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Immediate Invisible

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Foreword

When I was little I went to buy a mood ring from a toyshop like everyone else. I spent time reading about all the different hues that were changing in the ring, and how they represented my emotions.

I wanted to know how the ring was able to do this, and soon I found out that the change was based on the temperature of my skin. At first I felt annoyed and somewhat deceived.

Then I realised that colour changes according to temperature were actually far more curious phenomena to view, than randomly colour-defined emotions, which I did not actually even want to be displayed. I still have that ring.

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1. Introduction

In the past few decades new technologies have become a substantial part of our personal lives. Phones have become mobile and Internet access is ubiquitous. At the same time, we have become connected to each other *via* social media, and have had to start defining our relationship towards revealing personal information and publishing images that expose us to the assessment of others.

As mobile technology has become the new norm, portability has started to merge with wearability. In the past few years it has become increasingly possible to explore embedding technology and electronics into soft textiles and fashion. New workshops and more extensive course modules on wearable technology have started to be an essential optional part of the curriculum in fashion and textile education, making the subject more and more accessible to fashion and textile students. From conductive materials to computing and interaction design, these concepts have become more familiar and approachable.

The aim of this thesis project is to create an artistic women's fashion collection that has possibilities to grow into a bigger performative entity, and to explore fashion as an ever-shifting conversation of what can be revealed or concealed. The thesis consists of a written study and an artistic practice-led project with an outcome in the form of a collection.

The objective of this thesis is to show the theoretical background for the artistic work, as well as to give a narrative of the complex collaborative artistic

process of creating a fashion collection that combines fashion, responsive systems and sound. Science, art and technology act as a playground for thoughts and concepts in experimental design. They are an important source of inspiration for me to create, as they have been such for others throughout the history of fashion.

The practice-led artistic project is an interdisciplinary collaboration with an interaction designer and a musician.

1.1. Underneath

“Clothing is an extension and modification of the body,”¹ as well as a way to construct or to reveal personal identity. Individual garments and how they are worn can be used to display for example social status, wealth and taste. In some ways a dressed body is exposing much more information than a nude one ever could. As the clothed body is a norm in our social encounters with others, it seems that what we wear has evolved to be an inseparable part of our daily social bodies. What is appropriate to wear or not to wear is coloured with the diverse expectations set by our surroundings and ourselves.

In fashion the parts of the human body that are usually displayed are skin, hair and posture. The high interest in having ever thinner models could even suggest this is all that is needed as far as the beauty industry is concerned. Curvy shapes or blood vessels visible on the outside can be perceived as reminders of the biological body that is present. When thinking about a female body in this perspective, those reminders can be seen as enemies of beauty: something against which the beauty industry is fighting, and which must be concealed by individuals for the sake of

¹ Mary Ellen Roach and Joanne B. Eicher, *The Visible Self: Perspectives on Dress* [USA: Prentice-Hall Inc, 1973], 58.

their own personal best. New contemporary forms and meanings for dress can be found by looking for inspiration and ideas from beyond these aspects.

I find that our conscious, dressed-up presence as a means to communicate with others is limited to only a narrow area of our existence. Exploring what is behind that can allow us to experience unforeseen beauty. The very aspect that inspires me is the immediate and invisible present in everyday life, crucial to our existence. My aim is to showcase the invisible fragments of our actively functioning bodies, which are not in the attention of fashion, with my artistic work. When we are not performing anything in particular, the body's physiology is always and unconsciously active, responding to its immediate needs and environment. The name for the practice-led part of this thesis was formed from this conceptual inspiration, and therefore the project was titled *Immediate Invisible*.

With the help of new technologies and sensors, it is possible to observe physiology as a hidden interior underneath the skin, and reveal it so that it is brought out as part of our knowledge and social observations and interactions. This study explores the exposure of oneself with responsive fashions, and a completely new type of nudity that is not related to being naked, but which is possible through new technology.

1.2. Idea

This study started to formulate into an actual Master's thesis subject and artistic women's fashion collection due to the impulse of an artistic design concept driven by creative ambition. From the very beginning, the idea was to create an artistic women's fashion collection for exploring a new type of nudity and bodily display.

The idea included biofeedback sensors, processors and audio systems built inside of individual garments. Biofeedback sensors are able to harvest data such as heart rate and oxygen saturation. The sensors enable the harnessing of physiological input to give modified soundscapes as an output, thus exposing the active functions that exist beneath the skin.

