appendix*, 2011 (Figures 33,34), by the author, is a wearable, networked tail for a human body (the *Hybronaut*). Conventionally, the appendix organ that is within the human body has been regarded as a potentially troublesome, redundant organ without any beneficial factors. However, some scientists believe that the appendix is a site for beneficial bacteria to localise in, as a reserve, in the event of disorders caused by harmful bacteria. This function is nevertheless still under debate, due to the fact that humans who have their appendix removed appear to carry on with life without it causing problems.

[101] The full scale of wearable technology art works by the author is provided as an appendix.

33. Figure: *Appendix* 2011. Photo © 2011, Laura Beloff.

Central to the author's constructed *Appendix* tail are the relationships between: the body and technology, and the human and his surrounding environment. These are elements which are increasingly based on technological or artificially created features and connections.

Similarly to the way in which the function of the inner appendix organ is not fully comprehended in science, the functional purpose of the *Appendix* tail is purposely left open. Rather than aiming to be an enhanced function or ability of a human, the work creates a situation which attaches the user (the *Hybronaut*) to a network within *hybrid environment*. The work presents an aesthetic experiment in which it is not known beforehand what the benefit is or what kind of experience it will create. Even though the structure of the work is based on technology, it purposely lacks an instrumental technological use as a means for achieving a predefined goal. This feature also points to an intended use of irony in the work. Instead of providing the users and viewers with easily understandable remarks and answers, the work aims at proposing questions and testing new possibilities.

In parallel to its physical existence, the *Appendix* extends the *Hybronaut* with an invisible *tail* of relations. These relations are impacting upon his evolving worldview and defining his identity(ies). The work *Appendix* highlights the humans' dependency on and connectedness to things, nature, other people and various systems. It presupposes that many of the connections with various human, non-human, artificial and organic entities will be increasingly (re)constructed and modified by technology in the future.[102]

The Appendix is an open artistic experiment that investigates a situation without a predefined single goal, but aims at creating an experience that can potentially reveal new insights into the future circumstances of a human.

[102] The *Appendix* is constructed as a robotic tail, which is connected to a network. While in use the *Appendix* tail becomes a (new) body part of a wearer; a technological limb the movement of which is controlled by several networked systems: The current version (the first version) of the tail has two real-world data connections:

- Connection to nature phenomenon; the tail is receiving real-time data regarding the wave height of the sea, which is visible on the tail as an upward movement.
- Connection to a system; the tail is following the real-time data of a city public transport system and signals with a specific gesture the current/real-time direction of a tram.

These kinds of artistic experiments, like the Appendix, are comparable to scientific work and approaches. However the difference is that instead of aiming at attesting solely to verified facts and demonstrating genuine evidence, like is often expected of science experiments, this kind of art speculates on various aspects and perspectives, generating different, novel questions about them. Roy Ascott has remarked on the difference between art and science in an interview; that often science proceeds only where funding allows, but art has the potential to break away from this box[103]. In the best scenario, both science and art experiments involve the idea of exploring the unknown.

Scientists Sandberg and Boström give the interesting example of Steve Haworth, who inserted a small magnet into his fingertip, making him able to sense magnetic fields due to their effect on the magnet in his finger. "The result was an extended perception of magnetic fields in the environment. Static fields were experienced as pressures while oscillating fields such as from electric motors were more noticeable vibrating sensations. Although intended more as a conceptual tool than a useful enhancement it demonstrates an entirely new sense" (Sandberg & Boström, 2006). Interestingly, there was no knowledge or expectations that this would happen before the experiment was conducted; no human had a magnetic sense before Haworth implanted the magnet into his finger. The experiment originated without any specified scientific or other question to answer; it was carried out in order to see if there would be any effect and if any, what kind of experience it would produce. The completed experiment created a situation which had the potential to reveal new phenomena. Similarly, the *Hybronaut* creates situations that can potentially reveal something new and unexpected, either mentally or physically, from the experiences they offer.

[103] http://dotsub.com/view/50e1a634-0e92-42be-8f38-52182a97ba2e [last accessed 12.6.2011]

34. Figure: *Appendix* 2011. Photo © Laura Beloff.

V.2. Experience in Art

Lygia Clark's artwork *The I and the You* consists of two full-body overalls, one for a man and one for a woman, with large hoods covering the wearers' eyes. The wearers of the suits are expected to examine the pockets and openings of the other one, in order to discover one's own sex in the other (Brett 1994).

Brazilian artist Lygia Clark's[104] works from the late 1960s are examples of an approach in art to sensorial experiences that are centred around the body. The *Nostalgia of the Body* series consists of goggles (Figure 35), masks, gloves hoods and suits that are meant to be used by the participating viewer. Clark's series of goggles are designed to be used by one person or in a dialogue by two persons. The goggles contain small mobile mirrors, which are attached in front of the eyes. These mirrors can be turned individually to reflect the surrounding world or the user's own eyes, or be positioned horizontally to reveal the eyes of the other person, in a variety of combinations. In Clark's work the emphasis is given to the users' participation, perception and the experience, which is produced and manipulated by the wearable artefact. The works are supposed to be "lived" by the participant, not performed or simply looked at (Brett 1994). In a

[104] http://www.lygiaclark.org.br [accessed 31.10.2011]

sense, the artefact itself was left in a secondary role. “Clark's apparently simple creations are, in fact, demanding propositions that ask viewers to infuse the work with their lives and energy. Clark was never concerned with self-expression in art, but instead with the possibility of self-discovery, experimentation, invention and transformation” (Osthoff 1997, p. 283). Even if Clark’s works are non-technological, they nevertheless address many issues currently present in interactive media and participatory art practices, as is pointed out by Osthoff (Osthoff 1997). The meaning of the wearable works by Clark is not in the artefact itself, but in the experience they produce. These art objects go beyond the traditional context of a museum into the environment and everyday life and give importance to an experience which is lived.

35. Figure: *Dialogue goggles*, 1968, by Lygia Clark. Photo © Laura Beloff.

Lygia Clark's works' obvious resistance to becoming main-stream art commodities locate the meaning of her works in the *experience* produced for the users through their participatory nature, that goes beyond the more passive act of looking at an object of art. One can say that in particular, artworks that require the public's participation are often very concretely founded on an idea of an experience. There is a very different relationship in action between the viewers of traditional representational art and the users of works that require participation.

The works in the field of wearable technology do not settle for representing the ideas and concepts on paper, but are realised as actual wearable artefacts to be physically tested and used. The requirement of *use* steers the focus of the works on the production of experience, which is initiated and also directed by the design and functionality of the wearable artefacts. In this experience, the human user is both a subject that experiences the world and an (art) object to be perceived in this world.

36. Figure: *Tuneable Touch*[105] by Ebru Kurbak, 2011. Photo © Martin DiCicco.

[105] *Tunable Touch* (Figure 36) enables one to sense physically the invisible milieu based on electromagnetic waves and feel the imperceptible outlines of electronic objects.

V.2.1. User Experience

In wearable technology research the focus is often located in the relationship between the user and the wearable device. This emphasis stems from the tradition of the human-computer interface (HCI) design, which has specifically concentrated on the relationship between the user and the device, on usability studies, and recently also on the production of smooth and intuitive user experience (UX) through a technological device. Marc Hasselzahl argues that the recent focus on user experience (UX) shifts the attention from product and material level development to humans and feelings; to the subjective side of product use (Hasselzahl 2008). Yet, the focus is almost exclusively on the relationship and interaction between the product and the user. Rarely is this situation looked at as a relationship between a user and the surrounding world.

The author's wearable technology artworks differ from the common approach by concentrating on the user-world relationship rather than on the user-device relationship. In this approach, the wearable device and its user are considered as a merged entity. The user's formation of the subjective *Umwelt* becomes the core concept; how a user's perception of the world is formed and influenced by his enhanced techno-organic abilities. The idea of user experience (UX) is still present in these approaches even if the focus is directed to a different relationship. Yet, it is important to remember that the wearable technological artefact, which is intertwined with the situation, can only initiate, support and impact an experience, because, after all, it is up to the users to allow experiences to take place. Rather than aiming at producing single detailed functions, these works aim at a more holistic experience of being in the world, and at bringing forth a fresh different perspective on the situation.

V.2.2 Art as Experience

By definition, an experience is an event or occurrence that leaves an impression on someone and often leads to an accumulation of knowledge[106]. This dissertation follows the

[106] http://www.thefreedictionary.com/experience

pragmatist philosopher John Dewey's perspective of art as an engine for an experience, the premise for which is a relationship between an organism and its environment.

Dewey saw life as going on in an environment and through interaction with it. "Experience occurs continuously, because the interaction of live creature and environing conditions is involved in the very process of living" (Dewey 1934, p. 35). Dewey called for art that was part of the process of living and based on an experience, instead of having art isolated from the rest of living. Dewey claims that: "Instead of signifying being shut up within one's own private feelings and sensations, it [experience] signifies active and alert commerce with the world; at its height it signifies complete interpenetration of self and the world of objects and events" (Dewey 1934, p.19). According to Dewey, the live creature uses its organs to interact with its environment through trial and error in order to overcome possible resistance. This kind of experience is both mental and physical activity that is caused by events and things developing in the context of the live creature. The creature itself is also affected by this interaction with an environment.

Dewey mainly investigated traditional arts, in which he distinguished between a physical, potential object and art, which he called *the art product* and *the actual work of art* that is active and experienced, and refers to what the product does with experience (Dewey 1934). As Dewey perceived experience within everyday life and its circumstances, he found the *art for art's sake* perspective and the relegation of art into museums problematic, because they separated art from normal everyday life experiences.

Richard Shusterman argues that Dewey's most important aesthetic theme was possibly "the privileging of dynamic aesthetic experience over the fixed material object which our conventional thinking identifies - and then commodifies and fetishises - as the work of art" (Shusterman 1992, p. 25). According to Shusterman, Dewey saw the value and meaning of art in the dynamic and experiential activity through which they are created and perceived instead of valuing them solely as material artefacts. However, Dewey also insisted on the importance of material objects in art, which he saw as unavoidable in guiding and structuring the production of aesthetic experience. In

a sense, Dewey saw art as instrumental in "improving our immediate experience through socio-cultural transformation where art would be richer and more satisfying to more people, because it would be closer to their most vital interests and better integrated into their lives" (Shusterman 1992, p. 19).

Specifically, the Deweyan message of art being essentially a process, the value and meaning of which lies in the produced experience, is strongly present in wearable technology art and in the works by the author such as the Appendix described in the previous chapter V.I.I. The wearable nature of the equipment locates it within an intimate vicinity to the user's body, which enables it to become part of the user and connected to his immediate physical realm. This kind of constructed relationship between *a user–a wearable object–the world* impacts upon the self-image of a user, as well as his perception of the world in the ongoing situation.

37. Figure: *Der Ton-Anzug* by Bernhard Leitner, 1975. Photo © Laura Beloff.

An early example of wearable technology art that embeds the whole body into an experiential situation is e.g. Bernhard Leitner's *Der Ton-Anzug*[107], the *Sound-Suit*, from 1975 (Figure 37), which was a full-body overall with the possibility of attaching a loudspeaker for acoustic stimulation on any point of the body. The composition of the sounds moving around the body between separate loudspeakers, which are worn directly on the body and which face the body, create a spatial, sensitive sound sculpture. In this work, sound waves are designed to influence the vegetative nervous system of the user through the strategically located loudspeakers, allowing it to become a whole body experience. "The passive viewer becomes an individual agent in the artistic process, an element that is inseparable from the artwork in that his or her role as the beholding subject shifts to that of the object beheld" (Liewehr 2011). Leitner proposes that hearing is not solely the task of a person's ears, but that a whole body can be an acoustic sensorium. "Haptic acoustics play a major role in my work. The ear is a miracle, but we also hear with the skin, with the bones, with the bone innards, the hard plated of the skeletal structure, with membranes, hollows and channels. Being bodily touched by the physical pressure of sound waves and reverberations through the body is a quintessential part of hearing" (Fricke & Leitner 2008, p. 170). Leitner's decades long work with sound and space are expanding the conventional modes of hearing and perceiving sound and space. The artwork *Sound-Suit*, 1975, was, first and foremost, created as an experience for a human body within an acoustic-based environment.

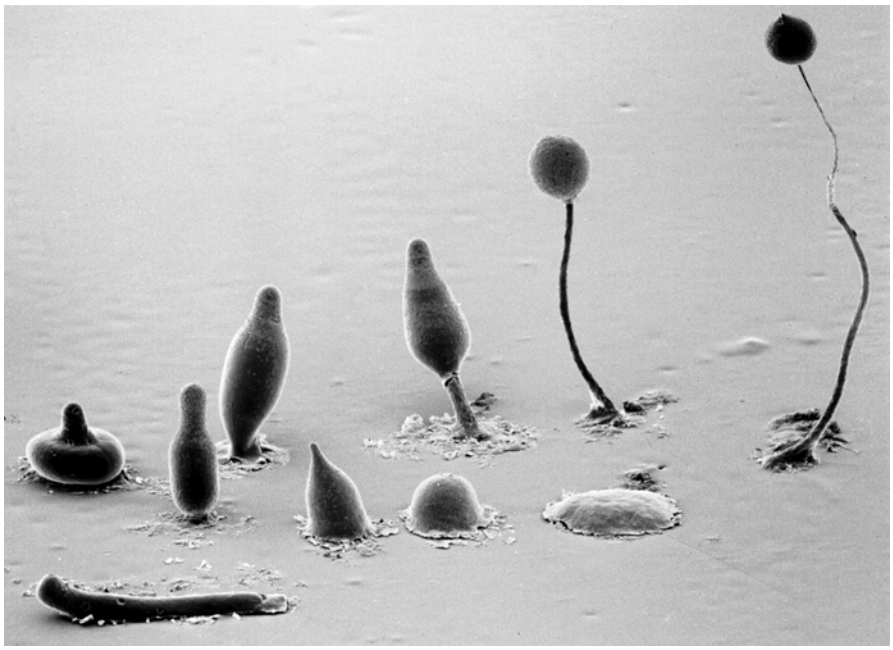
The meaning of this kind of experiential art, which is based on the construction of a situation or potential, emerges from the produced experience through the thoughts and associations evoked by it. When the work is successful, it generates new ideas and possibilities to see a human, a self and one's relationship with the world from a new perspective. Typically in these kinds of works, the literal, fixed meaning of the artwork is left open; they offer a contingency for a subjective experience and personal interpretation, but they also open up potentiality for something new to be discovered, which may reveal directions for further development. In other words, these kinds of artworks are initiators of new possibilities and

[107] http://www.bernhardleitner.at/works [accessed 10.10.2011]

thoughts that are specifically based on empirical research, in which a physical experience is a consequential factor.

The *Hybronaut's* equipment is based on concrete experience with technological, wearable equipment in the aim of investigating possibilities of the constructed situation. Additionally, these situations which are initiated by the *Hybronaut's* equipment, utilise irony as a way to produce a situation that has no one single correct interpretation and perspective, but one that opens up potentiality for various diverse interpretations.

V.3. Identity



38. Figure: Dictyostelium. Photo © M.J. Grimson & R.L. Blanton; Biological Sciences Electron Microscopy Laboratory, Texas Tech University.

Straddling the relation between individual and collective on a microscopic scale is the amoeba Dictyostelium (Figure 38). An interesting aspect is its formation into an aggregate during times of starvation. A Dictyostelium grows as an individual single-celled organism in which there is no apparent difference among cells. But in times of starvation, it interacts to form multicellular structures. The cells signal to each other by releasing a chemoattractant that directs their movement to form an aggregate, surrounded by an extracellular matrix. The aggregation creates

a differential environment for the cells and subsequent cell differentiation. The multicellular organism formed in this way is capable of producing fruiting bodies and spores, as well as of migrating to a place with more food where new spores can germinate[108].

Evelyn Fox Keller describes this faculty of Dictyostelium as follows: "On the one hand, here is a single-celled organism, existing in a population of apparently identical organisms, and on the other hand, it is a part of a differentiated organism assuming a particular role and structure in the larger entity, the multicellular organism. Here is an object that traffics back and forth between the one and the many and between sameness and difference" (Keller 2007, p. 298). The Dictyostelium is a living organism, which is not a fixed and stable entity, but changes back and forth between growing as a single-cell to an aggregated multi-cell organism[109].

In reference to Dictyostelium, the *Hybronaut* can be metaphorically seen both as a single cell entity and as a part of a multi-celled structure. When looking through the *Hybronaut*'s subjective *Umwelt*, he is the individual centre point from which various connections and relations emanate, but when looking from the opposite direction, the *Hybronaut* is seen simply as a single node in a large networked aggregate. This network can consist of humans, but potentially also non-humans. For example, in the author's work the Appendix, the network is includes solely non-humans. Even if the *Hybronaut* subjectively selects his network of connections and relations, he is also affected and directed by a structure and events within the network he is part of. Rather than performing, or presenting, an identity in a traditional sense, the *Hybronaut* performs a kind of connectivity, in which the self emerges from various relationships with the world.

Our time is characterised by possibilities, but also by demands, for multiple identities in complex reality, which includes physical reality and various technologically enabled virtual

[108] http://dictybase.org/tutorial/ [accessed 10.11.2011]

[109] An example of technological *aggregate* structure is wireless and mobile ad-hoc networks, which grow and shrink according to the people connected to them. Ad-hoc networks do not rely on pre-existing infrastructure, but are created dynamically on the basis of each connected device functioning as a node, which route the information traffic forward. An art & design project Umbrella.net explores the potential of ad-hoc networks for causing sudden, striking, and unexpected connections between people in a public and urban space. It examines how the chance of rain can act as an impetus for a formation of an ad-hoc network. When (custom-made) umbrellas are opened in a public space, an ad-hoc network is formed between them and when an umbrella is closed, it is also disconnected from the network. Collaboration with Katherine Moriwaki, Ken Greene, Linda Doyle, Stephen Hughes, Ronan Coyle. http://www.coin-operated.com/coinop29/2010/05/04/umbrella-net-2004/ [accessed 18.11.2011]

environments. Each context and each different environment defines one's immediate identity and one's performance of self, in that situation. When our perception of identity and the relationship to the world shifts we need to create new stories and theories, which challenge the existing ones. A networked human in this dissertation is understood as an entity which is constructed of physical, social, technological and other relations formed in the *hybrid environment*. The *Hybronaut* proposes a state of human whose existence and identity are deeply intertwined with his networked *hybrid environment*. It suggests a perception of human as a system, which breaks away from understanding a human as a clearly framed whole entity with borders.

V.3.1. Performance of the Self

We all perform ourselves to others in order to establish an identity via social interaction according to Erwin Goffman's seminal research on performance of the self in everyday life (Goffman 1959). Goffman sees our daily routines as performances, which are acted out in order to create impressions about the actor and his intentions for those observing the performance. Goffman investigates our everyday life, where performers are not necessarily aware of their performance-like acts but see it as reality, in comparison e.g. to theatre, where the performance is framed within a setting that distinguishes it from other life. Goffman claims that almost all of our social interaction with others is based on performances where one presents oneself in the role expected by the audience. The role of the performer is communicated and enforced by a variety of means, such as behaviour and carefully selected props: appearance, clothing, signs of profession, home, etc. The performances are commonly moulded to fit the expectations and understanding of the audience to which it is presented. This influences the tendency of a performer to offer idealised impressions, which reaffirm the existing values of the community (Goffman 1959). These everyday performances are part of the process of identity construction; what kind of impression we give to others of ourselves. The performance of self always needs an

audience, in other words, these performances always take place in relation to others, whose presence will also affect the performance.

Goffman's notion of performance of self has a clear correlation with personal impression management in various social media forums and other online communities, where a lot of the activity is focused on identity construction through various settings or props; designed appearances in simulated metaverse worlds, and uploaded images and updated status comments on social media platforms. The selection, or gathering, of friends into one's network is one primary feature of current social media applications. This circle of friends, who they are and how many they are, forms one's image, status and public identity to others. The performance of self on social media platforms is completely based on one's network of relationships that also functions as the audience for one's performances. Life is a performance of one's self, as Goffman claims (Goffman 1959), but in the case of social media, the performers are fully aware of their actions and the impressions they want to give others. Social media have become a new stage for one's performances.

There are still only a few examples of combining wearable technology with online social media applications. The author's work *Heart-Donor* from 2007 (described in detail in the chapter VII), is possibly the first developed artwork aiming in this direction. The commonly perceived separation of virtual reality and online forums from one's physical reality gets complicated with wearable technology, which merges them into one entity. Wearable technology situates one's public performances into the *hybrid environment* where the potential audience can be virtually or physically present.

Wearable technology, especially when it is constructed to be physically visible is amplifying the performance in the physical realm. Often, the self is performed in conjunction with new inventions and the latest technology, which in turn can be seen as a manifest for progress and humanity's possibility to develop.