The idea is in itself modular when the outfits with responsive sounds are designed to be created from separate garments. The soundscapes expose the physiology for others and the wearer in an aestheticised form. This idea for a collection relates to the endless play of revealing and concealing in fashion. Questions and assumptions could be raised in performative responsive and interactive encounters with the outfits.

One of the assumptions that arose from the idea was that an outfit, which continuously reveals the soundscapes of the body for the wearer, assists or obtrudes the wearer to consider themselves strangely nude and more present in the moment. This assumption was based on my own previous experiences with artworks that use sensors worn on the body. The actual performer of the *Immediate Invisible* is not the wearer of the outfit, but the body that is made visible by sound. The wearer gets a new kind of experience of being nude, and the wearer and the viewer are able to relate to the wearer's body in an intimate and more holistic way.

The concept differs from conventional fashion design. It uses sound and biofeedback as part of its aesthetics, while it also focuses on the experience of the user. The collection encourages thinking about what can be revealed and concealed: how can the body be displayed through fashions? Is it possible to feel naked when fully dressed? Do we need boundaries for what is allowed and can

be revealed? How does an imbalance between bodily or social exposure of separate individuals affect them? Will the passiveness of the non-revealing viewers turn into concealment and secrecy? Although staging a live performance and analysing its results are not part of this thesis, taking these more artistic questions into account guided me in my process of designing, as well as reviewing literature and other sources.

When working at the intersection of art, technology and fashion, it is possible to achieve something beyond the initial aims and assumptions. With artistic work it is possible to ponder over the philosophical issues related to the subject, which technological development has already made possible.

Fashion endeavours to look forward. When electronics and tangible garments are merged, the outcomes are often regarded as the fashions of the future. However, the aim of this thesis is not to create a collection that should be evaluated as a reflection on what the wardrobe of tomorrow could include. The motive of *Immediate Invisible* is that it could cause people to halt and experience something new about displaying themselves as a work of art in this day. This objective is based on my own experience with sensors displaying my body, which I found beautiful and wanted to further explore. This thesis is not a manifesto against conventional beauty, rather than an exploration of invisible beauty in the human body.

1.3. Thesis Overview

This thesis is structured in eight chapters. In the first chapter the subject is introduced for the reader, and in chapter two I have described my own motivation for this artistic work. Chapter three concentrates on previous works; examples

have been compiled from fashion, art and technology. The examples include historical references, as well as artworks and explorations, which use technology for harvesting data and displaying the body.

Chapter four introduces the methods and frames the subject by defining the concepts and terms used. Both literal and visual references are presented. Revealing and concealing in terms of dress are discussed within the historical context of the origin of clothes.

The practice-led part begins with the presentation of conceptual and visual inspiration in chapter five, followed by the artistic process of the project *Immediate Invisible* in chapter six. The multifaceted process and collaboration with others are described and analysed in detail.

The process description is followed by reflection on the photoshoots and filmmaking undertaken for documenting and presenting the outcome.

The final chapters consist of reflections on the outcome and conclusions based on the research questions.

2. Immersed in Between Circuits

The first time I enjoyed and was intrigued by embedding electronics into garments was a small project that I did during my bachelor studies. In a one-week workshop I created a pair of simple gloves that had LEDs in the knuckles, to shine light on what the wearer was doing with their hands. At that time, I could not anticipate that this small experiment would lead to many more.

Later, in my masters studies I took part in a large-scale wearable electronics course. The course gathered together students from different faculties in Aalto University and artists from Muu Association.² Teams were formed with people from various disciplines and backgrounds, and were allowed to create anything that would incorporate wearability, electronics and interaction.

I was a costume designer in a team that created a game-based dance performance titled *Impulse/Control*. Media Lab student Forrest Oliphant and artist Hannele Romppanen created the original concept; my contribution was the creation and visualisation of the played characters and designing the functionality on the body. In *Impulse/Control* it is possible to

² Muu is a Finnish interdisciplinary association that represents and promotes new and experimental forms of art and is run by the artists. Accessed October 8, 2013. http://www.muu.fi/site/?page_id=2&lang=en

lead two dancers with arcade controllers, which send signals into vibrating motors integrated into the costumes, close to the dancer's skin. The project culminated in a demo-day on December 12th 2011 in Muu Gallery.

As previously mentioned, the idea for this thesis started to formulate based on a personal experience: at the aforementioned wearable electronics course, another team included Valtteri Wikström, a Media Lab student and Metti Nordin, a costume design student. They created a headpiece titled *Brainwise*³ that was able to read the wearer's brain activity when worn. It displayed the harvested data with optical fibres and RGB-LEDs, and it was possible to view the changes of state in the wearer's brain. When I wore it on the demo-day, the experience was not what I had expected. As the headpiece started reacting to my brain, I noticed how the public was staring at me, flaring up with excitement. I realised that I felt nude in front of them, in a way that I could not completely understand. The feeling was not associated with the shame related to involuntary exposure of my body, nor was it in any way erotic. My communication with others was wordless: I viewed their reactions while they observed mine from a headpiece that was not in my conscious control. The event was a strangely intriguing loop of reactions.

This sudden feeling of passive exposure and being viewed stayed in my thoughts. It needed further investigation and experimentation with the concept.

Before being introduced to this interdisciplinary potential, in my Master of Arts studies, I had concentrated on functional design, expressing artistic views and conceptual thinking. Suddenly I was in a field where it was possible to

³ *Brainwise* <http://wearable.mlog.taik.fi/2012/03/27/brainwise/>

combine the threads of my background and to discuss with other artists, designers and scholars with similar interests and ambitions. I had found a domain that felt like a playground with open possibilities to play with and positiveness.

This curiosity led me to do an internship for the artist and inventor Di Mainstone in London in 2012. Her background is in fashion design, but she has frequently worked as an artist, also in several artistic residencies. She considers herself a body-centric artist and her work is often about augmenting the wearer's possibilities for bodily expression. Mainstone creates narrative-based objects, garments and instruments, which are then presented in short films that she writes and directs. Mainstone's works are designed to invite dancers, performance-related artists and other participants to play with them. Many of her works combine a visual aspect with sound. Therefore they can often be viewed as wearable musical instruments. During the internship, I was surrounded by people with whom I could exchange thoughts, and the idea for this thesis started to find its form.

Even though my interests appear to be leaning more towards electronics and technology, it is not the technology in itself that inspires me, but the conceptual and artistic possibilities it allows us to explore in fashion and art. The value of electronics is that it offers both a fresh point of view, and the possibility to express novel ideas in a visual and multi-sensory way. It is likely that the future will make the same ideas accessible in a more subtle way. *Immediate Invisible* was first only an idea about a new type of nudity brought out with the help of sensors, after which it evolved through a mass of sketches and much-needed technical solutions into an experimentation of displaying one's body with responsive outfits.

3. Review of Related Works

In the past few decades, engineers, artists and fashion designers have increasingly explored the potential of combining fashion and technology in versatile projects and in research. New technologies allow previously unimagined creative innovations.⁴ In this chapter, I will present a few examples from researchers, artists and designers who have contributed to this vast field, and whose work I personally find relevant to the subject of the thesis.

The field that has been developing at the intersection of art, technology and fashion has been very active in publishing literature in order to define itself. Researchers such as Sabine Seymour, Suzanne Lee and Bradley Quinn have been able to gather the versatile history and ongoing work and paradigms in a literary form. Laura Beloff has defined several concepts in the field of wearable electronics. Susan Kozel has combined philosophy and her own artistic work as a dancer, using technology in various types of performances.

The history of wearable technology can be considered to have begun with the invention of glasses. The earliest record of the use of optical lenses is from the year 1268, albeit reading glasses were already used in China and Europe.⁵

In the year 1665, Robert Hooke called for inventions for augmenting or improving the other human senses: hearing, smell, taste, and touch.⁶ In 1762, John Harrison invented the pocket watch, which was the first practical marine chronometer.⁷ Later in the 20th century, the innovations and the interest towards portable and wearable technology have been constantly expanding.

In the history of fashion, designers have quickly embraced new technologies and fabrication procedures.⁸ The desire to play with appealing concepts appraising technology in fashion goes back further than one would expect. Already in 1936, Elsa Schiaparelli presented a fashion collection that included prints of thermometers for 'registering' the wearer's passion.⁹ In the 1960s fashion designers such as Pierre Cardin and Paco Rabanne got their inspiration from the space age and pop art for experiments with new synthetic materials, shapes and styles.¹⁰

In the last few decades the interest towards technology has begun to transform from inspirational use towards actual use. Electronics incorporated into garments transform traditional fashion elements such as color, texture and cut to include movement, touch, light, sound and interactivity as new aesthetic interaction interfaces, thus increasing the expressive value.¹¹ Some contemporary fashion designers have been able to embed the electronics into their collections. Hussein Chalayan uses his artistic work to investigate issues such as cultural identity, migration, technology, anthropology,