An interesting historical example is C. P. Stirn's Concealed Vest camera, which became a commercial success soon after becoming available in 1886[110]. The camera was specifically designed to be disguised or embedded into clothing. It was round and flat in shape to fit unobtrusively inside the front of a jacket, with only the lens looking out from the buttonhole. One can only speculate on the motivations behind the concealed nature of this wearable technology; whether it was designed to be hidden because of social pressure from the community that opposed photography as public practice, or if its concealed nature was induced with popular interest in becoming a self-appointed detective[111], and was the actual appearance of this device triggered by the desire to physically enhance the abilities of a human with technology?

In wearable technology artworks the idea of a performance is often in the forefront. These performances are not necessarily constructed in a similar manner as Goffman described in performance of self (Goffman 1959), but self becomes an unavoidable part of the performance. The visually distinctive wearable works are typically conveying an idea or a message, which is impacting the identity of the user. This is also true in the case of the *Hybronaut*. The *Hybronaut* equipment impacts the user's self-image and identity through their playful and visual aesthetics. At the same time the user is demanded to adapt to his new aesthetical and technological features and offered a possibility to discover new aspects about oneself and ones' relation to the surrounding environment in this experimental situation.

Self and identity are in the focus of the artwork The Mouthpiece (Porte-Parole), 1993, by Wodizcko, which is an instrument designed for immigrants. The wearable device covers the wearer's mouth with a small monitor and loudspeakers and it replaces the immigrant's actual act of speech with an audiovisual broadcast of pre-recorded, edited and electronically perfected statements, questions, answers, which are acted out by the immigrant's mouth and voice.

[110] http://historiccamera.com/cgi-bin/librarium/pm.cgi?action=display&login=vestcam [accessed 4.3.2012], http://camerapedia.wikia.com/wiki/Stirn_Concealed_Vest_Camera [last time accessed 4.3.2012]

[111] Anna Novakov writes about the miniaturized and concealed detective cameras of the 1870s. These cameras were meant for flâneurs and self-assigned detectives in the city to secretly take pictures as evidence that could be scientifically evaluated later (Novakov 1998).

Wodiczko claims that the immigrant appears as a poetic interrupter of established life in a public space and the dominant culture. The immigrant is equipped to speak better than others who have yet to overcome speechlessness in their encounter with strangers. "Strangers in their relation to the self and to the non-stranger (as well as to other strangers) need a thing-in-between, an equipment-artifice that will open up discussion and allow them to reveal and to share (communicate) their experiences, identities, visions, and unique strangenesses" (Wodiczko 1997, p. 13). In this work an object is used for supporting the performance of the self in a challenging situation.

Towards similar direction of observations, John Law suggests that almost all of our interactions with other people are mediated through some kind of object. Communication between people, for instance, may be mediated by a network of objects; the computer, the paper, the printing press, or by a network of objects-and-people, such as the postal system[112]. Law argues that these various kinds of networks contribute to shape the social. Law continues his argument by claiming that "what counts as a person is an effect generated by a network of heterogeneous, interacting, materials" (Law 2003, p. 383).

An example of this is Liv, who is a physically disabled person living in a house designed for disabled people. Liv is able to function in her everyday life in a wheelchair by controlling her technologically enhanced environment through a physical device embedded into the chair. It moves her around, opens doors, and controls a TV and a radio among other tasks. Liv's physical prosthesis functions as an extension of her physical abilities. According to Moser & Law, Liv is a cyborg, but not solely because of her deeply intertwined human-machine relationship, but because she is irreducible to a unity. "Liv is made, created, within an economy of non-coherence, a heterogeneous economy, an economy that cannot be told and performed in one place at one time" (Moser & Law 1999, p. 215).

[112] John Law is one of the founders of actor network theory, along with Bruno Latour and Michel Callon. Even though some of their formulations relate to the way the author considers certain aspects of the concept of network, the author is not aiming at locating this research within or parallel to actor network theory.

One can draw the following conclusion from Moser's research; an individual should not be perceived as a unity, but as a composite of parts that bear some kind of relation to one another. The heterogeneous network of various elements, one's actions in this network and one's abilities to act, determine one's identity. This is manifested in the *Hybronaut*, in the complexity of constructed elements and emerging connections.

Goffman articulated the performance of the self concerning an individual within one's social, physical environment. The *Hybronaut* further complicates this perspective by including in it an individual who is extended with new technological faculties, which also enable one's presence in hybrid environment. The self is formed in a complex network of things, humans and relations and it is performed within multiple stages of hybrid environment.

V.3.1.1. On Style

Goffman has claimed that *performance of self* commonly follows the expectations of the audience and reaffirms their existing values. This is visible e.g. in connection to various music genres, according to Dick Hebdige, such as punk style, specific in how it subverted the roles of ordinary everyday objects through use of them in incompatible ways. "Safety pins were taken out of their domestic 'utility' context and worn as gruesome ornaments through the cheek, ear or lip" (Hebdige 1983, p. 107). Punk garments and decorations offered "self-conscious commentaries on the notions of modernity and taste" (Hebdige 1983, p. 107). Typically, specific signs or objects, such as safety pins, are appropriated by the whole group. They become meaningful through this appropriation, which forms a kind of unity within the group and reflects the central values shared by the group. The style can be conservative or progressive according to Hebdige, through the constructed style the members of a group integrate themselves with the values of the community or, alternatively, they define themselves against prevailing *parent culture* (Hebdige 1983). Hebdige's research shows how visual appearance can convey a message and how it can be used as a

strategy to oppose prevalent values. The style becomes part of the identity of the wearers, through which they non-verbally signal political, ideological or other beliefs to the others.

Wearable technology has at least two distinctive types of projects; those which aim at the invisible and intuitive integration of the user and device - seen as the current parent culture, and projects which clearly oppose the invisibility and functionality proposed by the parent culture - challenging the existing values and expectations in the field through their employment of a progressive style. The author's artistic works presented here fall into the latter category. These wearable technology art works juxtapose unexpected elements in an attempt to disrupt and reorganise meaning.

V.3.2. Identity and the Net

Our everyday life is associated with diverse networks. Technologically constructed communication networks, which are primarily based on information delivery, have gained a lot in importance over the last decades. The Internet and mobile networks form an environment where we spend considerable amounts of our time socialising with people, retrieving information and delivering real-time updates on our activities and emotional states of mind. According to Finnish national statistics (published November 2011)[113], 95% of people under the age of 54 use the Internet in general and 59% of the whole population between 16 and 74 years uses the Internet several times a day.

Connectivity to a technological network has become one of the key attributes of contemporary life. Based on the research, the most important motivation in mobile phone usage is the simple fact of being reachable for one's acquaintances, which also implies the value of belonging to a community, or a tribe, as Claire Lobet-Maris argues (Lobet-Maris 2003). The social network of contacts can be seen as indicative of the social construction of self, which shapes the choices for the presentation of one's persona.

[113] http://www.stat.fi/til/sutivi/2011/sutivi_2011_2011-11-02_tie_001_fi.html [accessed 6.4.2012]

In 1995, Sherry Turkle published a book Life On Screen on identity in the age of the Internet and the way the Internet and online worlds have contributed to thinking of identity as multiplicity (Turkle, 1995). “Once we take virtuality seriously as a way of life, we need a new language for talking about the simplest things. Each individual must ask: What is the nature of my relationships? What are the limits of my responsibility? And even more basic: Who and what am I? What is the connection between my physical and virtual bodies? And is it different in different cyberspaces? These questions are framed to interrogate an individual, but with minor modifications, they are equally central for thinking about community” (Turkle 1995, p. 231). In the 1990s these were some of the central concerns in dealing with the emerging possibilities of cyberspace and virtual reality.

By the second decade of the 21st century, the appearance and wide use of mobile devices and ideas, such as the Internet of things, in which everything in the physical reality gets networked, have formed a new kind of situation that profoundly impacts upon our perception of the world and ourselves. As previously mentioned, the technologically enabled networked environment is no longer seen as a separating factor between physical and virtual bodies and necessarily as its own entity distinct from physical space. We are now equipped with networked mobile devices that enable real-time access to virtual information flows. In her recent book *Alone Together* (Turkle 2011) Turkle looks at the social behaviour and communication affected by networked mobile devices and our relationship with sociable robots, which are both increasingly defining contemporary life and having an impact on the formation of our identities. "As social robots propose themselves as substitutes for people, new networked devices offer us machine-mediated relationships with each other, another kind of substitution. We romance the robot and become inseparable from our smartphones. As this happens, we remake ourselves and our relationships with each other through our new intimacy with machines" (Turkle 2011, p. 3). Turkle sees these technologies as a possibility for a new state of the self whose existence is dependent on technology. But also according to Turkle, the continual connectedness offered by

the networked mobile devices can be a threat to identity development, due to a lack of time and space for solitude, which these always-on devices do not readily offer. "The romantic reaction of the 1980s made a statement about computation as a model of mind; today we struggle with who we have become in the presence of computers. In the 1980s, it was enough to change the way you saw yourself. These days, it is a question of how you live your life" (Turkle 2011 pp. 289).

In Turkle's viewpoint is present the idea about physical reality as the primary world which is separate from virtual reality although connected. The technologically enabled, virtual world is seen as the one, which is claiming more space and time in people's lives and replacing the physical realm of social interaction with networked communication and online presence. In Turkle's vision this kind of situation has caused the emergence of what she calls tethered selves, people who live in a continuous state of waiting for connection; a call, a message or an update of status (Turkle 2011). Turkle argues that this situation with always-on communication in a world of rapid responses offers almost no possibility for disconnection from this arrangement. According to Turkle, our technological devices provide the social and psychological navigation system for tethered selves (Turkle 2011). The sense of self is developing together with this kind of technology and it is not clear how benefits and costs are divided.

The perception of separate physical and virtual space was prevalent thinking throughout the 1980s and 1990s, which can be seen e.g. in the production of experimental immersive installations in the arts, where the visitor in a way left physical reality and his physical body behind and stepped into another space[114]. The continuation in this direction of development is seen in simulated immersive environments e.g. in the various online *metaverse* worlds. Second Life, as an example among others, creates a simulated parallel world in which one participates represented by avatars with self-designed identities. One's life in *metaverse* world rarely meets with the other life in physical reality, although correlations between the lives may exist. For example, someone

[114] Char Davies's installation Osmose (1995) used wearable equipment as an interface to explore the virtual world. It is "an immersive interactive virtual-reality environment installation with 3D computer graphics and interactive 3D sound, a head-mounted display and real-time motion tracking based on breathing and balance. Osmose is a space for exploring the perceptual interplay between self and world, i.e., a place for facilitating awareness of one's own self as consciousness embodied in enveloping space." http://www.immersence.com/osmose/ [accessed 13.3.2012]

who got married in SecondLife and lives there happily under a fictitious personality, whilst in physical reality, he is struggling with an unhappy marriage (Turkle 2011). Besides these kind of mental and social correlations there are currently only a few signs of a true merger of the physical, material reality and simulated *metaverse* worlds. However one that should be mentioned is the SecondLife currency Linden Dollar, which has become exchangeable for U.S. Dollars[115]. The future will show if the metaverse worlds and our immediate material reality will merge together and in what ways.

Approximately 78% of people under the age of 34 and 45% of the whole population follow some social media application. The mobile application analytics firm Flurry[116] claims that daily time spent with various mobile applications is gradually overtaking the traditional use of the Internet. According to their statistics the most time is currently spent on mobile game applications and in social networking.

Social media applications and fora have become some of the most popular arenas within the net. Sharing of instant messages and other data in real-time with other users have become part of our daily activities and possibilities for it are provided by many applications, such as Facebook, Twitter, Skype and LinkedIn to name a few.

Taking part in the social software communities requires one to hang out online and expects frequent updates of one's profile and immediate status. One needs to be continuously connected and available for receiving new messages in the midst of normal daily activities. According to Danah Boyd, social media applications are primarily used to maintain relationships with people in close physical and social proximity (Boyd 2006). Only to a very small extent are they used for actually establishing new friendships, but existing relationships of friends and colleagues in the physical reality use these fora as a virtual extension of their social connections.

[115] An example of wearable technology, which connects Second Life and physical sensations: Tachi Labs have developed a wearable hugging module HaptiHug, which sits over the shoulders, and when it receives a signal from your Second Life session, it contracts to give a hugging sensation. http://www.gizmag.com/haptihug-ifeelim-tachi-labs-second-life/14814/ [accessed 25.11.2011]

[116] http://blog.flurry.com/bid/63907/Mobile-Apps-Put-the-Web-in-Their-Rear-view-Mirror [accessed 26.7.2011]

For example, Facebook is an application that invites people to join and create profiles with detailed personal information. The profiles can then be linked to the profiles of other people who have joined Facebook. The created profiles, individual or collective, signal social norms in, for example, the use of names or images or short status texts. The impression one gives of one's persona to others is influenced by the person's displayed network, the collection of friends, groups and likes, in a very similar manner to how this works in physical reality. The creation of one's personal profile on Facebook is also affected by peers' profiles and their likes. On the basis of these activities is an identity creation, or rather personal impression management, which according to Boyd is an inescapably collective process (*Ibid.*). According to Sherry Turkle, friending in Facebook is reminiscent of the Victorian era ritual of calling cards. Visitors came to call, but were not necessarily expecting to be received, and if they were not, they left a calling card, which was a symbol of asking for friendship. In this way, one controlled whom one saw and to whom one was connected (Turkle 2011). It also shows that, maybe even more rigidly than now, one's personal impression in the Victorian era was tightly connected to one's social status gained and presented through the social network[117].

The social media is just one concrete example of how the technologically enabled networks and the possibilities they offer are merging with the real world. These networks have become an increasingly significant part of our everyday life and they are no longer to be considered as a separate virtual space. Networked wearable technology offers a concrete example of this by its ability to merge concretely the physical and virtual worlds into one body and one space. This also means that the networked identity, in comparison to how it is currently theorised in relation to networked virtual spaces that are seen external to physical reality (e.g. by Turkle), is actually

[117] In comparison to various online metaverses such as Second Life, many of the social media platforms, like Facebook, restrict the creation of multiple identities within one name and specifically with one email address. These applications appear to be directly connected to the physical reality of the user and are often based on the traditional idea of a single individual and the unified self. This can sometimes be tricky; the created profiles can only present a single identity within the whole network. Signals pertaining to one's participation in one social context may not always be appropriate in another group's context. Specifically, the boundary between professional communities and personal relationships has been found to be problematic (Boyd 2006), because we present different identities in different contexts; at home, at work, with friends, with parents, etc.

forming differently with wearable technology. It is not based on the idea of multiple identities, which are separated as virtual identity and physical identity, but more as a sort of composite identity which is harnessed for different purposes, and which can perform in different spaces simultaneously. In a sense wearable technology possibly impedes total freedom for the development of completely new identities, due to its irrefutable coupling with the existing physical body. Networked wearable technology points to potential new ideas and aspects about identity and its formation in the *hybrid environment*.

V.3.2.1. Style and Identity Online

Style is one of the prominent factors in online metaverse worlds, such as Second Life, where one is represented by an avatar. One's construction of identity is tightly linked to one's appearance in metaverse worlds with a freedom of choice on gender, race, form and style. To a certain degree, this gives users opportunities to challenge existing concepts about identity and one's behaviour. Within Second Life there are various communities and groups, which are marked by visible signs. For example, Neko-people signal themselves with cat ears and tail. An expert in Second Life, Elif Ayiter, characterizes Neko-people as a community, but also as a culture. She explains that Nekos are usually dark, small avatars and their expected behaviour would be irreverent, cheeky, politically incorrect and mischievous. "When you see a Neko you would expect a very naughty person; a troublemaker even. And quite a few of them are serious troublemakers; they can be very good coders who can crash down an entire sim" (Ayiter 2011). Neko is an example of a group-identity with a specific type of behaviour. It is often easier to adopt an identity within a group, which challenges the expected behaviour, than alone as a single individual. Dick Hebdige argues that certain style, e.g. punk emblems, shared by members of a group forms unity within the group and manifests shared values (Hebdige 1983). Also in Second Life a group provides a sense of community and a certain degree of safety, as well as ready-defined rules for behaviour. However, one should remember that nothing is permanent in online

worlds; one can choose to perform with a Neko-identity today but with something totally different tomorrow. The online social platforms are, in a sense, supermarkets of identities. "While avatars offer some interesting and productive opportunities for individuals to control and craft their online identities, and to experiment with new identities, they can also be seen as representing an increasing consumerisation and commodification of identity" (Cleland 2007, p. 41). One's identity has become a commodity that is tightly related to one's appearance, and one which is sold, traded and exchanged both online and in the physical reality, at an increasing rate.

In considering popular culture, the singer and pop-star Lady Gaga has gained a reputation for her ever-changing sense of style in music, appearances and performances. She opposes the traditional idea of fixed identity by crossing over gender boundaries and appearing as an androgyne or inhabiting a male alter ego, such as Jo Calderone[118]. Showing her wit and knowledge about popular culture and contemporary arts, Lady Gaga creates an ironic carnival of cultural signs and icons[119]. Lady Gaga is a physical reality counterpart to the identity shifting practices in Second Life, a demonstration of our increasingly fluid approaches towards the body, appearance and identity.

V.4. The Hybronaut's net

> "Experience is a matter of the interaction of organism with its environment, an environment that is human as well as physical, that includes the materials of tradition and institutions as well as local surroundings." (John Dewey 1934, p. 246)

[118] http://gagadaily.com/2010/12/50-best-lady-gaga-moments-of-2010-part-4/lady-gaga-poses-as-jo-calderone-for-vogue-photo-01/ [accessed 29.11.2011]

[119] For example, one of her celebrated costumes was made of raw meat. http://content.usatoday.com/communities/entertainment/post/2010/09/lady-gaga-explains-her-vma-raw-meat-dress/1 [accessed 29.11.2011] One should note here that a very similar idea for a dress was produced as an artwork by Jana Sternbak[119] as long ago as 1987, named *Vanitas: Flesh Dress For An Albino Anorectic* http://www.janasterbak.com/images.html [accessed 29.11.2011]

The *Hybronaut* is a human whose existence is profoundly based on the *hybrid environment* and various kinds of relationships, physical and networked, which are constructed within this environment. In this situation, networked technology is no longer considered solely as a communication channel for taking care of tasks or delivering messages. Technology has become a feature and dimension of the everyday environment and an element of the human body. This research has considered the *Hybronaut* not as an enhanced isolated body, but as an entity that is tightly connected to his environment.

The *Hybronaut* investigates the way in which these technologies enhance our perception of the world and our presence in it by becoming an integral part of our identity and physiology. This does not only concern the modification of a human body and appearance through wearable or body-embedded technology, but also the establishment of relationships with heterogeneous networks of humans and non-humans. While being the *Hybronaut*, the user is not only appearing in the physical environment, but is simultaneously appearing in the virtual sphere. The possibilities for concretely linked relations are expanded by means of technology. These relationships form a complex network of physical and virtual interactions, materials, humans, and organic and technological components simultaneously. The *Hybronaut* can be seen in relation to the actor-network theorist John Law's argument: "what counts as a person is an effect generated by a network of heterogeneous, interacting, materials" (Law [1992] 2003, p. 4). This kind of perspective is core to the *Hybronaut*, who is constituted of relations, actions and diverse materials in a heterogeneous structure. The body is enhanced by a wearable device to comprehend its connection, spatial placement and possibilities within a network including both physical and virtual characteristics.

The *Hybronaut* is an individual with a choice of creating his own relational network, but simultaneously he will become a node in this network and be affected by the structure, events and organisation of the network. This structure is comparable to most of the current social media applications, and has been true for centuries of social life in general. The difference is that the

Hybronaut's relational network not only provides social contact with other humans, but also offers possibilities for connections with non-humans. The *Hybronaut*'s network is the base for his living environment, the *hybrid environment,* which has become a constitutive part of the *Hybronaut* and his life.

VI. The Hybrid Habitat

Zbigniew Oksiuta's artworks start with the idea of a threatened existence of the human species and their environment. Through his work he researches possibilities of creating biological habitats for humans, animals and plants. According to him, the construction of protection, such as making clothing and putting a roof over one's head is a universal and primeval activity of humans that has secured survival, existence and development (Oksiuta 2008). In his work, the natural biological environment of the human lies in the need for re-evaluation, according to which new environments need to be explored and invented. His project Breeding Spaces[120] focuses on creating a habitable system; a bubble-shaped living membrane, which gradually evolves into a habitable living plant object (Oksiuta 2008). In this project, the separation between interior and exterior environments is based on an active structure that is more like a bond between the inner and outer environment than a separating boundary.

The previous chapter introduced the *Hybronaut*, a figure coupled with an artistic wearable device, who observes life and explores his existence in a *hybrid environment*. This chapter presents the *hybrid environment* as the *Hybronaut*'s living environment, to which he is irreversibly connected. The *Hybronaut* is an extended human continuously present in the virtual layer of reality in addition to physical reality, which together constitutes the *hybrid environment*. His dependence on the connection with the *hybrid environment* forms the basis of his identity, self-image and perception of the world.