6 Ibid.

7 Ibid.

8 Lee, *Fashioning the Future*, 15.

9 Ibid.

10 Ibid., 16.

11 Sabine Seymour, *Functional Aesthetics: Visions in Fashionable technology* (Vienna: Springer-Verlag, 2010), 54.



fig. 1



fig. 2



fig. 3

fig. 1 1884, Monsieur Trouve created *Electric Jewels* for dancers and stage performers. [Lee, *Fashioning the Future*, 99]

fig. 2 Jean Cocteau embroidery sketch for Elsa Schiaparelli [Palmer, *Elsa Schiaparelli*, 46]. The aesthetics combine a human figure and a jacket in a surrealist manner.

fig. 3 *Cardine Dress*, Pierre Cardin, 1968



fig. 4 Hussein Chalayan, *One Hundred and Eleven*, Spring/Summer 2007 Ready-to-Wear

nature and genetics.¹² His Spring/Summer 2007 collection was titled *One Hundred and Eleven* and it presented 111 years of fashion history in a unique way.¹³ In the collection, five outfits with mechanical construction transform from one decade to another, and the metamorphosis continues to the present day.¹⁴ The last outfit of the collection included a large hat that collected the model's dress inside of it, finally revealing the model's nude body in front of the fashion show audience.

In the field of wearable technology and art, there have been several projects that embedded audio systems, processors and sensors in garments or e-textiles in a conceptual and artistic way.

12 Sabine Seymour, *Fashionable Technology: The Intersection of Design, Fashion, Science, and Technology* [Vienna: Springer-Verlag, 2009], 28-30.

13 Ibid., 30.

14 Ibid., 30.

Susan Kozel's project *Whisper(s)* was a participatory installation that invited the public to put on garments with physiological sensors for pulse and respiration.¹⁵ After getting dressed, the participants entered a space where they were able to access their own data, send it to visualisations in the space or pass it on to another participant, revealing relationships between themselves, others and the ecosystem.¹⁶

In 2006, Philips Design developed the *Skin Probe Project*, which explored a new kind of material that would be able to emulate some of the skin's particular functions.¹⁷ As part of this project, an interdisciplinary team, including designer Lucy McRae, created *Bubelle – Blush Dress*, which was designed to respond to the wearer's body and represent one's emotions visually.¹⁸

In 2009, Karina van Heck created a contemporary wearable artwork titled *Body Speaker*. *Body Speaker* allows the wearer to listen to their unaltered internal body sounds *via* a headset, making the wearer more aware of the body's needs.¹⁹

Daan Roosegaarde and V2_Lab collaborated with young fashion creators to experiment with relationships between intimacy and technology.²⁰ Together with fashion designer Maartje Dijkstra,

15 Susan Kozel, *Closer: Performance, Technologies, Phenomenology*, [Spain: MIT Press, 2007], 288.

16 Ibid.

17 Seymour, *Fashionable Technology*, 140.

18 Ibid., 141.

19 Degn Hansen, et al. 'Future Textiles' [Denmark: Knowledge Center for Smart Textiles], Accessed October 10, 2013. <http://www.viauc.dk/pressesite/artikler/Documents/Katalog%20om%20udstillingen%20Pretty%20Smart%20Textiles%20hos%20TEKO,%20VIA%20University%20College.pdf>

20 Sofia Pantouvaki, 'Technology-inspired Experimental New Transparencies'. In *Lace, Fashion and Transparency*, ed. Corinne ter Assatouroff, [Brussels: ICOM Costume Committee, 2013], 172.



fig. 5



fig. 6

fig. 5 *Audio Ballerina*, Benoît Maubrey, 1989

fig. 6 *Bubelle Dress*, Royal Philips Electronics, 2006



fig. 7 *Intimacy 2.0*, V2_Lab and Studio Roosegaarde, 2011

Dan Roosegaarde and V2_Lab created a dress titled *Intimacy White* in 2009, which was followed by collaborating with designer Anouk Wipprecht from Studio Roosegaarde to make *Intimacy Black* in 2010, and *Intimacy 2.0* in 2011.²¹ The designed high-tech garments contain embedded sensors, interactive technologies and opaque, smart e-foils that are able to turn transparent.²² *Intimacy 2.0* responds to heartbeats and becomes transparent based on the wearer interacting with others.²³

In functional fashion design, the use of non-invasive physiological sensors in commercial garments is already expanding to become conventional. Heart rate monitors are used widely, and a new pair of trainers can even have a ready-made space for a small computer in the sole for collecting kinaesthetic data. A new field of industry aims to find concepts that are able to assist athletes with training, help patients recover in their homes or doctors to notice when medical aid is required.²⁴

²¹ Pantouvaki, 'Technology-inspired Experimental New Transparencies', 172.