VI.1. Technologically Enhanced Environment

During the recent decades we have been witnessing a shift from a world marked by boundaries and categories to a world that is structured by relationships and networks, in which the division between the virtual and the physical is rapidly disappearing. We shape our

[120] http://www.oksiuta.de/films4.html [accessed 15.1.2012]

technologies, and create and break the connections between organic and artificial, physical and virtual matter. Reciprocally, these developed technologies and connecting structures shape us and our perception of the surrounding world. The inventor of the World Wide Web Tim Berners-Lee has said that: "The web is more a social creation than a technical one. I designed it for a social effect — to help people work together — and not as a technical toy. The ultimate goal of the Web is to support and improve our web-like existence in the world" (Berners-Lee & Fischetti 1999, p. 226).

39. Figure: *Seven Mile Boots* by Beloff_Berger_Pichlmair, 2003-04. Photo © Laura Beloff.

The author's project Seven Mile Boots, 2003-2004 (Figure 39; described in the appendix 2), is an example of a wearable artwork that very early on treated the Internet as a spatial concept rather than a medium for connections[121]. The project consisted of a pair of wearable interactive and networked shoes with audio output. A user wearing the boots was able to walk around in the

[121] http://randomseed.org/sevenmileboots/

physical world and through the literal world of the Internet simultaneously. However, the user's movements did not follow the familiar logic of physical geography, but the user was allowed to walk in different directions and at different speeds in the net and in the physical world.

While walking in the physical world, a user could suddenly encounter a group of people chatting in real time in the virtual world. This encounter was perceived when the conversations could suddenly be heard coming out as a spoken text from the boots. The user could walk past the group of people chatting online, or he could decide to stop for closer observation.

The piece was built upon feet and shoes as an interface to move within the text-based "non-space" of the chat rooms. Part of the focus of the project, at the time of its creation, was on the construction of a technological base-structure, which could be filled by real people in real time; real life, but through a network. Chat rooms (irc-channels) were a real-time social environment that created a feeling of space and place. At the time the project was realised, 2003, social media fora were primarily irc-chats, news- and email-lists.

The boots were designed to be ready for use and functioning in any location with an open wireless network. Wherever the boots were being worn, physical and virtual reality would merge together. The project concentrated less on a specified functionality achieved through technology than on the enhancement of the perception and experience of spatiality and presence. The Seven Mile Boots offered a fresh perspective on processes that have since become part of our current lifestyle.

Looking back today, it is obvious that the project was aiming towards the merger of the virtual world of the Internet and the physical world. This concept was constructed as a wearable artwork that could be experienced by the public. The project enhanced the physical body with a new kind of spatial potentiality that enabled mobility within the *hybrid environment*. It proposed the possibility that the data based virtual layer of the world could become something more and something different. In the Seven Mile Boots project, the physical reality and the virtual layer for the first time in the author's artworks became a merged living environment where neither part

was seen as enhancing the other or subordinate to the other. Additionally, the wearable artefact, the red leather boots, visually enhanced its user. The Seven Mile Boots were deliberately designed with prominent and conspicuous visual features to make them noticeable to the public.

VI.1.1. Ubiquitous Technology

Ubiquitous computing was a vision Mark Weiser proposed in 1988, as a situation in which computation dissolves into the environment, whereby computer technology will reach a level at which it becomes invisible to us and we lose awareness of its impact on our everyday life[122]. In this vision, computers are present everywhere and nowhere (Weiser, 1991; Weiser, Gold & Brown 1999), the computing system is spread throughout the environment, thus enabling mobility and endorsing seamless interaction that does not require any conscious control of mechanisms. In this system, the network facilitates communication among various actors, elements and participants. Ubiquitous computing sees digital technology as integrated into an environment and everyday activities, rather than having computers as separate, distinct objects. "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" (Weiser 1991, p. 94). Part of Weiser's vision has become reality; portable and miniaturised mobile devices have become our cognitive tools, offering us information on the move. They provide for parts of our memory as a phonebook, a calendar and a notebook; they are simultaneously a clock, a phone, a camera, a radio and an entertainment centre with games and music. Today wireless networks and mobile devices are almost a requirement in urban contemporary life style.

The 1990s' vision of disembodied minds roaming and growing in immersive virtual environments (Viseu 2001) has given way. In its place is a conception that perceives the current situation as a merger of the physical and virtual worlds. This tendency is clearly visible e.g. in the increase of use of mobile and wearable technologies. Instead of having fixed phone line connections between locations, mobile phones offer connections between people irrespective of

[122] The term *ubiquitous computing* was coined by Mark Weiser in 1988 at the Computer Science Lab at Xerox PARC.

their location. The communication network, which was originally drawn as a fixed blueprint in which people were moving between fixed nodes, has been replaced by an image of a dense network of constantly moving nodes that represent people. Small-scale wearable and networked devices position an individual in a *hybrid environment* in which continuous connectedness has become a property of an individual body. In the *hybrid environment*, the physiological evolution of a human has been replaced by the self-defined design of new technological faculties, and the aim for survival has been superseded by the aim for continuous presence in a connected *hybrid environment*, *staying online*. William J. Mitchell has noted that: "The constants in my world are no longer provided by contiguous home turf: increasingly, my sense of continuity and belonging derives from being electronically networked to the widely scattered people and places I care about" (Mitchell 2003, p. 17).

Other people, the Internet and various other things are currently accessible via mobile terminals, such as smart phones, web tablets and portable personal computers. Increasingly we are seeing a move from the Internet as an idea of separate data based space and structure, to the Internet of things (Kranenburg 2008), which incorporates the whole physical world into a technological network. Rob van Kranenburg argues that the challenge for design will be an implementation of digital connectivity in an analogue environment, proposing to meet this through the creation of a working concept of corporal literacy that incorporates all of our senses (Kranenburg 2008). This means that Weiser's vision of the ubiquitous world would come true.

VI.1.2. Hybrid Environment

The technological enhancement of our environment and the move towards the Internet of things (Kranenburg 2008) has been enforced by developments such as the GPS-coordinate system and geolocalised data, tagging and geo-tagging, environmental data mapping, real-time communication channels and social media forums which all are accessible via mobile devices and

contribute to the concept *hybrid environment*[123]. The author's impression is that these technologies are commonly used by people based on an idea of presence, for instance, by leaving a virtual mark of one's presence on the physical geographical location through geo-tags or on the social media forum by small public comments. Presence as a physical attribute is giving way to hybrid presence, which comprises both physical and virtual features.

According to research studies, mobile technologies have influenced the material and code-based notions of space and place. Changes in perception of these concepts and their impact on individuals and society have been investigated by various scholars, e.g. Timo Kopomaa, Anthony Townsend and Adriana de Souza e Silva, among others.

Timo Kopomaa sees a mobile phone as a device for communication, but also as a device that re-organises space. He writes that as a communication device, the mobile phone can be interpreted as a kind of virtual space parallel to work and home. A mobile phone with its connections forms a third space for socialising and meeting friends, as well as providing a place to withdraw into privacy and safety within the midst of an urban lifestyle. According to Kopomaa, chatting in the third space is a primary function and a major way of expressing one's personality and individual self. The meeting of two people in this third space is considered completely private in relation to the surrounding environment: it is one's own personal zone of freedom. The mobile phone is firmly linked to sustaining connectedness. As Kopomaa writes, the mobile phone is not solely a device for keeping in touch, but also a device for being together (Kopomaa 2002).

Anthony Townsend has observed that time is the most important change occurring with the new lifestyle opportunities offered by mobile phones. Time is a commodity, which is bought, sold and traded over the phone. Instead of living within a more traditional schedule based on minutes, hours and weeks, individuals now live within a constant stream of negotiations, reconfigurations

[123] Over the last decade, also artists have begun experimenting with the hybrid environment by expanding it in various directions and testing out its possibilities. The Milk project, 2005, was carried out by artists Esther Polak and Ieva Auzina. In this project, they used GPS tracking to trace the route of milk from Latvian farmers becoming cheese sold on the Dutch food market. The project made one of the innumerable movements of the international food trade visible. http://milkproject.net/en/index.html [accessed 3.4.2012]
Nomadic Milk was another project by Esther Polak, in which she followed the milk trade in Nigeria. http://nomadicmilk.net/blog/ [accessed 3.4.2012]

and rescheduling. One can be interrupted and interrupt others at any time. Townsend has defined this as phonespace. He argues that a person living in the phonespace cannot let go of it; it is a primary link to the temporally and spatially fragmented world of personal networks of friends and colleagues, as well as offering constant reconfigurations of schedules and meetings. "It has become their new umbilical cord, pulling the information society's digital infrastructure into their very bodies" (Townsend 2001, p. 70).

As mobile phone users, we carry individual spaces, as described by Kopomaa and Townsend, with us everywhere. They see the technologically enabled space parallel to physical space that is impacting the everyday routines in our physical reality. Yet, in their formulation these spaces are considered as separate from the physical world with their own distinct tasks to handle.

The author sees these individual spaces enabled by mobile phones, not as pockets of privacy within public space, but as a part of one's individually formed perception of the world, which evolves in the *hybrid environment* and includes both the physical and virtual aspects of the world.

Adriana de Souza e Silva defines a concept of hybrid space in order to re-conceptualise physical spaces through the connectivity of digital mobile media. She claims about hybrid space: "It is exactly the mix of social practices that occur simultaneously in digital and in physical spaces, together with mobility, that creates the concept of hybrid reality" (de Souza e Silva 2006a, p. 265). Her idea of hybrid space is not constructed by technology, but by social practices which use mobile technologies as social devices and in this way blur the borders between physical and digital spaces. Thus according to de Souza e Silva, we can no longer address the disconnection between physical and digital spaces, due to the dynamic relationship between the network and mobile devices (de Souza e Silva 2006a).

De Souza e Silva's hybrid space is based on human social communication and activity, taking place simultaneously within physical and digital realms. Whereas the author is using the term *hybrid environment*, which she defines with a wider perspective, not only as a space that is

formed solely around social activity, but as an environment in which various organisms, e.g. humans, plants, animals and microorganisms, live and operate. This environment is based on physical and networked virtual aspects of the world. Like in de Souza e Silva's hybrid space, also the author's *hybrid environment* includes human relations that are formed in both physical and digital space. But additionally it includes information flows between the nodes and evolving connections between various aspects, things and institutions in the *hybrid environment*. The author perceives the *hybrid environment* as the merger of physical reality and virtual, technologically enabled reality. The *Hybrid environment* is a living environment, rather than a space for specified tasks. In this dissertation the term *hybrid environment* is used specifically in reference to the connection between the enhanced, networked human and his technologically enhanced habitat.

Ana Viseu perceives that wearable computers are, to a great extent, the product of ubiquitous and embedded computing (Viseu 2002b). They offer a new way to interact with the environment, which is also expected to be responsive and communicative. Viseu formulates what she calls a *hybrid actor* as a body coupled with a wearable device. She argues that when physical bodies, or actors, are augmented with computational devices, they participate in the processing of information. This creates new synergies that would be beyond the abilities of each individual actor. "Rather than building self-contained machines, or leaving the body behind, machines and humans are coupled together into a new hybrid actor" (Viseu 2002b, p. 4). In this formulation, a human is not a measure of things, which machines are designated to imitate, but a human body is enhanced with computing capabilities, which creates a new emerging entity (Viseu 2002b). Viseu is critical on the discourse around the production of wearable technologies, which according to her, focuses mainly on "quantifiable, causal relationships, thus overlooking the fact that the augmentation of the physical through the digital does not result in physical plus digital, but in a new entity with its own specificities. An augmented human being has a distinct reality, and this raises new issues regarding the place of the human body and self in its relation to technological artefacts" (Ibid., p. 12).

The author's perspective is that networked wearable technology locates the user in the *hybrid environment* more rigorously than current mobile devices. Typically wearable technology is physically attached to the user's body, instead of being something that is taken out of the pocket and investigated in the hand through a screen like e.g. a mobile phone. Technology, which is wearable and attached to the user's body, is no longer just an entry point to the virtual, but a full vehicle that positions the user into the *hybrid environment*[124].

VI.2. Networks

In 1979, Sophie Calle (Tarsia 2009) started following random people around Paris, which eventually led her to follow a man for two weeks travelling from Paris to Venice. One day she followed a man whom she had randomly selected and then lost sight of him. By chance, she was introduced to him at a party later the same day. There she learned that he was planning a trip to Venice; Calle decided to continue following him in disguise. She tailed him through Venice dressed in a wig and dark glasses, made notes about his movements and took photographs of him and of the views he was photographing. These evidences (photographs and notes) were later exhibited and published as a book. Sophie Calle's work Suite Vénitienne, 1980, as well as many of her other works, are based on observations and on voyeuristic action that attracts human curiosity. But they also establish random connections between strangers and, further more, connections with locations. These connections are constructed randomly without a clear purpose or meaning; they may exist for a shorter or longer period and vanish as easily as they are

[124] The author wants to additionally point that a technologically equipped and networked human in a *hybrid environment* is obviously subject to surveillance and control and being a target of personalised advertising. This reminder of the control society is one of the features of the *hybrid environment*. There have been several initiatives and works within various areas of the arts (locative media, media-art, mobile media, participatory media) that have dealt with aspects such as the collection of personal data, which is connected to the privacy of an individual, to the geographical location of a human, or object under observation, and to electronic identity in general. Wearable technology is obviously one potentially rewarding area for these kinds of data-mining and surveillance-based practices that are linked to humans. However, these aspects have received relatively little attention from creators of wearable technology works. There is, however, one notable exception: Steve Mann's advocated term sousveillance within wearable computing specifically references this area. Sousveillance refers to surveillance data that are available and controlled by the observed *owner* of the data. However, even the author acknowledges the importance of the issue, in this practice-led dissertation this area is paid less attention. http://en.wikipedia.org/wiki/Sousveillance [accessed 14.3.2012]

established, leaving behind a trail of evidence. Calle's work is in a way inseparable from her life; she takes on multiple roles and identities as a performer, character, author, detective, and as a scientist conducting an experiment. Her work creates a rhizomatic image of a world in which any point can be connected to any other without them necessarily having anything to do with each other. It is a world based on a multiplicity of connections, roles and random encounters.

VI.2.1. The Term *Network*

Network as a term originates from a combination of the words "net" and "work", according to the etymological dictionary. In the 1550s, the term "network" was defined as a "net-like arrangement of threads, wires, etc." In the late 1830s it was used in reference to transport by rivers, canals and railways, as a complex, interlocking system. In the early 20th century, "network" referenced broadcasting systems of multiple transmitters and in the 1940s it referenced the sense of interconnectedness among a group of people. As a verb it was related to computers in the 1970s, and in the 1980s it was for the first time used as a verb in reference to the activity of persons[125].

Today the term is commonly used in relation to the Internet and other systems that connect separate technological components or humans to each other through technology. According to Bruno Latour, in the late 1970s the term network had some freshness as a critical tool as opposed to notions such as institution, society and nation-state. "At the time the word network, like Deleuze's and Guattari's term rhizome, clearly meant a series of transformations – translations, transductions – which could not be captured by any of the traditional terms of social theory. With the new popularization of the word network, it now means transport without deformation, an instantaneous, unmediated access to every piece of information" (Latour 1999, p. 15). The new use of the term was exactly the opposite of what Latour had meant. In Latour's

[125] http://www.etymonline.com/ [accessed 28.10.2011]

viewpoint the appropriation of the word network by information technology has abolished all the critical cutting-edge notions, which the term previously had[126].

Rhizome is defined by the dictionary as a horizontal subterranean plant stem that produces shoots above and roots below, and is distinguished from a true root by the characteristics of buds, nodes, and usually scale-like leaves[127]. As a philosophical concept, rhizome (and rhizomatic) was developed by Deleuze and Guattari to describe research and thinking which allows for multiple, non-hierarchical entry and exit points in data representation and interpretation (Deleuze & Guattari 2004)[128]. Deleuze and Guattari place the rhizome in opposition to the concept of arborescent that references the genealogy of trees and their unidirectional progress without retroactivity or binary cuts. The rhizome, on the other hand, resists the organisational root-tree system with its non-hierarchical and horizontal notion; the rhizome has no beginning and no end, but always a middle from which it grows. Rhizomes connect any point to any other point, creating a heterogeneous mesh of links between things that may have nothing to do with each other and no respect for any specificity of species. It is made up of lines and dimensions, which distinguish it from a structure that is defined by points and positions.

VI.2.2. Computer Networks vs. Biological Networks

Networks have become one of the principal structures of contemporary life that penetrate their influence to almost every aspect of society.

Galloway and Thacker challenge the widely accepted idea that networks are inherently egalitarian. According to their viewpoint, there are new means of control embedded into network structures, which subsequently require a new way of thinking: in a manner appropriate to networks. They define a network as any system of interrelationality that can be biological or informatic, organic or inorganic, technical or natural (Galloway & Thacker 2007).

[126] These notions by Latour were written about in an article that recalled the actor network theory and its use of the term network, which Latour saw as a failure (Latour 1999).
[127] http://www.merriam-webster.com/dictionary/rhizome [accessed 28.10.2011]
[128]The concept was developed in Deleuze's and Guattari's Capitalism and Schizophrenia (1972-80) project.

Galloway and Thacker argue that a concept of protocol is profoundly related to the concept of networks. Protocol according to Galloway and Thacker refers to "all the technoscientific rules and standards that govern relationships within networks" (*Ibid.*, p.28). Protocol is a horizontal, distributed control apparatus that guides both the technical and the political formation of computer networks, biological systems and other media. It is thus an apparatus that facilitates networks as well as a logic that governs the way things are done within that apparatus. "In the broadest sense, protocol is a technology that regulates flow, directs netspace, codes relationships, and connects life-forms" (*Ibid.*, p. 30). The protocol is one of the key factors of control within networks, including technological computer networks and also biological networks. Galloway and Thacker argue, "informational, protocol-based understanding has led to the development of biotechnologies that take on a network form" (*Ibid.*, p. 47).

The informatic view of biological and genetic life was originally developed through an interaction between cybernetic perspective and biology. For example, the control of biological molecules was located in a code and pattern, in an informational sequence of DNA, RNA, or amino acid molecules. The concept of this kind of informatic view of biological and genetic life is called base pair complementary. It implies "an informatic approach to studying life but also implies a notion of biological control (gene expression, cellular metabolism, membrane signalling)" (*Ibid.*, p. 50). This viewpoint is the principal behind many of the current biotechnologies that have enabled such things as the development of genetically modified organisms (GMO) and transgenic animals. According to Galloway and Thacker, as an informatic principle "base pair complementary can operate across different material substrates, be it in the living cell, in a petri dish or test tube, or, more recently, in a computer" (*Ibid.*, p. 51). Galloway and Thacker claim that with their use of databases, gene-finding algorithms and automated genome sequencing, computers demonstrate the principle of base pair complementary in silico, in addition to the in vitro and in vivo. "In short, the increasing integration of cybernetics and biology has resulted in an informatic view of life that is also a view of life as a network ('biological

control')" (*Ibid.*). Galloway's and Thacker's claim is that computer logic and the concept of network has widely penetrated our perception and approach to many areas of life, including biology and organic matter. They see computer networks and biological networks in parallel, with protocols facilitating the integration and standardisation of these two types of networks. "In both computer and biological networks, the primary function of protocol is to direct flows of information" (*Ibid.*, p. 55).

The parallelism described above between the technological computer network and biological network demonstrates how the concept of network has become part of our fundamental mindsets, which also includes the perception of a biological body. The comprehensive concept of network in our current thinking seems so inherent to all digital technologies, including wearable technology that it appears likely that without the indication of a network-concept about creating new entities through connections, wearable technology would not have developed in such a way as it is today.

Even if wearable technology is wearable and currently located externally to the body, the design of wearable devices perceives the body as a biological system, to the functions of which the wearable device connects. In this situation, the concept of network is in a major position; it allows the body and wearable device to be understood as a connected entity, which is formed as a multilayered network of body parts, biological functions, machine parts and technological functions. When looked at from this perspective, the body appears as a mesh of connections criss-crossing within the body and between the body and the wearable device. This body-technology entity is connected to a surrounding environment downstream via various established connections and links. This construction is visible also in the author's *Hybronaut*-concept and in the realized wearable technology artworks, e.g. in the earlier work *The Head*, 2005-06 (Figure 40; the appendix 2).

40. Figure: *The Head (wearable sculpture),* 2005-07. Photo © Laura Beloff.

One of the features of *The Head*-sculpture is its availability for free public adoption. The person adopting the wearable sculpture becomes responsible for it. The Head-sculpture becomes their second head, which follows a new foster-parent everywhere she or he may go.