²² Ibid.

²³ Ibid.

²⁴ Lee, *Fashioning the Future*, 153.

4. Framing the Subject and Used Methods

This thesis is an artistic process with a literature based analysis and experimental outcome. It consists of a written study and an artistic fashion collection titled *Immediate Invisible*; the two parts evolved hand in hand even though at some points the workload has required focusing mainly on one or the other.

The main methodological tool for answering the main research question is art-based practice, which is how do body-worn sensors enable the creation of an artistic collection, which reveals a new type of unexplored nudity, and which discusses revealing and concealing in fashion?

As fashion can be treated as a tangible object, an abstract idea, a phenomenon, a system or a cultural value,²⁵ the literature and references used have been drawn from diverse fields. The theoretical context is an amalgamation of thoughts gathered from fields such as sociology, psychology, phenomenology and history of fashion. However, the main contribution of this study is located in the area of fashion design, wearable technology and art.

The written part explores the chosen subject in a way that the artistic project *Immediate Invisible* can be

²⁵ Yuniya Kawamura, *Doing Research in Fashion and Dress: An Introduction to Qualitative Methods*, [Oxford: Berg, 2011], 15.

connected to a wider philosophical entity at the intersection of art, technology and fashion. Similarly the artistic process and its outcome give a designed form of the discussed issues.

The artistic project is interdisciplinary and collaborative. It focuses on the actual design proposed and its interpretation into a creative modular collection with performative qualities, designed through an artistic hands-on process.

As the project is the most creative and intuitive part of the thesis process, I have collected images as references that I have found helpful in defining the concept and visuality of the collection. In addition, a body-centric and functional design approach was needed.

The design process was an integral part of this study. It included designing, conceptualising and coordinating the collection as well as hands-on work in making the garments. Designing the collection started in autumn 2012, and continued together with the making of the collection, until the end of spring 2013. Some finishing touches were added in summer 2013, before photographing the collection.

Most of the practice-led work took place in studio spaces provided by Aalto University Department of Design and the Department of Film, TV and Scenography, with the support offered by the studio masters and faculty both in design, as well as in sewing and pattern making.

The perspective of this thesis is subjective, as I was allowed to choose my own topic.²⁶ I am also the designer and artist of the project, which means I am inherently attached to the subject.

²⁶ Ibid., 34.

4.1. Research Questions

The main research question was: how do body-worn sensors enable the creation of an artistic collection, which reveals a new type of unexplored nudity, and which discusses revealing and concealing in fashion? This is answered mainly through the practice-based project that is located within the field of art.

There were also several additional questions that could be raised both to find background knowledge, and to go further into the practice-led part: What types of concepts are related to this artistic design project? How can dress be used to display physiology? How can the early ideas and thoughts be visually entwined in the artistic process and the outcome of the project?

4.2. Drawing Outlines

In summary, the focus of this thesis lies in the idea of *Immediate Invisible* and its interpretation into a creative modular collection through an artistic hands-on process. At the same time it examines revealing and concealing as a continuous play of communication within dress and fashion. The core of this study involves the investigation of novel feelings of nudity, while displaying one's body through new technology without judgemental or erotic connotations. In this study, nudity is understood as revealing the body through biometric data and not through its surface.

The study of fashion and dress can be regarded as an interdisciplinary area of knowledge in itself, as it has emerged from theories and findings that transcend traditional boundaries.²⁷ The idea for the artistic project *Immediate Invisible* is in the intersection of fashion, art and technology. Therefore it needed a holistic approach and the sources and theories are

²⁷ Ibid., 13.

diverse. Entwistle points out how there is surprisingly little concrete analysis of the relationship between body and dress.²⁸ Even though taking part in this discussion is not one of the main aims of my work, I believe that the research and the tangible outcomes within wearable and fashionable technology often respond to this need.

With this written part I try to entwine thoughts, concepts, theories and my own practice in a way that forms a diverse, holistic and meaningful entity for the reader, even if the sources and issues seem miscellaneous.