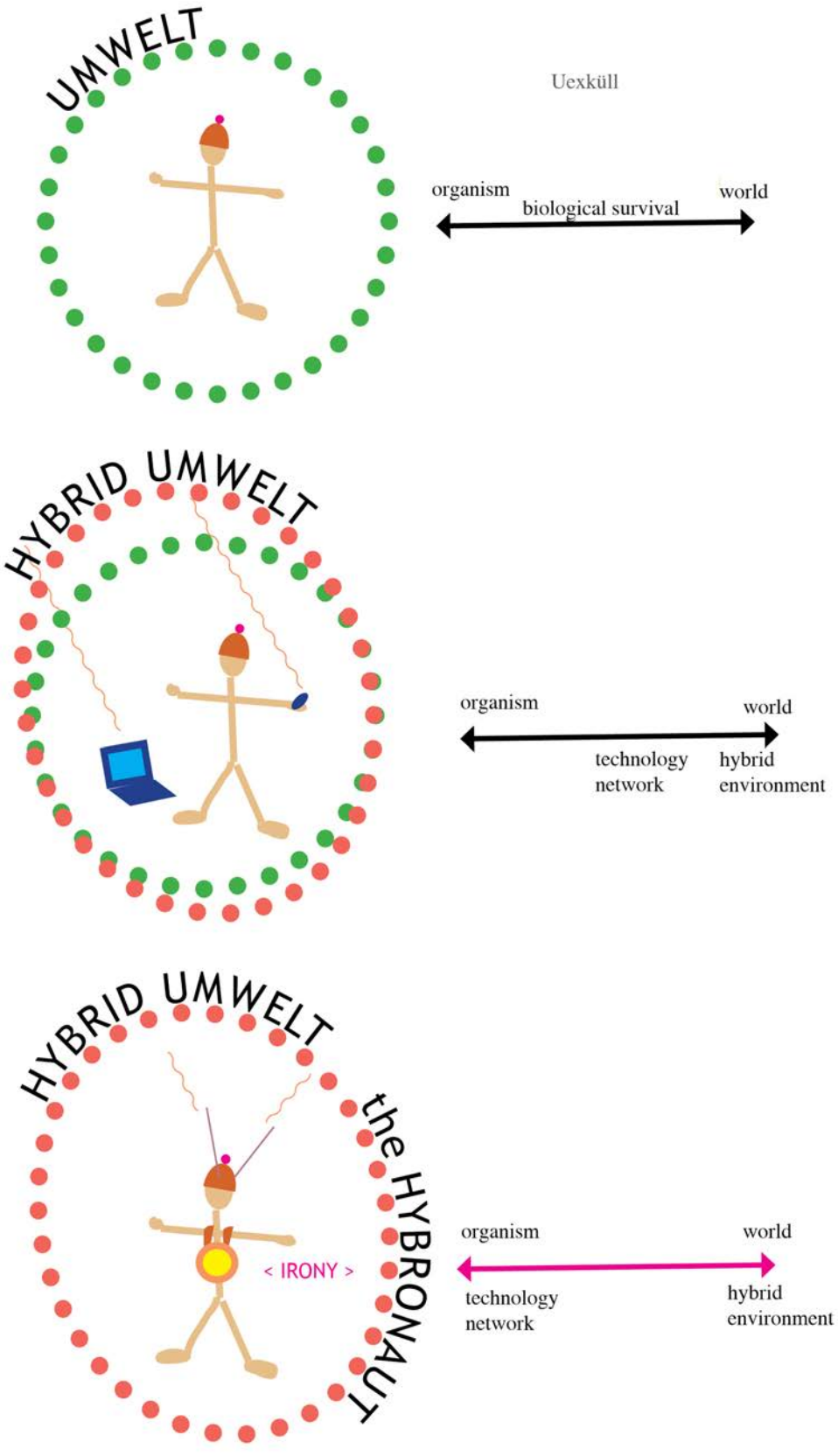
The Head is constructed with an open channel to enable the public to access it via their mobile phones (via sent text-messages). When *The Head* receives a text-message, it responds by triggering its technological eye to capture an image and ear to record a sound. These captured records, or evidence, that prove its ontological existence on the Earth, are sent back as a reply to the sender. The image-files are also automatically uploaded to a public image database in Flickr.com. "In a similar way as many of us use Flickr for storing and sharing our photos, *The Head* does the same. The dedicated Flickr-site can be thought of as the mind of *The Head*-sculpture with

a continuous accretion of memories. On the site, one can see everything The Head observes. It develops into a collective memory. *The Head* will be adopted and carried around by various individuals and its vision and hearing triggered by others to collect memories on the way."[129]

In the original plan for the work was an idea that *The Head* should be occasionally adopted by specific public figures; for example, a police officer, a politician, a tourist guide, or a teacher - all of whom work in professions that have publicly and politically guided viewpoints on society. The open access to *The Head* via text-message would have remained open for any members of the general public equipped with mobile phones.

The Head sculpture has no permanent location. It is thought out as a nomadic structure living amongst the people, carried around from place to place and independently watching the world with the aid of the public. The work is located in the *hybrid environment*, where it is accessible at all times via mobile phone. The work is extending the human body with an external body part that can see and hear, but requires public participation via a technological network to succeed. In a way, it is extending the carrier's body, but not his physiological abilities. The extension is directed towards a network and its connection to the current parent of *The Head*. In this work, the concept of network is understood compendiously as a construct of relations to technical, human and non-human artefacts.

[129] Excerpt from the website of The Head by Beloff 2006. http://www.realitydisfunction.org/head/ [accessed 23.3.2012]



41. Figure: Shifting Umwelt, 2012. Photo © Laura Beloff.

VI.3. The Hybronaut's Umwelt

One of the central aspects of Uexküll's *Umwelt* concept is the organism's ability to interpret visual signs. This interpretation is a semiotic process guided by an organism's physiological faculties and needs. According to Uexküll, the organism's subjective *Umwelt*, the perception of the world, is created on the basis of recognisable signs, in other words, what it is able to see or sense, which is subsequently guided by its physiological abilities.

Also Francisco J. Varela's investigations have revealed that our cognition is dependent on experiences that are affected by having a certain kind of body with certain kinds of sensor and motor capacities, which are embedded in a biological and cultural context. Varela emphasises that "[…] sensory and motor processes, perception and action, are fundamentally inseparable in lived cognition. Indeed, the two are not merely contingently linked in individuals they have also evolved together." (Varela, Rosch & Thompson 1991, p 173). Varela argues that the perceiver's activity changes the local situation, which also guides the perceiver's actions. "Since these local situations constantly change as a result of the perceiver's activity, the reference point for understanding perception is no longer a pre-given, perceiver-independent world, but rather the sensorimotor structure of the cognitive agent, the way in which the nervous system links sensory and motor surfaces" (Varela 1992, p. 320). This perspective sees reality as perceiver-dependent, whereby what counts as a relevant world is inseparable from the structure of the perceiver.

There are similarities between how Varela perceives the relation between physical body, its environment and human cognition, and how Uexküll has articulated the formation of an organism's *Umwelt*. In both argumentations, the sensorimotor body perceives the world, or local environment, within a frame of its physiological structure and acts in the situation on this basis, which may then change the local situation. The perceiving body and the local situation of an environment are in a continuous feedback cycle.

The *Hybronaut*'s design includes a network faculty, which is a vital aspect for the constitution of the *Hybronaut*. Firstly, this faculty locates the *Hybronaut* within a technological network and supports the emergence of the *hybrid environment*. Secondly, it is one of the core issues in the formation of his identity based on various relations in the *hybrid environment*. And thirdly, the *Hybronaut*'s subjective *Umwelt* always depends on what his biological and technological faculties allow him to perceive and sense. The merger of human and technological systems is an intrinsic feature of the *Hybronaut*, whose present form is based on being connected to various kinds of entities. A desire for connectedness, which is often executed through technology, is also a typical trait of contemporary humans. The biosemiotician Claus Emmeche argues "we continue to be that kind of animal, who can only survive in its present form by being interconnected to a global techno-societal system" (Emmeche 2007, p. 476).

Survival is a key component in the *Hybronaut*'s techno-organic environment. The survival at stake is not a biological one, but one related to connectedness. Consequently, the *Hybronaut* is modified for survival in a hybrid techno-organic environment. The *Hybronaut*'s unique *Umwelt* is constructed within the merger of physical reality and technological space. What counts in this kind of hybrid *Umwelt* is connectedness. Connectedness to the technologically enabled network has become his new umbilical cord, and the aim of being continuously online is the driving force behind the *Hybronaut*. A lost network connection causes a loss of *hybrid environment* and loss of his subjectively constructed *Umwelt*, as well as a loss of identity as the *Hybronaut*.

Uexküll imagined a world full of interconnecting and overlapping soap bubbles, each holding its own perception of the world. In this kind of world of multiple perspectives, each organism and individual has its own *Umwelt* and a human perspective is just one among many others. Uexküll presents us with a viewpoint, which clearly challenges an anthropocentric worldview. T. Geoffrey writes about Uexküll's multi-world perspective: "When multiple worlds overlap, the same space or same object engenders different associations. We metaphorically swim

within a particular current, unaware of the streams of perceptions that surround us" (Geoffrey 2010, p. 141). These individual *Umwelt*- perceptions differ from each other in their construction, depending on the species, their specific needs and their living environment and circumstances.

The *Hybronaut*'s *Umwelt* and its structure are in some ways comparable to an astronaut's situation. To be able to travel and survive in a space environment, an astronaut has to be equipped with proper equipment. Without a specially constructed suit equipped with the necessary functions and other devices, he will not survive in space and will not be able to experience the astronaut's *Umwelt*. The wearable equipment becomes an essential part of an astronaut, as well as a requirement for the formation of his *Umwelt*. The equipment opens up a new space and new potentials. In new circumstances, a new kind of *Umwelt* is emerging, the signs and meanings of which have to be learned from the start.

In a similar way, the equipment constructed for the *Hybronaut* brings forth a new spatial dimension, which together with physical reality forms a *hybrid environment*. The designed and constructed equipment constructs a situation in which the *hybrid environment* is understood in the first place as a spatial concept and a coherent living environment. This viewpoint of the situation differs from the common perception, where networked reality is seen primarily as a channel for communication that is largely separate from immediate physical and material reality.

For the *Hybronaut*, staying online is a vital condition. Similarly to the way in which an astronaut's suit enables survival and experience of outer space, the *Hybronaut*'s networked faculty, which is provided by the designed equipment, enables his existence and experience of the *hybrid environment*. This situation provides space and opportunity for the emergence of a new state of the self, the existence of which is based on the combination of technologically wired and biological faculties. The *Hybronaut* perceives and constructs his subjective *Umwelt*

within the frame of his physical and cognitive abilities, which are extended, and sometimes also hindered, by the wearable equipment.

VII. Constructing the Hybronaut and Structuring Research

Art is often considered as a free zone, which is kept isolated from the experiences of everyday life. Similarly to the way in which it does not make sense to separate organisms from their environment, the author focuses on artistic practices that involve and combine everyday life, its circumstances, environment and organic human body into processes, which connect these aspects with each other.

The *Hybronaut* emerges from the arts as an experience, which is located within everyday life in a *hybrid environment*. Similarly to how John Dewey saw experience as an interaction between the live creature and its environment, the *Hybronaut* interacts with a *given* technologically enhanced environment through its organs, which are both biological and technological. This interaction creates a context in which the boundaries of the body are re-negotiated and self gets formed and reformed in relation to the immediate perceptible environment.

In many of the described examples of artworks throughout the dissertation the focus is on the production of an experience, initiated by a physical, dynamic object that is wearable. The wearable equipment immerses the user's physical body into the core of the experiential situation. The aim of these kinds of works is not in detailed effects, but in offering users an experience that can open up new insights into living and understanding the world. These strategies are strongly present in the author's works. The *Hybronaut* equipment is wearable, dynamic and visually distinct objects or garments that locate the user within specific conditions. The *Hybronaut* is unique in its approach to investigating and promoting the network and connectedness as a physical experience, in which network is understood as a feature of an environment as well as a characteristic of a human. This is visible e.g. in the Appendix work by the author. The *Appendix* makes users aware of being connected to, or perhaps being bodily trapped into, a networked environment that comprises aspects beyond task-oriented functions. The physical experience advocated by the work

directs users towards the possibility to perceive and to experience the world as a techno-organic environment.

The Hybronut offers an aesthetic experience based on art, which is tightly connected to everyday life. The *Hybronaut* works are not aimed to be exhibited in the traditional manner of the museum; they are designed to be used by people. The *Hybronaut* equipment, as artworks, can be seen in light of Dewey's claims, that art's special function and value is in satisfying the live creature by serving a variety of ends and, above all, by enhancing our immediate experience which invigorates and vitalises us (Shusterman 1992). Dewey found it problematic to have art shut away in museums and separated from the realm of everyday life; instead, he saw art as instrumental in enhancing the life and development of the human organism in coping with her environing world (*Ibid.*).

VII.1. Equipment for the Hybronaut

The expansion of worldview and space has developed hand in hand with the aims to improve human biological senses, through a development of many scientific instruments and other human utilities. For example, sight has been improved by reading and magnifying glasses, microscopes and telescopes. In 1609, Galileo Galilei developed an improved telescope for military purposes, in order to be able to spot the enemy at a distance. But by turning the telescope towards the sky, Galileo realised that it was possible to discover new things with it; it was possible to see things people had never seen before. In January 1610, Galileo observed three small stars around Jupiter and after a few days of observations on their moving positions, he concluded that they were orbiting Jupiter. This was followed by the first recorded observations on the phases of Venus. Based on the movement of the shadow on Venus, Galileo came to the conclusion that Venus actually circles around the sun.[130] With his telescope, Galileo was not only enhancing human sight, but was also expanding space and making a permanent change to the

[130] http://en.wikipedia.org/wiki/Phases_of_Venus [accessed 7.12.2011]

prevalent worldview. His observations revolutionised the perception of the world; the earth was no longer seen as the centre of the universe.

Today, telescopes that gather information in space and transmit it to us are still at the forefront of our current understanding of the universe. In a similar way as well, microscopes allow us to see into a nanoscale world. These human-designed and built instruments at the same time open up new aspects about the world before our eyes, as well as becoming essential components of our self-constructed subjective *Umwelt(s)*; our perception of the world. They plug into the biological human sense, in this case sight, extending its capability beyond the natural competence.

In a comparable way, wearable technology plugs into the human body to enhance the body's abilities beyond its biological ones and extend our understanding of our potential. Body-worn technology becomes a firm part of the individual's constructed *Umwelt* through its impact on human capabilities, subsequently influencing one's subjectively formed perception of the world.

For example, devices that are both networked and wearable make the emergence of a new kind of space, which includes features from physical reality and virtual networked reality, possible. Merged together, these two realities form a *hybrid environment*. It is important to realise that the *hybrid environment* appears individually for each person on the basis of his or her subjective construction of it. It is very similar to how Jakob von Uexküll described the organism's subjective *Umwelt* in a biological world (Uexküll 1934). On that basis, one could argue that the emergence of a *hybrid environment* is dependent on the existence of technological networked infrastructure, and the formation of a personal hybrid *Umwelt* is dependent on the physiological abilities of a human, some of which are innate and some are (currently) technologically constructed; the crucial one for the *hybrid environment* being the newly designed networked faculty of a human body.

This research experiments with the construction of the above-described situation by creating networked technological artefacts in intimate proximity to the body. The starting point

has been the concept of the hybrid *Umwelt*: the interplay between a body's faculties and their relation to the construction of the *Umwelt*. In other words, the way in which technological additions to a human body's faculties, together with its natural biological faculties, form a perception of the world, which cannot be achieved any other way. The focus has been on the experimental approaches that concentrate on holistic body-involved experiences of presence, space and the construction of subjective networks of relationships, which form one's individual hybrid *Umwelt* as the base for one's identity in a *hybrid environment*.

Both Galileo in his time and the *Hybronaut* in the current techno-organic constellation of the world, have been exploring the new perception of the world and extending space. This chapter reports on a series of art projects, the *Hybronaut* equipment, that encompass the body of practice developed in the course of the present study. The practical experiments carried out while investigating the topology of wearable technology, its networked nature and experimental use, have been necessary in order to comprehend the nature of the experiences, and their potential. This chapter details three projects (and summarises several others) that were conducted in order to examine various aspects of body-worn networked objects and devices.

Equipment for the Hybronaut is the umbrella title for a series of three art projects that encompass the body of practice developed in the course of the present study. The first part describes the projects *Appendix*, *Empty Space* and *Heart-Donor*. These works are presented on the DVD that accompanies the dissertation, and can also be accessed on the author's website.

VII.1.1. *Appendix* 2011

The project is a wearable, networked tail constructed and designed for a human (for the *Hybronaut*). In the core of the *Appendix*-tail are the relations between body and technology and between the human and his/her surrounding environment: all elements, being increasingly based on technological, or artificially created, features and connections.

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42. Figure: *Appendix* 2011. Photo © Laura Beloff.

The *Appendix* is constructed as a robotic tail, which is connected to a (mobile) network. While in use, the *Appendix*-tail becomes a newly established body-part and a techno-organic faculty of the wearer. It is a technological member of a body and its movement is controlled by two networked non-human entities. The current version of the tail has two data connections: Firstly, a connection to natural phenomena; the tail receives real-time data regarding the wave height of the sea, which can be observed in the tail as an upward movement. Secondly, a connection to a system; the tail follows the real-time data of a city public transport system and uses a specific gesture to signify the current/real-time direction of a tram.

As the author described in the chapter IV.4.4., the name *Appendix* was taken in reference to the human appendix organ, which operational and beneficial factors are still under debate. In a similar sense the author's *Appendix* work is left without a clearly defined purpose. It places the user of the *Appendix*-tail into *hybrid environment* with a new technological organ. But the user is not expected to control this moving organ, although it becomes part of his body and his *Umwelt*. The tail movements are signs of connections in *hybrid environment*. The meaning of the work is intentionally left open; it is an experiment investigating a certain situation with network wearable technology. The work is an open experiment with the possibility of revealing new insights into the issues at hand.

In parallel to its physical existence, the *Appendix* extends the *Hybronaut* with an invisible "tail" of relationships, which have an effect on his evolving worldview and define his identities. The users become aware of being connected to a networked environment that includes elements outside of routine purpose. The physical experience advocated by the work directs users towards the possibility of perceiving and experiencing the world as a techno-organic environment. It anticipates that many of the connections to various human, non-human, artificial and organic entities will be increasingly (re-)constructed and modified by technology in the future. In the current version of the *Appendix* work, the relationships include human-constructed systems and natural phenomenon. These relations and aspects become a part of the *Hybronaut's* hybrid *Umwelt* and also an essential part of him as the *Hybronaut*. The work also demonstrates that not all relationships are selected by oneself, but that there are many arbitrary, and possibly absurd, relationships that may become part of one's subjective *Umwelt*. The *Appendix* work concretely merges the techno-organic body with the techno-organic environment.

Produced in 2011 with the support of a Central Art Committee of Finland production grant. Programming: Joseph Knierzinger and Filip Cruz. Support: Erich Berger and firstfloor-server.

43. Figure: *Empty Space*, 2009. Photo © Laura Beloff.

VII.1.2. *Empty Space* 2009

The work *Empty Space* was initiated on the basis of the following thoughts about the everyday life of a human: "Our lives are full of people, events and things which completely fill up our world and time. These worlds are organized and full until an occasional loss of someone or something leaves an empty space in it. This empty space exists until it gradually fills up again."[131] The *Empty Space* work became a physical instantiation of this idea; the invisible empty space that may occasionally enter our lives.

The work *Empty Space* consists of a wearable transparent capsule, which is constructed as a vacuum. This actual physical object is offered to the general public for use. It is designed to be worn within people's everyday lives: at home, out on the streets and anywhere else they happen to be. The piece is equipped with a networked small screen, which constantly displays the currently scheduled dedication of the piece. This means that the general public are offered the opportunity to dedicate the piece temporarily to their own needs via an online website: www.emptyspace.info. Anyone can reserve a date/hour/minute within the 3rd millennium during which time the capsule will be dedicated to that person's cause; be it a private and personal or universal cause with an impact on the entire globe. The dedication, the short text submitted, will be shown on the small screen attached to the capsule at the set time and date.

The *Empty Space* is accessible for public dedications through an online site and these dedications will be visible on the physical and wearable capsule, which is available to and dependent on public use. The *Empty Space* work cannot *perform* without the participation of the public, rather it is dependent on it; the work requires *wearers* of the capsule and dedications by people. The persons who are wearing the *Empty Space* will be volunteering for other people's needs, as well as their own, by carrying the capsule irrespective of whose dedication is displayed at that moment in time.

The work *Empty Space* is constructed specifically for the *hybrid environment*; it locates the user of the *Empty Space* concretely in a *hybrid environment* and makes apparent the socially and

[131] http://www.emptyspace.info [accessed 12.12.2011] Texts by Laura Beloff 2008.

technologically networked world in which our lives are entangled. In this work, technology is no longer seen as a utility, but part of our everyday existence. In a way, the work can be considered as a "traditional", material-based sculpture, which manifests existence in a *hybrid environment*. The inherent feature of *hybrid environment*, mobility, is demonstrated by its dependency on humans; the sculpture travels on the back of someone.

The sculpture is dedicated to the individual's feeling of loss; this *memorial* object offers itself as an available service in a *hybrid environment*. The use of this object is based on human relationships; a human is considered as a node and the necessary component, which enables this networked object to "perform". The relationships established globally through the object are more or less arbitrary, but at the same time, very concrete. The personal dedications made not only appear in public on this sculpture, but they also enter the *Umwelt* of the *Hybronaut*, who is carrying the object. This work addresses aspects which are deeply related to being a human in a *hybrid environment* and which are rarely addressed by other technological devices or applications.

With a similar sensibility to Sophie Calle's work *Suite Vénitienne*, which is described in chapter IV.2.1, this work establishes connections between strangers. These connections appear for a shorter or longer period and vanish as easily as they are established, leaving behind only a trail of evidence. Both of these works posit a perception of the world, which is based on multiplicity of relations and randomly born connections.

Produced in 2009 with the support of a Central Art Committee of Finland production grant. Programming: Lluis Gomez I Bigorda, Erich Berger. Support: Attacksyour.net-server (currently transferred to the firstfloor-server).

VII.1.3. *Heart-Donor* 2007

The work *Heart-Donor* investigates the immediate human presence in the techno-organic *hybrid environment* and within a subjective social network. Similarly to the other works described above, this work takes its point of departure from a reflection on the differentiation of the virtual

and physical layers of the world. The *Heart-Donor* apparel is specifically constructed as an apparel addressing presence in a *hybrid environment*.

44. Figure: *Heart-Donor* by Beloff & Berger with Mitrunen, 2007. Photo © Anu Akkanen.

As introduced in the chapter IV.3., the *Heart-Donor* vest enables the user to collect 30 recording of heartbeats into the vest. These are intimate mementoes of persons one is close to. The recorded heartbeats will be stored into the vest and presented as small lights that blink in the rhythm of the recorded hearts.

The second layer of the *Heart-Donor* work deals with social media and the concept of presence in virtual and physical realities. After recording the heartbeat, the user is asked to submit his/her Skype name to a custom program created for a mobile phone. The light on the *Heart-Donor* vest blinks the user's heartbeat in green as a default, but after submitting one's Skype name it can also blink in red, if the person whose heartbeat is recorded and stored by a specific light goes online with Skype. In other words, the light blinks in green when that person is offline and in red when he or she is online with Skype. The owner or the user (the *Hybronaut*) of the vest can

observe his or her personally selected network of people shifting their presence between the physical and the virtual layers of the world, independently of their geographical location.

As concretely constructed apparel, *Heart-Donor* encapsulates the user's body and locates him within a continuous *hybrid environment*. The *Heart-Donor* vest is not created to be a tool, nor is it defined as a function aimed at specified tasks. It is apparel, which facilitates everyday existence in the *hybrid environment*. With the *Heart-Donor* vest, one not only becomes an observer of the techno-organic constellation of the world, but also a part of it.

When this work was realised, in early 2007, network-based social media were just beginning to become part of our everyday practices and Skype[132] was at the time one of the most popular social media applications. These kinds of applications and practices are transforming the concept of (human) presence from a physical, materially based concept into a perception of presence that is linked to technology. There is a whole generation within the western world, which is growing up without the knowledge of what it is like to be disconnected. The world is always online and we are continuously plugged in and linked up. This has become one of the defining factors of who we are and how we identify ourselves. The *Heart-Donor* work critically proposes that the *hybrid environment* should be increasingly investigated as a living environment – a place to be – rather than merely a communication channel as it is still commonly treated by current (commercial) mobile devices and their functionality.

Techno-organic life in a networked *hybrid environment* creates presence and its meaning in a new, different way. In this kind of situation, meaning is produced in cooperation between technological artefacts and organisms (e.g. humans) within one's subjective *Umwelt*.

Produced in 2007 in collaboration with Erich Berger and with assistance from Elina Mitrunen. Productions grant by Digitally Yours exhibition organization. Programming: Erich Berger, Aleksi Pihkanen. Support: Attacksyour.net-server

[132] Skype's first public beta-version was released in the autumn of 2003. [http://en.wikipedia.org/wiki/Skype]

VII.2. The Research Process and Initial Stages

45. Figure: *Hame*-installation by Beloff & Decker, 2000. Photo © Laura Beloff.

Initially this research stemmed from the author's long-term artistic practice, which for almost a decade has primarily focused on networked wearable technology art. Prior to embarking on this research journey there was an existing series of artworks by the author, which marked out the direction and area. However the author's art praxis was without an articulated theoretical framework and was in need of a profound research objective. This was the starting situation for the research. The aim was to analyse the author's interest area and develop a theoretical framework around her praxis.

The growing interest in wearable technology by creative people during the first decade of the 21st century influenced the development of the field and initiatives for interest groups that exist today. The first *networked* wearable technology work by the author, the *Seven Mile Boots*, 2003-2004, was developed without a real knowledge of the developing field. This work was a continuum for the author's already existing interest in developing works with technology embedded into clothing, which is seen in the author's earlier experiments, such as the *Hame*-installation, 1999-2000 (Figure 45), that was using wearable jackets as a user interface for stereographic interactive installation[133]. In addition the author's interest in the combination of

[133] The Hame-installation, 1999-2000, by the author in collaboration with Markus Decker. http://www.saunalahti.fi/~off/off/hame.html [accessed 10.4.2012]

physical world and virtual network is seen e.g. in the voodoo doll project *Nu-K-ke*, 2001 (Figure 46), which was created as a soft networked doll that could be stabbed with a needle[134].

46. Figure: *Nu-K-ke* installation by Beloff & Praxmarer & Lindinger, 2001. Photo © Laura Beloff.

There exists a clear trajectory of works by the author throughout last decades that present how the author's interest towards wearable technology was growing with a strong conceptual base and with an emphasis on the human as an actor in the world. Wearable technology as such was never the main focus or purpose of the works, but the form proceeded from ideas that involved a human.

This dissertation is based on research with two simultaneous facets; one which contains the practical side of constructing the actual wearable artefacts and one which is reflecting on the practice-based experimentation in written analytical format. Both processes informed each other; the development of practical works were impacted by the theoretical research and the actual

[134] The Nu-K-ke, 2001, was collaboration with Christopher Lindinger and Robert Praxmarer. http://www.saunalahti.fi/~off/nukke/ [accessed 10.4.2012]

construction of the works influenced the analytical research. The major part of the research was carried out through practical methods of developing new ideas and realising new works. Parts of this process were done in collaboration, which is introduced in the following chapter.

VII.2.1. Collaboration

Collaboration has been one of the practice-based working methods of the author for many years. The author's production has included several collaborations in different degrees, as well as individually produced works. Collaboration has proven to be a successful method for the author. Also in this research similar collaborative methods were employed.

The most of the collaborative projects realised throughout the years by the author have typically been initiated by her. Typically by starting a discussion on a specific conceptual idea and proposing it for potential collaborators. One of the very few exceptions is the work *Heart-Donor*, 2007, which was from the very first concept initiated together with artist Erich Berger. From the three art works submitted with this dissertation the *Heart-Donor* is the most collaboratively developed and realised work.

The conceptual development for the *Heart-Donor* was done through long discussions between the author and Erich Berger. Also technical solutions and physical construction was discussed and developed together (the detailed process of development is described in chapter VII.3.1.). After the conceptual idea was developed, designer Elina Mitrunen joined the team to help in the realisation of the actual physical garment and as an expert in textile materials. Because all the team members had a different background expertise, it was natural to divide the workload accordingly for the efficiency of the actual production. The practical work input can be roughly divided in a following way: Laura Beloff – conceptual development, physical construction, design, interface solutions, Erich Berger – conceptual development, technical implementation, interface solutions, Elina Mitrunen – design, physical construction, textile solutions, Aleksi Pihkanen – support in database construction. However in the process of making there were continuous

crossover situations. Large parts of the work were solved, decided and constructed together sitting side by side on the same table.

The obvious benefits of collaborative work in the *Heart-Donor* project were inspiring discussions that shifted between conceptual ideas and practical solutions. The team was also very successful in avoiding compromising solutions concerning the artistic and conceptual aspects of the work. However, it also became apparent that it requires much more effort to take a step back from a decision once it has already been made, when it involves several people in mutual collaboration, than when working more independently.

For the *Heart-Donor* project the group received a small amount of funding, which was used for materials. None of the artists received any fee for their work.

During 2008-2011 the author realised the two other works, *Empty Space* in 2009, and *Appendix* in 2011. During these years, partly due to the author's life circumstances, a fully developed collaboration like in the *Heart-Donor* project proved impossible. As well, the author's limited availability of time influenced the production method for the works. In both cases, the author received some funding for the realisation of the works that was directed for materials. This funding also allowed that the author was able to look for interested collaborators who would receive a small fee for their work.

The division of the work for *Empty Space* was done in a following way: Laura Beloff – conceptual development and construction of the actual physical object, instructions for programming, organisation of the project and its requirements, Erich Berger – Python programming for mobile phone, Lluis Gomez I Bigorda – construction of the online database. The work *Empty Space* was deliberately designed to have a simple technical structure. Both collaborators were necessary because of the author's limited programming skills on Python and PHP-scripting and for the efficiency in usage of time. The project was realised without any shared face-to-face meetings between the author and the collaborators, instead all the discussions were

done via email. The discussions concerned primarily technical and practical solutions and requirements for the realisation of the work. (The detailed process of development is described in chapter VII.3.2.)

The work *Appendix* followed a very similar method than the *Empty Space*. The conceptual development was done by the author alone, also the method and construction for the physical movements of the tail were designed by the author. However, the tail's movements required simultaneous programming and experimenting with a physical prototype of the tail. This was done in collaboration with Joseph Knierzinger while the author was artist-in-residence in Vienna during early 2011. In practice this meant long hours of sitting together and experimenting with motors, materials, physical movement of the tail and programming. After the first functioning prototype was realised the author continued testing and developing the work alone. The major components of the work were developed with the following division: Laura Beloff – conceptual and aesthetical development, design for technical solution, construction and design for the physical object, instructions for the programming, organisation of the project and its requirements, Joseph Knierzinger- initial programming for Arduino, programming of the GPRS-shield, technological and physical implementation together with the author, Filipe Cruz – PHP-scripts for the GPRS-connection and parsing of the online data, Erich Berger – provided technical support and help with problems, which the author was not able to solve by herself. (The detailed process of development is described in chapter VII.3.3.)

It is clear that the collaborators impact the work in progress in one-way or another and in spite of the amount of their input. The author's chosen methods for collaboration in these realised works have been impacted by her changing life situations (e.g. living in various countries) and the availability of time for the work. The chosen collaborative methods have enabled a certain kind of efficiency of working that has made the realisation of the works possible. It has been self-evident for the author to find collaborators for the parts of the projects, e.g. programming, which would

have otherwise required large amounts of time from her. However, the author's viewpoint is that the most fruitful and inspiring collaborations are the ones where everyone is fully involved with the project. In these kinds of situations the collaborative working methods open up much wider perspectives, as well one's ideas and thoughts are challenged by the others (in times both good and bad).

VII.3. Making of

This study has previously mentioned the fact that the author sees her artistic practice as a kind of free laboratory work within everyday environments, with the potential to bring forth new, unexpected aspects. Such an open working method always includes an element of uncertainty; one can never be exactly certain how the work will develop. This also means accepting the possibility of failure as part of the research process. However, it is important here to note that what someone else may consider a failure might not apply to the artist's point of view. The evaluation criteria differ depending on the aims, background and motivation of the creator. The artist's aims can be completely different from general expectations of anticipated results. This is visible in the wearable technology field, for example when comparing the results from engineering-oriented approaches in wearable computing with the results emerging primarily within the arts. Since the goals and methods are built differently, the nature of the resulting projects is also often different.

The personal, subjective perspective, which is often at the foundation of art making, provides an alternative viewpoint to the general direction and methods already established. Projects, which are typically emerging within the arts, are excellent examples of this. The artistic works of the author rarely focus on developing purposeful functions and their implementation, but rather examine the conceptual, aesthetic or philosophical questions through practice-based experiments. An additional aim is the production of the first-hand experience, which the works offer for the users.

The following chapter will give an account of the actual practical construction of the author's previously described projects, the *Heart-Donor*, the *Empty Space* and the *Appendix*. The three works that encompass the body of practice were developed consecutively and within a larger series of wearable technology artworks throughout the years. The work *Heart-Donor* was realised in 2007, *Empty Space* in 2009 and *Appendix* in 2011.

VII.3.1. The Making of *Heart-Donor*, 2007

The *Heart-Donor* work evolved from the earlier work *The Head (wearable sculpture)*, which was the first work by the author that was technically based on the mobile phone network and technology. *The Head* work investigates social and technological structures in everyday circumstances.

Dealing with the general idea of a networked human and his connectedness to other people, the work *Heart-Donor* focuses specifically on the importance of presence in social networks, combined with an idea about small mementoes of loved ones that people typically carry with them, such as photographs in their wallets.

47. Figure: *Heart-Donor* in progress by Beloff & Berger with Mitrunen, 2007. Photo © Laura Beloff.

After the main motivation for the work had been sketched out and framed, the heartbeat appeared quite quickly as an idea for a collectible and intimate memento of a person. The first idea for the work had several people's heartbeats in real time on a user's garment. However, after investigating the technological requirements the author realised that this idea would require

people wearing three heartbeat electrodes continuously. This would have meant that the project would need major organising and maintenance and would not be suitable for casual everyday use. The author concluded that the project needed more development.

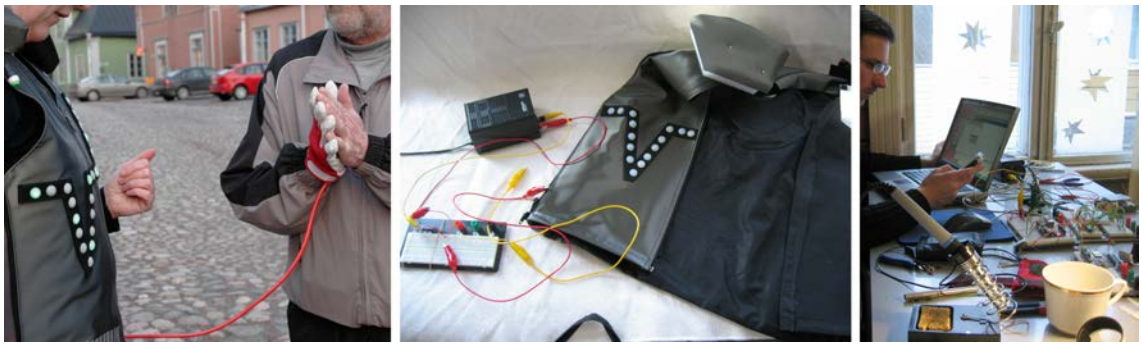
The time during 2006-2007 was an early phase of social media; hanging online simultaneously in the presence of others on a computer had just recently begun and Skype was one of the most popular social media applications at the time. Typically people were keeping the Skype interface continuously open and active on their screens, even if they were idle themselves. This was emerging activity, which was involving the idea of presence in *hybrid environment*; to be present and reachable by others at all times. This feature developed to become part of the work. The work aimed at developing a possibility where a user could select his personal network of people whose heartbeats he could record during a physical encounter. The heartbeats would be represented as small blinking lights and the colour of each blinking light would be determined by the person's presence online (Skype) or offline; green or red.

The next phase in the project was to investigate technological possibilities for realising the idea. The technical system could be divided in two parts. The online part involved Skype, network and mobile communication, while the other part focused on a possibility to record and store heartbeats.

The investigation revealed that it was possible to programme a Skype Add On, a small application that could read and write to the created server database. This developed server database was keeping track of the people's status on Skype, as well of the previously recorded heartbeats. In addition the technical system needed a way to fetch the data from the server. The author decided on a mobile phone, due to its successful use for data connection in the previous work. The advantage of the mobile phone in comparison to a Wifi-connection was that it could connect almost everywhere without any additional set ups. This also meant that the work could actually be used on the street and within everyday life without restrictions on locations. The mobile phone was used for collecting the data from the server every few minutes.

The ArduinoBT (Bluetooth) micro-controller was paired with the mobile phone for data exchange. The ArduinoBT was sending the heartbeat recording data to the mobile phone and it was receiving the current online status of the people back, which had been collected by the mobile phone from the server database. Based on this data the ArduionoBT controlled the colour and the blinking of the lights through a custom-made hardware driver.

To be able to record the heartbeats required an extra circuit, which was connected to an ArduinoBT micro-controller. This was obtained directly from Tunturi, a company that specialises in sport devices, including heartbeat sensor systems. The interface for detecting and recording the heartbeats was constructed as a textile and leather based glove for the *Heart-Donor* vest. The glove was made with four sensor pads. The conductivity of the pads was tested with various materials that were drenched in liquid conductive polymer of different strengths. A heavy cotton fabric proved to work the best with the most conductivity even after washing. This development resulted in a single glove interface; when a person put the glove on and pressed both hands together, the heartbeat could be detected and recorded. The final version of the vest had a possibility to record 30 different heartbeats.



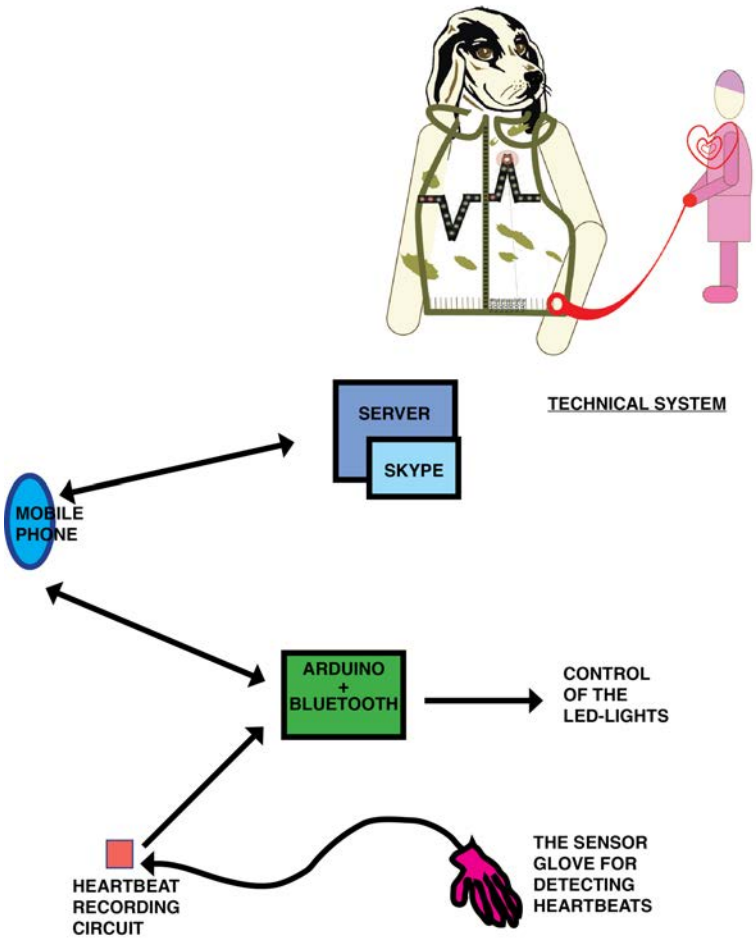
48. Figure: *Heart-Donor* in progress by Beloff & Berger with Mitrunen, 2007. Photo © Laura Beloff.

The entire technical system was embedded into a textile-based vest. Also the glove-sensor for detecting and recording the heartbeats was permanently attached to the vest. The vest was constructed from textile, plastic stuffing, zippers and various electronic parts. All the technological components were embedded into padded compartments, keeping them safe. The sides of the vest were designed with extendable parts that enable some adjustments for size. The

cover textile was chosen because of its lotus-effect surface that rejects dirt and can simply be wiped clean.

One of the practical problems in the work was realised only afterwards. Originally it was imagined that each recorded heartbeat-light had a name connected to it, which was done manually on paper and placed in small pockets on the hem of the vest. This proved to be too complicated. The next solution was an automated visualisation on the mobile phone that showed the recorded names and the arrangement of the lights. This system worked better than the previous one.

The aesthetics of the work developed parallel to other parts; the vest took its inspiration from a life jacket, the shape of which it ironically imitated. The blinking LED lights were embedded on the front of the vest to form an iconic and *kitchy* image of a heartbeat curve. The work was an early experiment connecting real time social media to a physical and wearable artefact.



49. Figure: The *Heart-Donor* technical system, 2007. Image © Laura Beloff.

The full list of hardware and software components used in the work:

ArduinoBT (Bluetooth) board –with custom programme controlling the entire technical system.

Hardware display driver – custom-made for driving the 60 LEDs via Arduino.

LED display – constructed out of 30 red and 30 green LED lights embedded into the vest.

Mobile phone – Nokia n90 with Symbian operating system and custom written Python s60 software for communication between Arduino and the server.

Heartbeat sensor circuit – producer: Tunturi.

Heartbeat sensor glove – custom-made textile based glove with conductive polymer applied on cotton. Conductive polymer producer: Panipol.

Server – running Apace webserver, custom written PHP-scripts and mySQL database.

Computer – running Skype with custom written Python Skype Add On.

Battery pack, recharger, on/off switch – regular electronic components.

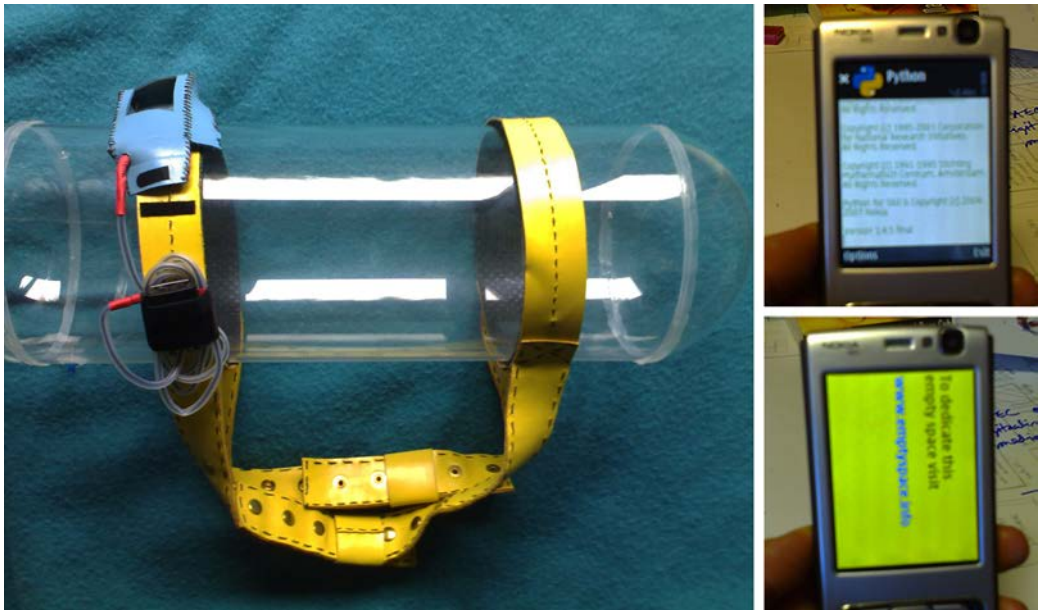
VII.3.2. The Making of *Empty Space*, 2009

The *Empty Space* begun initially with a thought about loss and its concrete relation to a physical artefact or a person. Loss of something means that something has vanished and is no longer in its physical existence part of one's *Umwelt*. The idea was to construct a work, which could commemorate a loss in *hybrid environment*. The project was divided into two parts; one part is the created physical artefact travelling with a user, the other part is the technological network, which attaches the artefact and a user to the *hybrid environment* and enables the public use of the service.

The motive for the *Empty Space* artefact was an idea to create it as a physical object correlating to an idea of memorial. This correlation was ironic, because traditionally memorials are fixed and heavy physical monuments. However, the author's version of the memorial takes an atypical form. At the same time as the artefact is physical, it is also a *real* empty space, a vacuum. In other words, it is a physical instantiation of a loss, which has left an immaterial empty space to

one's subjective *Umwelt*. In addition, this memorial requires a vehicle to move around the world and be visible for the public. The user of the work, the *Hybronaut*, becomes that vehicle.

The *Empty Space* aims towards a viewpoint where the self is seen in relation to others in the *hybrid environment*. The self is not perceived as the centre node from which all the connections start, but as a single node among other nodes in the network. As a comparison, the *Heart-Donor* and the *Appendix* focus on the user as the centre point. The *Heart-Donor* is based on the user's possibility to choose and create an own network of people and the *Appendix* is an additional organ created specifically for the user's body. In turn the *Empty Space* is more rigorously in the service of others in the *hybrid environment*. In other words, the work itself is availing the user as a vehicle and a functionary, being a person who acts as a function of the apparatus (Flusser 2000) without necessarily realising it himself.



50. Figure: *Empty Space* in progress, 2009. Photo © Laura Beloff.

The physical object combined with the user is connected to a continuous *hybrid environment*. Through the online website the public can reserve the *Empty Space* for their purpose. The user of the work will exist in *hybrid environment* as a kind of service-giver, whose service is open to others through a technological network. The perspective of the work is not focused on the individual,

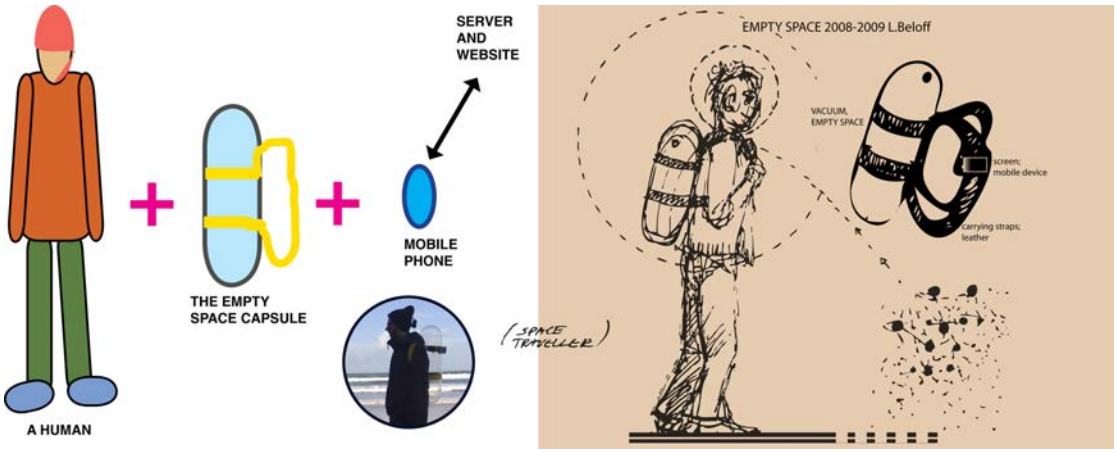
but on an individual as a part of open and wide network. The user is a node in a network among other human nodes, which he also services.

The ironic approach of the work is also seen in the visual aesthetics and form of the work. When a user carries the transparent capsule on his back it creates various immediate associations. The user with a capsule will remind one of an explorer of extreme environments, who traditionally carries the terrestrial environment with him to be able to survive, such as an astronaut whose equipment provides him with oxygen, heat and gravity among other features. In this case the user is carrying the necessary equipment to be able to exist in the continuous *hybrid environment* in the setting designed by the author. The work experiments with how intentionally built ironic features can intervene in expected circumstances and generate a situation which opens itself up for new viewpoints and enables original interpretations.

51. Figure: Sketches of *Empty Space*, 2008. Photo © Laura Beloff.

One of the focus points of the work was the design of a suitable object that would be able to retain the conceptual idea and technical system for the work. The chosen object is a custom-made polycarbonate capsule, which is pumped empty of air through a one-way valve. The carrying straps and pocket for the mobile phone are crafted together from leather. The recharging cable is permanently attached to the phone, the users are asked to recharge the work during the night. Maintaining this work does not require any special skills; the work is easy to reboot and restart in case of problems. The main detected problems have appeared with different phone service companies, whose protocols vary from country to country.

The technical setup of the work is executed in the simplest possible manner. It includes a mobile-phone with a custom written program, an online web-server set up with PHP-scripts and mySQL database, which enable communication between the *Empty Space* capsule and the network, a public website where the dedications can be submitted, and a human, required for carrying the work around.



52. Figure: The *Empty Space* construction, 2009. Image © Laura Beloff.

The full list of hardware and software components used in the work:

Mobile phone – Nokia n95 with Symbian operating system, running custom written Python s60 program.

Server - running Apace web-server, custom written PHP-scripts and mySQL database.

Website – for reserving time and submitting a message.

53. Figure: *Empty Space* by Beloff, 2009. Photo © Laura Beloff.

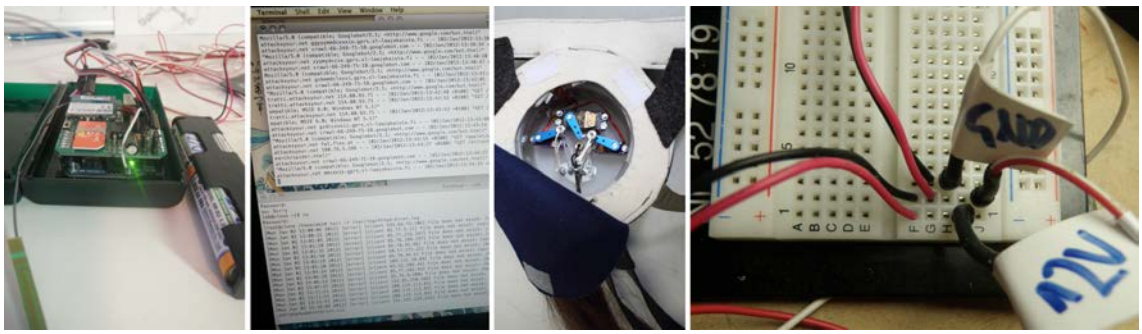
VII.3.3. The Making of *Appendix*, 2011

Having previously made works that were constructed as wearable, but which did not directly aim for visual anatomical modifications of the body, the work *Appendix* was specifically designed with this in mind. Previously produced works were focused on connections between humans in the *hybrid environment*. In *Heart-Donor*, as well as *Empty Space*, the *hybrid environment* is largely perceived as a network structure between people. In the process of their construction, the chosen connections in these works were carefully thought out based on conceptual ideas.

The *Appendix* work is intentionally taking bigger risks. The *Appendix* is a networked tail designed for a human. Firstly, it is based on two non-human connections, one to natural phenomenon and the other to an artificially constructed system. The tail receives real-time data from both connections, which affects the robotic movements of the tail.

54. Figure: *Appendix* by Beloff 2011. Photo © Laura Beloff.

One of the challenges for this work was the actual construction of the tail with its robotic movements. The aim was to minimise the electronic components that are required for moving the tail. For complex and larger movements, it would require more and heavier technological components. The agreeable solution was to make a short stub of a tail moving with motors, and extend that with another fluently moving *passive* material. In this way the motors could be fairly small and light, with reasonable power consumption, and the tail would still have some length. The idea for the moving parts was adapted from a wooden mechanical snake toy, which moved fluently in a horizontal direction, but not a vertical direction. With small adjustments it was possible to use the same principle but adapt it to move in all directions. For the passive extension of the tail the author tested glass fibre, which has an ability to transport light, but it proved to add too much weight for the tail to be able to move. The second and final solution was to use horsehair.



55. Figure: *Appendix* in progress, 2011. Photo © Laura Beloff.

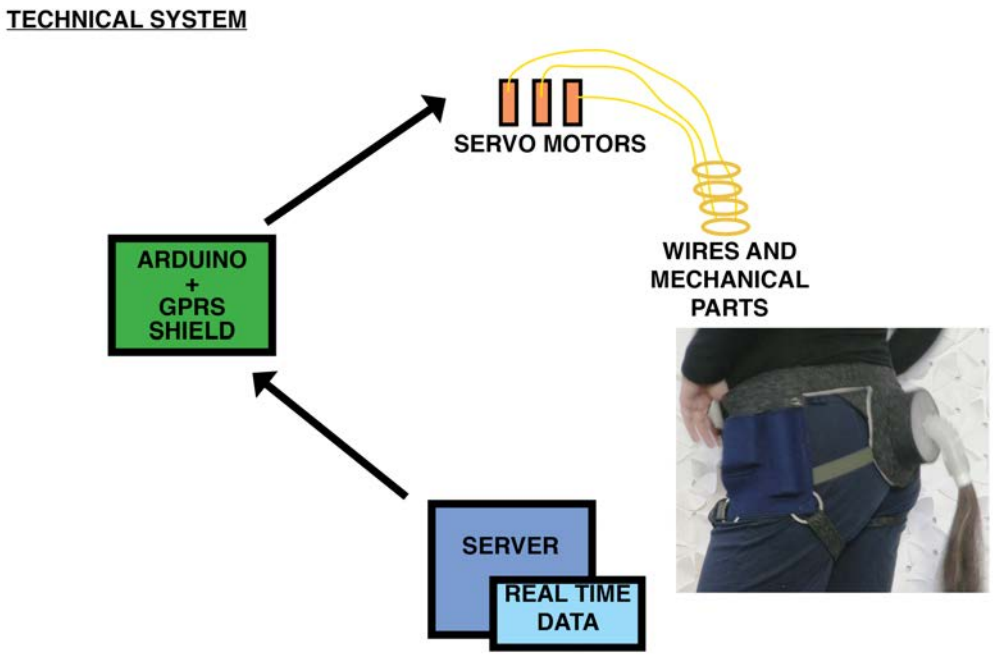
The online server set up was in principle similar to the *Empty Space* set up, with small PHP scripts handling the network data. The physical tail is installed with an arduinoUno micro controller, which receivesthe online data and controls the motors accordingly. It was possible to avoid the mobile phone as the device for data connection, as there was a GPRS-shield available for arduino that could handle the data communication. This aspect considerably lowered the construction expenses for the work. It also made the technical set up in its entirety to be cleaner and simpler. From the two newly available models of GPRS-shields one was chosen. The challenge was that the shield needed to be programmed with traditional modem commands (AT). It also required extra power to be able to establish the data connection. This was solved by providing an extra battery pack. In the final version the physical tail accommodates two battery packs with four batteries each, the arduino board with the GPRS-shield, and three servomotors.

56. Figure: *Appendix* in progress, 2011. Photo © Laura Beloff.

The original plan was to embed the tail into leather shorts (lederhose), but this proved to be difficult and clumsy. The second attempt was to make the shorts from a softer and more

flexible material, for which industrial felt was chosen. Neither was this solution satisfactory, the shorts required too much effort in dressing and it took attention away from the actual tail. Also, the shorts made the work feel too much like dressing up for a role. The final solution was to make a simple belt-like construction from industrial felt with pockets for the technical components and an adjustable and robust attachment system. This solution has proven to be functional and simple to use.

The original sketch for the *Appendix* also included a plan to have a connection to humans via Twitter, but during the process of constructing and testing, the work developed clarity and the author decided to leave out that feature although the scripts for it already existed. The author has also now realised that the best solution for this kind of work would be to programme it in a manner that would enable easy and fast changes in the connections. In other words, both the actual (data) connections and their affect on the tail movements would be easy to change and modify. This would support, firstly, experimentation with various connections, secondly, investigation on how the meaning is conveyed in this kind of work, and thirdly, it would enable research on possible differences between distinct connections and their ability to become part of one's body and *Umwelt*.



57. Figure: The *Appendix* technical system, 2011. Image © Laura Beloff.

The full list of hardware and software components used in the work:

Arduino Uno board –with custom programme controlling the servomotors.

GPRS shield for Arduino – obtaining the data from the server.

Servo motors – creating mechanical movement by pulling strings.

Server – running Apace webserver, custom written PHP-scripts and mySQL database.

Battery packs – regular electronic components.

VII.4. Wearing, Using and Presenting the Works

This kind of author's artistic practice, like the author's, which is clearly focused on the creation of experiences with a research-centred approach, and which is based on the development of concepts and processes rather than the construction of objects and installations, is somewhat resistant to the traditional context of museums and galleries. However these above described three works have been mainly shown to the public in traditional art settings such as in museums, other exhibition venues or art events. Occasionally the works have also been shown on catwalks or privately to individual viewers. The works have always been physically presented within the art context, but in journals or other media they have been referenced also in the context of design, technology or innovation.

It has become obvious to the author that exhibiting these kinds of wearable works is challenging on many levels. These works demand an audience that is willing to participate and more planning, arranging and maintenance from the organisers than might usually be expected from visual artwork. Yet, the author has strongly wanted to have the works presented publicly within the art context and not outside of it, which is the case when organising the use situations privately. The following chapter describes the presentation situations and their challenges in more detail.

VII.4.1. Presentation of works

Even if the above-described works by the author have been conceived for individual long-term use, in practice, the works are often exhibited and experienced in short-term situations arranged in the context of museums or festivals; only on a few occasions have the organisers been able, or willing, to create an opportunity for a longer-term adaptation of the works. For example, the earlier work *The Head* was offered for longer-term public use in the context of the Urban Interfaces[135], 2007, exhibitions in Oslo and in Berlin. This was found to be quite successful, although it required more work and new arrangements from the organisers. For example, in Berlin, *The Head* (the actual work rather than a user of the work) received private invitations to appear at private parties and other events.

Primarily the author's works have been invited to be shown in exhibitions organised in traditional ways. In a few cases the works have been rejected by an exhibition venue after realising the way the works are intended to be exhibited. The main problem detected has been the author's request for an offered possibility for the public to be able to take the work with them outside of the exhibition venue; in which case the exhibition would only have the documentation present and occasionally the returned work. To solve this problem, the author constructed two almost similar pieces of the *Empty Space* capsule; one aimed for public use and one presented in the exhibition venue. Nevertheless, this solution did not much improve the overall situation. Additionally, the *Empty Space* work is also offered privately on its website to interested volunteers for use: in the case of interest the work would be shipped to the volunteer who has agreed to wear it when in public. After the period wished by the volunteer, the work would be returned back to the author. Until today, no one has contacted the author with this request.

In general the majority of the venues where the works have been presented have been somewhat reluctant to support the public use of the works, or the exhibition set-up has not allowed digression from the defined plan, for example in cases where many different works by different artists have been presented strictly in a similar manner on dummies or hangers. Usually

[135] http://oslo.urban-interface.net/ [accessed 20.12.2011]

these situations have been made clear in advance, and in some cases the author has developed an installation set-up for the work (typically requiring e.g. different electricity connections).

The privately organized use of the works has been partly successful but also problematic in some ways. For example, the audience reach is very limited with a single long-term user, usually including only the author's and the user's closer networks. The lack of 'official' art context is also perceived as problematic. The official mark of being art and belonging to a 'real' artistic context is seemingly important for participants to be seriously interested and willing to wear the work in public.

The public presentation of the works is an unsolved problem for the author. This problem is not solely coming from the organising side, but it is partly also present in the resistance of the public to actually take the work for use, which is described in the next chapter, as well as conclusions that one can draw from it.

VII.4.2. Audience Resistance

Like mentioned above, there has been a noticeable resistance on the part of the participating audience towards a long-term usage of the works. It is apparent that people are very eager to try out the works in the safety of exhibition settings, but the idea of having an artwork with them that is visible to others still needs to mature in their minds. That said, there have always been certain individuals who have, or would have taken the opportunity for long-term use, if it has been possible. However, for the majority of people, understanding the concept of the work, seeing it worn by someone else and/or experiencing the work concretely by physically testing it out for a short moment has provided the desired and satisfactory content. On many exhibition occasions, this kind of on-the-spot use has sparked interesting discussions with the author, or commentary on the work and its further potential and use of technology. Other aspects of the works, which expand beyond the exhibition place and time such as the possibility to take the work with one, have caused some degree of confusion.

This kind of resistance towards having these works in one's everyday life circumstances points to the relevance of Erwin Goffman's concept of performance of the self, whereby one presents oneself in the role expected by the audience[136]. Goffman claims that there is a tendency on the part of a performer to offer idealised impressions, which reaffirm the existing values of the community (Goffman 1959). This is firmly linked to one's construction of identity and self-image, which, in public situations, is connected to one's appearance and clothing, which may give clues about one's profession.

Additionally, the author sees in this resistance by the audience signs of irony in action. As it is claimed, irony is a situation where the first meaning presents itself as the apparent truth, but gradually the context of the first meaning reveals a contradicting second meaning or reality and the first meaning may suddenly seem limited or false (Knox 1973). Irony is a situation where one perspective is able to produce multiple conflicting perspectives, which direct the observer to distrust the first, often literal, meaning. It is apparent that the author's works cause a certain kind of distrust or confusion, which is visible e.g. in the public's partial resistance towards using the works. This confusion is caused by the contradiction in the elements and the context of the works. For example, instead of highlighting a user with sleek technologically savvy look, these works create a slightly absurd image of a human and technology, which is also emphasised through their unusual functionality. However, at the same time the works offer real, functioning technological features and very honestly constructed concepts. In other words, the conflicting aspects of the works and their relation to our present social, political and cultural reality are intentionally constructed by the author. The aim is to raise questions and reveal new perspectives for which irony -used in these works- has proven to be a functioning strategy.

When Galileo pointed his newly constructed telescope towards the sky and saw things that nobody had seen before, he went beyond an existing boundary. His investigations pointed to new knowledge that contradicted the prevalent understanding of the earth as the centre of the

[136] This is described in the thesis chapter IV.3.

universe, which was the truth advocated by the church. This situation is a concrete example of observing irony in real life; Galileo is simultaneously given two different perspectives, one truth by the church and another unexpected one seen through his technological instrument.

VII.4.3. Notes on Use

In the commentaries, which have been initiated in situations in which the work has been exhibited in the more traditional setting of museums or other exhibition venues, the works have inspired the users to imagine new ways of using them or developing their concepts further. One of the users once mentioned feeling very empowered by the works, even if there is no immediate action visible. Another user talked about being strongly aware of the connection and having a presence that was expanded beyond physical reality. In a presentation setting of an earlier work, *Seven Mile Boots*, one of the users proposed to create a similar function to his skis, which would enable him to ski simultaneously through the open landscape and through the Internet, whilst another user wished that he could simply shout to his friends on Skype through the *Heart-Donor* vest.

In one of the longer-term use situations, which was organised privately by the author, a user of the work commented that the wearable artefact completely changed her status on the street, from a fairly unnoticeable middle-aged woman with muted clothing to a distinctive performer, who seemed to evoke a different reaction on the street and attract direct responses from the public. The user of the work is usually advised to explain the work briefly to curious individuals and in addition, small printed flyers (with the url, the author's contact information and a brief description of the work) have been given to the user to hand out to people. This situation showed that the strategies employed by the author were successful. The peculiar aesthetics of the work were attracting the public's curiosity, subsequently leading to a discussion of the work and its potential meaning.

One aspect of the works, which has caused some degree of perplexity in the users, has been the different approach to technology present in the works. There appears to be a clear expectation of controlled use of technological devices by the users; the idea of participating in a project in which the user is placed in the position of an observer *and* as someone contributing to the possibility for others - who may or may not be physically present - to use the work, is clearly an unexpected feature. This shows how strongly we are accustomed to thinking of technology as separate from ourselves, and as something which we can control. As Johan Redström[137] has pointed out, our understanding of technology focuses on the fact that it is merely the means for achieving certain ends, often by amplifying the power of our actions (Redström 2005).

In summary, the author's works challenge the users' common expectations of art, by being physically wearable, offered for free individual use, and by their approach to technology, which is not focused on the development of purposeful functionality, but instead concentrates on technology as part of our techno-organic reality. These works point out how technology influences our thinking and how it has become part of us, our everyday circumstances and our private *Umwelts*; when technology does not follow its projected expectations, it intervenes, creates new questions and proposes new directions.

VII.4.4. Performance and Participation

Erving Goffman describes everyday life and its daily routines as *performances* of the self. The ideal (imagined) image of the self defines the *performances* that happen within everyday life (Goffman 1959). According to Goffman these daily acts are performed to create impressions about the actor for those who observe the performance. "For if the individual's activity is to become significant to others, he must mobilize his activity so that it will express during the interaction what he wishes to convey." (Goffman 1959, p. 40) Goffman's performers are usually not aware of their performance-like acts within their everyday routines and there is no distinguishable frame around their actions, like there is in theatre or staged art performances.

[137] The thesis chapter IV.1

When a wearable technology project does not follow the expectations for purposeful functionality of technology, the work is easily related to the tradition of performance. However, most of these kinds of projects do not advertise themselves as performances, nor do they follow formal traditions of staged performances. This is an important distinction, which impacts in that the projects are located in the field of wearable technology, rather than into the fields of theatre or performance[138]. In the author's wearable technology works one can detect some typical and repeating characteristics; for example, they are related to performativity in everyday life, they require audience participation and they avoid clear separation between performers and an audience.

Allan Kaprow created a form of art called *Happenings,* which were perfomances set within everyday circumstances and locations, and which intentionally avoided separation between the performers and the audience. Kaprow writes: "The fine arts traditionally demand for their appreciation physically passive observers, working with their minds to get at what their senses register. But the Happenings are an active art, requiring that creation and realization, artwork and appreciator, artwork and life be inseparable." (Kelley [1993] 2003, p. 60) *Happenings* are a form of participatory art that fully emerged during the 1960's in the United States[139].

In a comparable way to *Happenings,* in the author's works the action leads the way with an inherent element of chance involved. The works are based on the production of experience; they are offered for concrete use of the public. There exists no prewritten script for these experiments, and therefore there exists no separation of the audience and the artwork. Rather than considering the interested people as traditional audience, these works require volunteers and participants. These works are based on a participatory aesthetic and optimally they exist in everyday environments.

[138] The author notes, that there are wearable technology works which are specifically created for theatere, dance or other performance events, as well there are wearable technology projects that are intended to be shown as performances. However, focus of the dissertation is on wearable technology projects that are not necessarily intended for use in "staged events", but are typically imagined for everyday use or works that concretely relate to everyday life and circumstances.

[139] Other well-known forms of participatory art that developed during the same time are Situationism which developed in Europe and Neo-Concretism in Brazil, which representative is e.g. artist Lygia Clark (introduced in the chapter V.2.)

In these works the everyday experience of the user is set up and framed by the technological features and functions offered by the wearable device and by its occurring re-actions to the user and possible other impulses. This kind of framing is part of the theatrical characteristics of these kinds of wearable technology works; instead of being framed by a traditional context e.g. of a theatre play, the immediate experience is framed by designed artistic technology and functions. Obviously the participants, or users, of these wearable technology works must agree and accept that there may be an uncontrollable impact on their self-image caused by the wearable device. Life is a performance of one's self, like Goffman argues, but in the author's wearable technology works the performers are fully aware of the impact of the wearable device on their self-image, their actions and everyday routines.

VIII. Conclusions and Future Research

VIII.1. Conclusions

This research study focused on a technologically enhanced human and the way in which his subjective perception of the world is formed in interaction with his environment, which is also enhanced by technology. The aim was to investigate this situation from the perspective of the art practitioner and to find an artistic strategy which could reveal new perspectives of the situation. This was anticipated as an opportunity to direct a critical eye at the prevalent use and conception of technology and furthermore a way to suggest alternative viewpoints. The research has included focus on networked wearable technology in artistic projects.

One of the findings of this research was achieved through an initially conducted comparison of the author's works to other works in the field of wearable technology. This and a thorough investigation of the wearable technology field led the author to the realisation that the field contains works which do not follow the same criteria and aims as the rest of the field, but which share specific characteristics with each other[140]. This finding provided the author an initial framework through which these works could be reflected on and analysed within the larger field, as well as that which the author's own research framework could be based on.

The concept of the *Umwelt* by Jakob von Uexküll provided a framework for understanding the relationship between an organism and its habitat, and the formation of subjective perception in this situation. Uexküll's concept concerns the organic world, where an underlying necessity is biological survival. The author's research comprises the organic world as enhanced by network technology, including humans and non-humans. The question of biological survival is superseded by the aim of existing in a continuous *hybrid environment*.

[140] Examples of these kinds of works are given throughout the dissertation and they also include the author's practice-based works. E.g. G. Savicic Constrained City (chapter II.1.) and K. Wodiczko (chapters II.2.1., II.2.2., IV.2.4.)

The underlying question of the research contemplated what kind of world view is held by the enhanced human, whose understanding of and connection to the world is increasingly transmitted via technology. As this is a profound and broad question with no obvious ways of resolving it in its entirety, the research set out to investigate whether there are ways in which art could intervene and amplify this situation, potentially producing alternative viewpoints. The research asked: What kind of artistic strategy reveals new insights to our subjectively constructed *Umwelt* in a hybrid environment?

Within the focus of the research has been the author's artistic works, which are based on wearable technology and art. These practice-based works also provide the answer to the research question through their ironic nature.

Irony and playfulness are not the most common features in wearable technology, or in works dealing with human enhancement. However, playfulness is a frequent characteristic of other forms of digital media art, such as installation, screen-based work or toy-like objects. Generally in digital media works, playfulness with technology is often related to the idea of entertainment, rather than art. This can be the reason media artworks with playful characteristics typically have an instrument-like quality and are often constructed as tools or games[141]. However, the Japanese media art approach – Device Art – provides us with exceptional examples, which are not necessarily tools or instruments, but have playfulness as a quality in itself[142]. Device Art is characterised as being playful and critical at the same time, without necessarily being negative towards technology (Kusahara 2006).

Playfulness can be a prominent feature of digital media, but it is not a characteristic that is lightly accepted in more radical human enhancements that go beyond decoration. The only acceptable exceptions seem to be the very few cases in which the human body is considered to have an unavoidable defect and needs to be artificially enhanced to gain back its *normality*. Such is

[141] For example the installation by Mary Flangan: *Giant Joystick*, 2006

the case of Aimee Mullins[143], which is discussed earlier in the dissertation. The fact of not having biological legs has enabled her to have multiple sets of external legs, some of which are visually quite intriguing and humorous. In addition, she can playfully swap them and change her physical height like any other fashion accessory.

Being external to the body, wearable technology currently allows a wider range of experimentation on the body than more permanent and radical human enhancement. Wearable technology enables quick and easy changes, unusual approaches and possibilities to experiment with body-attached technologies without strenuous physical procedures. If wearable technology, similarly to prosthetics, is considered as a temporary phase towards a full merger of human and technology, as is generally insinuated in various contexts[144], wearable technology currently offers a good, available and flexible platform for various types of experiments concerning the human that include physical and mental adaptation for the prospective future changes. However, this means that to enable the emergence of new ideas and new kinds of approaches, a whole new strategy is required that is able to intervene in the prevalent processes concerning the development and use of mobile and wearable technologies.

This dissertation proposes that the use of irony in the works is one strategy that can interfere with existing ideas in the field. Irony has the ability to allow multiple simultaneous perspectives of any situation. That is to say that works which are located in the field of wearable technology and which use irony, can reveal several different perspectives simultaneously. These works are located within the field, but concurrently they present additional, alternative perspectives.

The situation, between the ironically tuned works and the large majority of works without irony in the same field, is comparable to Hebdige's division of conservative and progressive styles within a culture. According to Hebdige, appearance or style can be a distinctive, intentionally

constructed feature, through which individuals integrate themselves into the prevailing values of the group or, alternatively, define themselves as standing against the so-called *parent culture* and opposing its existing values (Hebdige 1983). Based on this, one can draw the conclusion that ironic wearable technology works, which typically differ in their aesthetics, functions and use from the other works in the field, present a critical subculture within the field of wearable technology, which do not, or at least not in a straightforward manner, buy into the prevalent values of the field.

Playfulness and irony are typically related to visual and perceivable qualities in visual artworks, but in interactive media artworks in particular, irony can also be integral to the functionality of the works.

Irony always provides a certain degree of doubt and criticism of the situation and purpose of the works. When used in wearable technology artworks, irony causes the user or the observer to become sceptical of the initially detected and possibly expected purpose and meaning of the work, leading to a situation where opportunity is opened up to re-evaluate the work and interpret a new meaning for it. Working in this kind of multi-layered manner, within the field which it also scrutinises, irony is able to critically interfere with the prevalent values of the field and predefined expectations of the user or the observer. Irony is able to reveal the base structures of our values, desires and fears.

Part of practice-based methodology has included experimentation with the actual constructed artefacts. This has typically taken place within various art exhibition contexts (described in chapter VII.4.). One of the findings of this research has been the partial resistance of the audience towards the concrete use of the works, especially in public, outside of the exhibition venue. The author sees this resistance as signs of doubt or distrust towards the works, which indicates that for some parts of the audience the intended function of irony has successfully opened up multiple conflicting perspectives and the potential users would yet need to decide on a satisfying interpretation for themselves.

The enhancement of a human, which enabled his existence in the *hybrid environment*, was made by networked wearable technology. One objective of the research was to emphasise one's presence in the *hybrid environment* and awareness of its impact on the formation of one's subjective *Umwelt*. Another objective was to experiment with how the wearability of technology affects one's perception of technology and the world. The *Hybronaut*, as a developed art-based concept and a concretely built figure, provides a vehicle for this. The *Hybronaut* is equipped with networked wearable technology to enable existence in a continuous *hybrid environment*. This setting provides an emphasised experience of a *hybrid environment* and awareness about the impact of technology on the formation of the subjective *Umwelt*.

As a concept which included the user and the wearable device as one entity, the *Hybronaut* enabled the author to focus the research on the relationship between the *Hybronaut* and his world, instead of interface issues relating to the relationship between the user and the wearable device, which is a standard research approach in the field of wearable technology.

The research is based on three case studies, each presents custom-built equipment for the *Hybronaut*: the *Heart Donor*, the *Empty Space* and the *Appendix*. These three constructed experiments are focused specifically on the capability of the enhanced human, the *Hybronaut*, to exist in a continuous hybrid environment. In this situation, the networked hybrid environment is understood as one's living environment, parallel and merged with physical reality and part of one's perception of the world. One of the research objectives was the construction of non-standardised technological situations, enabled through artistic wearable technology equipment. The created artworks examine the hybrid environment from a non-instrumental perspective, which is a different approach e.g. in comparison to currently available mobile communication devices, which are to a large extent based on a conventional and rational perception of communication and information networks. However, the three constructed case studies use the

same existing technological infrastructure, the wireless network, but with a different approach and perspective.

One research objective set out to investigate how to disrupt expectations in wearable and mobile technology, and reveal new aspects through the given situation. This was achieved through the use of irony as an artistic strategy in the works. Irony, playfulness and a certain peculiarity in the aesthetics are characteristic of all three works, such as the shape of a life jacket and the kitsch heart-beat curve on the *Heart Donor* vest, the reference to the explorer of extreme environments in the carried capsule in the *Empty Space*, and the *Appendix* as the rebuilt member of the human body, the tail, which has now taken a shape reminiscent of a horse tail, have been used as a strategy to attract the attention and curiosity of the public in the first place. The users or observers of irony will move from a *recognition state* to a *question state*, from fascination to critical outlook. The focused aesthetics of these works also functions as a way to direct the focus of the potential user or the public observers to the idea of an enhanced, networked human existing in a hybrid environment. The existence of connectedness to this hybrid environment is signalled in different ways in the works. In the *Heart Donor*, the blinking lights signal the continuous connection to the hybrid environment, in the *Empty Space* the signs are transmitted as short literal messages displayed on a small screen which is part of the capsule and in the *Appendix*, the connections are signalled through the movement of the tail.

The fact that the works are built on an existing technological infrastructure shows that in order for irony to work, it needs a strong connection to existing and plausible reality. The use of existing technological infrastructure, which typically offered functions which are familiar to the users, enables a base onto which the user or the observer can reflect the unexpected and surprising aspects of the works. This becomes visible for instance in the way the unexpectedness of the ironic wearable technology works evokes an automatic and immediate comparison to familiar everyday mobile devices and technology.

A similar connection to a familiar reality is also present in the design of the works, which are made to be used in everyday circumstances, preferably in the long term by the same person.

However, even if the author's case study works are based on networked infrastructure similar to that used by the common mobile technologies today, the structure of these works is based on entirely differently thought-out constructed connections and wired elements, as well as custom-built electronics and software.

All the elements of these three works, together with their aesthetical construction, differ drastically from all the currently available mobile devices or tools. Their functions, playful aesthetics and unexpectedness are incorporated into an ironic framework. This makes the users of the equipment and other observers question the meaning of the works and their application of technology pushing them to re-evaluate the situation. The works exist as markers of a different kind of understanding of our techno-organic hybrid environment.

These works prove that irony used as a strategy in networked wearable technology works is, in the first place, able to draw attention to the specified aspects of the research; to the technological enhancement of the human and his evolving connectedness to the world, and to the way one perceives the world when it has become a hybrid environment. Irony is able to reveal new insights into the situation, being basis for the formation of a subjective perception of the world, the *Umwelt*.

In this dissertation the author has enhanced the understanding of the situation, amplified by the case studies, between human, technology and the world, in which the subjective perception of the world is formed. The research has also shown that irony, as a strategy in art, is able to intervene with this situation in a way which can reveal new insights into it.

VIII.2. Limitations

Like already mentioned in the Introduction-chapter, subjectivity is one of the limitations of this research. Some degree of subjectivity is present in three aspects of the research; in irony, in the formation of the *Umwelt* and in the art-making.

Irony is a subjective viewpoint, which is irrevocably rooted in its immediate cultural setting (Hutcheon 1998). What one person perceives as ironic may not apply to someone else. Even perceiving the *real*, literal meaning of the work can differ from person to person. One person may perceive the work only at its face value and not see the irony. The author's case study works, for example, are clearly framed within the cultural setting that is based on the technological networks used in everyday life. For someone who is not part of this kind of cultural setting, these works hardly open up as ironic. To expect a certain effect of irony, its interpreter must be part of the same culture in which these works were produced. The ironic characteristics of the works can also be interpreted as a certain kind of absurdity in the works without any notions of irony, which would shift the intended purpose and meaning of the works.

The *Umwelt* is a subjective perception of the world, which is created in interaction with the environment. According to Uexküll this aspect is species-specific, which means that members of the same species may share a similar *Umwelt*. However, in the case of the human, it is very hard to prove that this would be the case. The author sees that each individual (human) has his or her own subjective perspective of the world. The case study works promise to open up the *Hybronaut's* perception of the world; this, however, happens within the existing framework of each individual user. The subjective existing perceptions are merged with the *Hybronaut's* perspective. Each performing *Hybronaut* will have his own subjective experience and perspectives.

Art-making is typically a subjective practice, which is strongly influenced by the cultural background and established values of the artist. However, this does not mean that the works would never open to members from other cultures. In the best case, the works may receive

completely new and interesting interpretations from members with different cultural backgrounds, even if the understanding of the works would not reflect the artist's original intentions. The three case studies in this dissertation originate from subjective perspective and thinking. They are constructed for the purposes of investigating and speculating on the changes of the human and his world in a manner which avoids literal interpretation and ready-made answers. Rather, the works aim at knowledge production through art as an experience, which generates questions and offers possibilities for subjective re-evaluation.

VIII.3. Future Research

As an implication of this research, the author sees the current development of technology as being rationally driven. Technology presents us with the purpose and means to achieve certain ends. At the same time, the human is being increasingly being re-designed through technology, currently with external devices and in the future increasingly with body-embedded technology. If our understanding and use of technology is increasingly instrumental, in what ways does this kind of rational perception impact upon human enhancement and the concept of the human in the future? Through her continuing research and practice, the author calls for a different perception of and approach to technology, whereby technology is understood from a wider perspective as a techno-organic material, as a part of a human and inseparable from our living environment.

The author has detected many gaps in the topics and areas relating to this dissertation and also many areas which could be further researched through the lens of this thesis.

Firstly, there is an obvious lack of objective theoretical research on the reasons for the emergence of wearable technology. No one has asked why wearable technology appeared in the first place and what have been the political, societal, cultural and technology-related reasons for it. In what kind of beliefs, institutions and systems is the wearable technology rooted? What are the forces pushing the progress of wearable technology and what kind of desires are embedded in

it? These are questions that are directly related to the field of wearable technology and its history and would require a cultural historical approach to them.

However, the author's currently emerging interests are more deeply directed towards the concept of a techno-organic world. This means a conjunction of quintessentially technological features, such as the network, and the organic world, including human and non-human, and animate and inanimate parts.

For instance, there are obvious signs that point towards the fact that in the future, our environment will be increasingly techno-organic by its very nature. Currently, the world is being transformed into a large-scale data-generating unit, which produces in real-time vast amounts of *big data* on everything from nature: weather, air, water, etc., to human activities: traffic, cities, pollution, people, etc. One could ask how technologically produced data and the prevalent scientific perception of the environment affect one's relationship with his immediate environment.

The technologisation of the organic environment has led to a situation in which today, there are more ways to perceive an environment and, potentially, to connect to nature than before. But this also means that what we use to understand as nature will not be what it used to be. What could be the new meaningful ways to construct or reconstruct these connections? What are the important elements to connect to? What kind of idea of (hybrid) environment emerges from *big data* and what is its relationship with the human?

58. Figure: *Appendix* by Beloff, 2011. Photo © Laura Beloff.

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X. Appendices

X.1. Appendix 1: The author's publication, conferences and seminar's list

X.1.1. Publication list

Beloff, L. (2011) Art Testing The Future, *-forthcoming in portuguese (Brazil) 2012*

Beloff, L. (2011) The Hybronaut Affair: an ménage of art, technology and science, *-forthcoming in Transhumanist-reader, Wiley Publishings 2012 (forthcoming)*

Beloff, L. (2011), Shared Motifs; Body Attachments in RL and SL, *Metaverse Creativity* 1, no. 2 (2011): 135-46

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X.1.2. Conferences and lectures

Conference talks:

2011 – International Symposium on Electronic Arts ISEA – Istanbul, Turkey

2010 - Consciousness Reframed Conference 11: Making Reality Really Real – Trondheim, Norway

2009 - Re:live, Media Art History Conference – Melbourne, Australia

2009 – Consciousness Reframed 10: Experiencing Design, Behaving Media – Munich, Germany

2008 - Consciousness Reframed 9: New Realities: Being Syncretic. University of Applied Arts - Vienna, Austria

2008 - HOMO LUDENS LUDENS Symposium - LABoral Centro de Arte y Creación Industrial – Gijon, Spain

2008 - Arte.mov Symposium - Belo Horizonte and Sao Paulo, Brazil

2008 – Match Making Symposium – Trondheim, Norway

2007 - The First Summit Meeting of the Planetary Collegium: Revisioning the Future, University of Quebec - Montréal, Canada

2007 - Researching the Future-conference, Art and Technoetics, Centro per l'arte Luigi Pecci – Prato, Italy

2007 - Mutamorphosis Conferenece - Prague Czech Rebuplic

2007 - The Porous City: Art Claiming the Urban Void – Oslo, Norway

2006 - F.A.q.: Questions about Art, Consciousness & Technology - Sao Paulo, Brazil

2006 - Consciousness Reframed 8: art & consciousness in the post-biological era - Plymouth, UK

2006 - Waves Festival and Conference, Riga Contemporary Art Museum – Riga, Latvia

2006 - Interface and Society Exhibition and Conference – Oslo, Norway

Single lectures:

2012 - Keynote at Senses of Embodiment Research Seminar, Aalto University – Helsinki, Finland

2012 - Presentation at Human Design lecture-series, Aalto University – Helsinki, Finland

2011 - Invited lecture at the Digital Art-department of Univeristy of Applied Art – Vienna, Austria

2010 - Invited lecture about wearable technology *Body in Posse* at the NTNU – Trondheim, Norway

2010 - Invited lecture at the seminar Art, Technology, and Dissemination to Children and Youth (NTNU) – Trondheim, Norway

2009 – Invited lecture at Researchers Forum in University of Art and Design, Helsinki

2007 - Artist presentation at Urban Void-seminar, Oslo (NO)

2007 - Lecture and presentation at CIANT – Prague, Czech Republic

2007 - Artist presentation at SparwasserHQ – Berlin, Germany

2007 - Artist presentation at Pixelache-evening – Helsinki, Finland

2006 - Invited lecture at University of Art & Design, Helsinki, Finland

X.1.3. Composite sessions attended

2006 - Tucson, Arizona
2006 - Plymouth, UK
2006 - Sao Paulo, Brazil
2007 - Montreal, Canada
2007 - Milan, Italy
2007 - Plymouth, UK
2008 - Gijon, Spain
2008 - Vienna, Austria
2008 - Sao Paulo, Brazil

X.1.4. Participation and organization

2012 – Curating and organizing an international lecture series on *Human Design or Evolution* for Media Factory / Aalto University – Helsinki, Finland

2011 – Participating in *Field_Notes* international art & science workshop – Kilpisjärvi, Finland

2011 – Invited Artists in Residence at Museums Quartier – Vienna, Austria

2011 – Participating in *Hackteria* workshop – Helsinki, Finland

2011 – Participating in *Digital Hybridity*-project, Derby Univeristy – Derby, UK

2010 – Jury member in *Live2011 Grand Prix*, media art prize – Turku, Finland

2010 - Board member of the Finnish Bioart Society

2009 - Organizing an event, symposium and a network project *80+1 Kilpisjärvi* in collaboration between Finnish Bioart Society, Kilpisjärvi Biological Station (Helsinki University) - Finland, and Ars Electronica Center – Austria

2009 - Deputy board member of the Finnish Bioart Society

2008 - Deputy board member of the Finnish Bioart Society

2007 - Member of the board of the Norwegian production network for electronic art: PNEK

X.1.6. Exhibitions

2012 - Galleri Friese, Solo Exhibition – Hamburg, Germany (June 2012)

2011 - Angewandte Schauraum / MuseumsQuartier, Solo Exhibition – Vienna, Austria

2011 - Re-drawing Boundaries, curated Leonardo On-line Exhibition,

http://www.leoalmanac.org/

2010 - Mäntän Kuvataideviikot - Mänttä Finland

2009 - Netherlands Media Art Institute – Amsterdam, Netherlands

2009 - 80+1 project - Kilpisjärvi Finland – Linz, Austria

2009 - Ich Maschine, Edith Russ Haus - Oldenburg, Germany

2008 - Arte:mov exhibition - Belo Horizonte, Brazil

2008 - Evolution Haute Couture: Art and Science in the Post-Biological Age, video screening – Kaliningrad, Russia

2008 - IX MediaForum, video screening – Moskow, Russia

2008 - Prototypisieren – Bremen, Germany

2007 - Enter3 Exhibition - Prague, Czech Republic

2007 - Urban Interfaces Exhibition – Oslo, Norway

2007 - Mobile Journey Exhibition, 52. Venice Biennale Extras – Venice, Italy

2007 - Urban Interfaces Exhibition - Berlin, Germany

2007 - Lab Cyberspaces Exhibition – Gijon, Spain

2007 - Digitally Yours Exhibition – Turku, Finland

2006 - Article Biennale – Stavanger, Norway

2006 - Lofoten International Art festival – Svolvaer, Norway

X.2. Appendix 2: The author's earlier wearable technology works

X.2.1. *The Head (wearable sculpture)* 2005-2007

The work *The Head* (wearable sculpture) is referenced in the text in chapters IV.1 and VI.2

The Head (wearable sculpture) is a work with a process-centred and participatory approach to the art practice. It deals with a view of contemporary, mobile and technologised society. *The Head* (wearable sculpture) is constructed as a wearable second head for the user, which appears to be independently observing the world.

One of the main features of the work *The Head* (wearable sculpture) is its dependency on public participation and availability for free public adoption. The person adopting this wearable sculpture becomes responsible for wearing it wherever s/he may go. *The Head* is constructed with an open channel for the public to access it by sending a text-message that will trigger the eye and ear to see and hear. When *The Head* receives a text-message, it responds by triggering its technological eye to capture an image and ear to record a sound. This captured evidence of its existence on Earth is sent back as a reply to the sender and are also uploaded to an online database, which develops as a collective memory. *The Head* will be adopted and carried around by individuals simultaneously as its vision and hearing are triggered by others, gradually forming a collection of memories.

Ideally, *The Head* sculpture should occasionally be adopted by specific public figures; for example, a police officer, a politician, a tourist guide, or a teacher, all of which are professions that have publicly and politically guided viewpoints on society. The public access via text-

messages would naturally remain open for any members of the general public equipped with mobile phones.

The Head sculpture has no permanent location. It was thought out as a nomadic structure living amongst the people, carried around from place to place and independently watching the world as the second head of the wearer. Its presence is located in the *hybrid environment*, where it is accessible at all times via mobile phone. The work is commenting on the existing form of the (human) body, extending it with an external body part that can see and hear, but requires public participation via a technological network to succeed. In a way, it is extending the wearer's body, but not his physiological abilities. The extension is directed towards a network and its connection to the wearer of the Head. In this work, the concept of network is understood compendiously as a construct of relations to technical, human and non-human artefacts.

The Head (wearable sculpture) contains custom-written software for a mobile phone with a hacked camera and microphone, all located within a custom-designed wearable device.

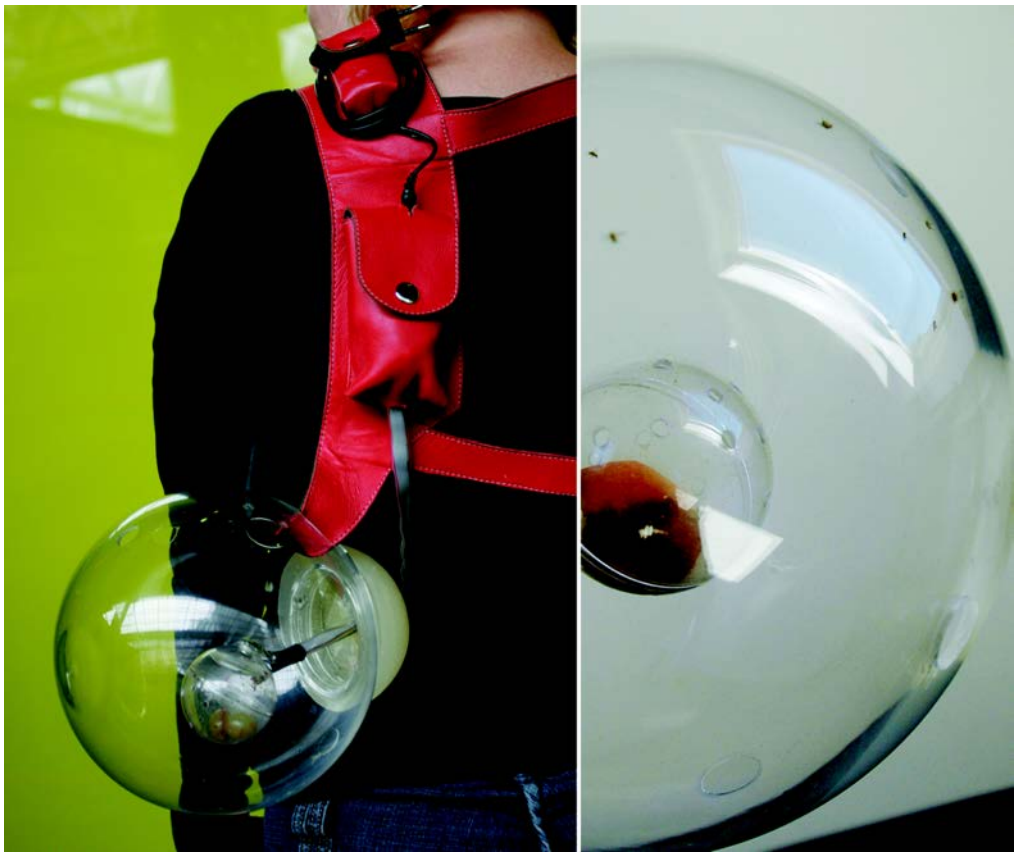
59. Figure: *The Head (wearable sculpture)* by Beloff, 2005-07. Photo © Laura Beloff.

X.2.2. *Fruit Fly Farm* 2006

The work *Fruit Fly Farm* is referenced in the text in chapter IV.3.

The *Fruit Fly Farm* is a wearable space station designed for fruit flies. The flies' nest is located in the centre of the created travelling artificial habitat. The public can observe the nest via captured mobile phone images.

The *Fruit Fly Farm* was constructed as the second work, in parallel to *The Head* (wearable sculpture), and uses one of the most common everyday technologies for observations, the mobile phone. While the sculpture *The Head* is observing outwards towards its surroundings and society, the *Fruit Fly Farm* consists of an entire community under observation. The *Fruit Fly Farm* has an embedded camera mobile phone, which observes the nest. The public can access the phone camera by sending a text message, which will trigger the camera to capture an image. The image will be sent back as a reply and also uploaded to a dedicated website where one can see all the uploaded images observing the fly nest.



60. Figure: *Fruit Fly Farm* by Beloff, 2006. Photo © Laura Beloff.

Traditionally, fruit flies are considered to be a nuisance and a pest. In this piece they are treated as a living community, which can be observed by the public. For the "owner" of this wearable *Fruit Fly Farm*, it is a "pet" that requires responsibility and to be taken care of. The nest is located in the middle of a transparent acrylic sphere; it contains rotten fruits and needs to be re-filled approximately once a week. The outer ball and the nest capsule are perforated with small holes which allow the flies to fly in and out of the nest freely.

The audience members are invited to adopt the work and become responsible for the fly farm. It is designed as a lightweight transparent ball with a custom-made, easy-to-carry system.

These kinds of works do not make a traditional division between the observer and the subject, but offer an immediate real-life experience, in which the user becomes a component of a techno-organic entity. In this work, the human experiences a co-presence with biological organisms and with other people in a hybrid environment: people accessing the work online and people encountering the work on the street.

The Fruit Fly Farm contains custom-written software for a mobile phone with a hacked camera and a custom-designed wearable device that is a suitable habitat for fruit flies.

X.2.3. *Tratti* 2006-08 - a prototype

61. Figure: *Tratti* by Beloff & Pichlmair, 2006-2008. Photo © Laura Beloff.

The work *Tratti* is referenced in the text in chapter IV.1.3.

Tratti is a constructed prototype for a wearable noise instrument with an artistic twist, aimed specifically at children of all ages. The initial inspiration was the idea of using the world as a constantly changing real-time score for the sounds. The *Tratti*-instrument records a short sound clip and continuously transforms it using the surrounding visual world as a score. In the work, both humans and technology can see the surrounding environment, but only technology can simultaneously translate it into audio that is audible to humans. In this work, human intentionality is directed towards audio results produced by the *Tratti*-instrument and the manipulation of these.

Technology has here a double role; it is obviously a material part of the physical world, but simultaneously it is a mediator of its own constructed (technological) reality, which in this way also becomes a part of the (human) user's reality and environment. In this kind of situation, technology becomes a part of a user's hybrid reality that has its basis in the physical experience of the world.

Tratti was a result of collaboration between Laura Beloff and Martin Pichlmair.

TRATTI contains custom-written software for a camera mobile phone, a microphone, a modified megaphone system with amplifier and rechargeable batteries, all within a custom-designed wearable device.

X.2.4. *Seven Mile Boots* 2004

The work *Seven Mile Boots* is referenced in the text in chapter VI.1.

The project *Seven Mile Boots* is an example of a wearable artwork that very early on treated the Internet as a spatial concept rather than a medium for connections. The project consists of a pair of wearable interactive and networked leather boots with audio output. A user wearing these boots is able to walk around in the physical world and through the literal world of the Internet simultaneously. However, the user's movements do not follow the familiar logic of physical geography, but the user is allowed to walk in different directions and at different speeds in the net and the physical world. While walking in the physical world, a user could suddenly encounter a

group of people chatting in real time in the virtual world. This encounter is perceived when the conversations all of a sudden are heard, coming out as a spoken text from the boots. The user can pass through a group of people chatting online, or he could decide to stop for closer observation. The piece was built upon feet and shoes as an interface to move within the text-based "non-space" of the chat rooms. Part of the focus of the project, at the time of its creation, was on the construction of a technological base-structure which could be filled by real people in real time; real life but through a network. Chat rooms (irc-channel) are a real-time social environment which creates a feeling of space and place. At the time the project was realised, social media forums did not yet exist as we know them today, there were no platforms such as Facebook, twitter, Myspace and Skype, among others, there were primarily irc-chats and news- and email-lists. The boots were designed to be ready for use and functioning in any location with an open wireless network. Wherever the boots were being worn, physical and virtual reality would merge together. The project concentrates less on a specified functionality achieved through technology than on the enhancement of the perception and experience of spatiality and presence. *Seven Mile Boots* offered a fresh perspective on processes that have since become an accepted part of our current lifestyle. Looking at the project today, it can be seen that it was profoundly aiming for a merger of the Internet and the physical world that could be offered as an experience for the users. The project investigated an enhancement of the body, the physical characteristics of which were amplified with a new kind of spatial potential that enabled mobility within a hybrid space. It proposed the possibility that the virtual layer could become something more and something different from the (at the time) typical idea of connecting virtual data to a defined physical place. In the *Seven Mile Boots* project, the physical reality and the virtual layer became a merged living environment; neither part was seen enhancing the other or subordinate to the other. Additionally, the wearable artefact (the boots) visually enhanced its users; it was deliberately designed with prominent and conspicuous visual features to make the project noticeable to the public.

The work *Seven Mile Boots* was constructed around the concept of being aware of a connection to a new kind of spatial world. At the time (2003), it also required considerable practical efforts. The social media forums only existed as irc-chats, and there were not open platforms for programming mobile devices or easily compiled micro controllers, such as Symbian and Arduino.

The work was a result of collaboration between Laura Beloff, Erich Berger and Martin Pichlmair.

Seven Mile Boots contains custom-written software for a PDA computer, custom electronics; speakers, amplifiers, a radio transmitter and receiver, an accelerometer, etc. and custom-made leather boots; two pairs.

62. Figure: *Seven Mile Boots* by Beloff, Berger & Pihlmair, 2003-2004. Photo © Laura Beloff.

X.3. Appendix 3: List of artists, designers, technologists and developers

The list of investigated historical and contemporary artists, designers, technologists and developers whose projects are relevant to the thesis. The idea of this section of the appendix is to provide reference list for researchers investigating wearable technology and human enhancement field specifically in relation to the arts. Some of these creators have several relevant works, some just a single work.

Art, Technology, Wearable

1.-Adam Bartholl
2.-Alfons Schilling
3.-Anthony Hall
4.-Atsuko Tanaka
5.-Auger & Loizeau
6.-Benoit Maubrey
7.-Bernhard Leitner
8.-Danielle Wilde
9.-Erich Berger
10.-FoAM
11.-Gordan Savicic
12.-Haus-Rucker-Co
13.-Jenny Tillotson
14.-Joo Youn Paek
15.-Jun Murakoshi
16.-Kelly Dobson
17.-Krzysztof Wodiczko
18.-Lawrence Malstaf
19.-Luisa Paraguai
20.-Lygia Clark
21.-Margarete Jahrmann
22.-Ong Kian Peng
23.-Paul Granjon
24.-Rachel Zuanon
25.-Ryota Kuwakubo
26.-Stahl Stenslie
27.-Steffi Weissmann
28.-Stephan Schulz
29.-Takehito Etani
30.-Troika
31.-Valie Export
32.-Walter Pichler
33.-Wolfgang Stehle

Fashion, Clothing, Technology, DIY

34.-Adidas Research and Development
35.-Alyce Santoro
36.-Anouk Wipprecht
37.-Barbara Layne
38.-CuteCircuit
39.-Despina Papadopoulos
40.-Di Mainstone
41.-Diana Eng
42.-Diffus
43.-Ebru Kurbak
44.-Elena Corchero
45.-Elise Co
46.-Elsa Schiaparelli
47.-Fashion Victims
48.-Fibretronic
49.-Fiona Carswell
50.-France Telecom
51.-Hannah Perner-Wilson (Kobakant)
52.-Hussein Chalayan
53.-Ideo
54.-Jennifer Darmour
55.-Joanna Berzowska
56.-K-cap
57.-Kate Hartman
58.-Katherine Moriwaki
59.-Kristin Neidlinger
60.-Leah Buchley
61.-Linda Worbin
62.-Maggie Orth
63.-Maurin Donneaud
64.-Mika Satomi
65.-Nike Research and Development
66.-Paco Rabanne
67.-Philips Design Research
68.-Reima Smart Clothing
69.-Sabine Seymour
70.-Sara Diamond
71.-Sonia Delaney
72.-Stijn Ossevort
73.-Susan Kozel
74.-Suzanne Lee
75.-Suzi Webster
76.-Techla Schiphorst
77.-Teresa Almeida
78.-Textronics
79.-Valerie Lamontagne
80.-Ying Gao
81.-Yomango

82.-Zane Berzina

Conceptual Clothing
83.-Alicia Framis
84.-Ana Rewakowicz
85.-Azra Aksamija
86.-Beverly Semmes
87.-Birgit Jürgenssen
88.-Donna Franklin
89.-Franz Erhard Walther
90.-Gilbert Rohde
91.-Giocomo Balla
92.-Hyungkoo Lee
93.-Lucy Orta
94.-Olivier Goulet
95.-Rebecca Horn
96.-Susumu Tachi
97.-Tobie Kerridge
98.-Walter Van Beirendonck
99.-Yinka Shonibare

Art, Human, Experience
100.-Bigert & Bergström
101.-Helio Oiticica
102.-Lygia Pape
103.-Marina Abramovic
104.-Sophie Calle

Media-art, Bioart, Techno-organic
105.-Andy Gracie
106.-Anna Dumitriu
107.-Carsten Höller
108.-Char Davies
109.-Diller + Scodifio
110.-Eduardo Kac
111.-Erkki Kurenniemi
112.-Georg Nees
113.-Gordon Pask
114.-Hiroo Iwata
115.-Jamie De Val
116.-Julius von Bismarck
117.-Junji Watanabe
118.-Kenneth Rinaldo
119.-Marc Dusseiller
120.-Maywa Denki
121.-Peter Weibel
122.-Philip Beesley
123.-R&Sie
124.-Rachel Wingfield
125.-Roy Ascott
126.-Susana Soares
127.-Symbiotica
128.-Toshio Iwai
129.-Zbigniew Oksiuta

Art, Human, Technology
130.-Bare: Skin Conductive
131.-Daito Manabe
132.-KnoWear
133.-Marcel li Antunez Roca
134.-Orlan
135.-Soomi Park
136.-Stelarc

Human, Technology
137.-Body Media
138.-HAL robotic exoskeleton
139.-InteraXon Research and Development
140.-Kevin Warwick
141.-MIT Wearable Computing Group
142.-NASA Astronaut Suits
143.-Sensatext SmartShirt
144.-Steve Mann
145.-US Army Wearable Computing; Force Warrior
146.-Vivometrics
147.-Xybernaut-Wearable Computer

X.4. Appendix 4: Full Bibliography

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