4.3. Defining Concepts

There are several terms and approaches that need to be defined. These are taken into account in this written study and in the practice-led part of this thesis. These definitions also serve as outlines for the subject.

4.3.1. Fashion

Fashion is not easy to define as a term.²⁹ Yuniya Kawamura describes the beginning of fashion in relation to weakening social customs, which allows creativity and aesthetic expression to answer the desire for social distinction.³⁰

Fashion changes through time, as it reflects the society's current ideology.³¹ It presents the common taste of a certain time, becoming a forum where separate individuals and groups can study their identity and existence.³² To interpret

²⁸ Joanne Entwistle, 'The Dresser Body' in *Body Dressing: Dress, Body, Culture*, ed. Joanne Entwistle and Elizabeth Wilson. [Oxford: Berg, 2001], 34.

²⁹ Kawamura, *Doing Research in Fashion and Dress*, 9.

³⁰ Ibid., 5.

³¹ Ibid., 127.

³² Ritva Koskenurmi-Sivonen & Anna-Mari Raunio, ed., *Vaatekirja* [Helsinki: Yliopistopaino, 2000], 6.

the changing zeitgeist, fashion quickly embraces novel materials and techniques.³³ Fashion can be observed as a visible change in the daily, weekly and yearly revisions of our appearances: the ways in which we see and present ourselves visually, with temporarily adopted objects.³⁴ In these objects fashion is an established mode, and a prevailing shape, style, pattern or manner.³⁵

Clothes are a mode of communication³⁶ and so fashion is both cultural practice and bodily protection, bound to our communication.³⁷ Fashion, more specifically clothing, exists in relation to the space and situation where it is worn. Bikinis can make a female body decent on a beach but not in a boardroom.³⁸ Similarly, inappropriate dress at a wedding reveals social illiteracy. Therefore the answer to what is appropriate to reveal or conceal in relation to the concept of nudity is malleable.

While society's fashionable ideals for beauty change with time, and multiple ideals may co-exist, dress can be used to achieve those ideals through modification, concealing flaws, or creating the illusion of an ideal.³⁹ Even when we are not conscious *per se* about our physiology and how it differs from that of others, can there be an illusion of an ideal or the expectations related to it? Is it possible to display ideal physiology?

³³ Lee, *Fashioning the Future*, 15.

³⁴ George B Sproles and Leslie Davis Burns, *Understanding Dress in Contemporary Fashion* [New York: Fairchild Publications, 1994], 1-3.

³⁵ Jennifer Craik, *Fashion, The Key Concepts* [New York: Berg, 2009], 2.

³⁶ Kawamura, *Doing Research in Fashion and Dress*, 27; Joanne Entwistle and Elizabeth Wilson ed., *Body Dressing: Dress, Body, Culture* [Oxford: Berg, 2001], 2.

³⁷ Craik, *Fashion*, 2; Soper, 'Dress Needs', 18.

³⁸ Entwistle, 'The Dresser Body', 33.

³⁹ Roach and Eicher, *The Visible Self*, 104.



fig. 8 *Half-and-half Attire* [1939] plays with revealing and concealing in a humorous way.

4.3.2. Concealing and Revealing Dress

Fashions and separate clothes are used to display the body and many other aspects related to our lives. Fashion reinvents the body with changing styles and innovations, finding new ways to reveal and conceal the body, making it visible and interesting to look at.⁴⁰ Throughout history, what is appropriate and modest has been affected by society, religion, cultural norms and individual morals.

Fashion has not only been used to reveal or conceal the body of the wearer due to modest or decorative motives, but also to reveal other social issues. Clothing is not only the surface of the wearer, but can be used as a vehicle to express our innermost secrets: who we are, where we come from, our age, personal preferences and profession, even though we are also inhibited to do this.⁴¹ Similarly all of these aspects can be concealed with the choice of dress. The main function

⁴⁰ Entwistle and Wilson ed., *Body Dressing*, 4.

⁴¹ Laurence Langner, *The Importance of Wearing Clothes*, [Los Angeles: Elysium Growth Press, 1991], 343-344.



fig. 9 Adam and Eve, H. Baldung Grien, c. 1514

of Victorian and Edwardian women's appearances was to display the wealth of her husband or father, and the more unfitted or impractical the chosen form of fashion was, the greater the value of the showcase.⁴² Dress does not simply reflect the natural body underneath or the wearer's identity, but it adds meaning that would not otherwise be there.⁴³ This is why it is possible to feel completely naked in front of others even when fully dressed.

Since strong moral sanctions against nudity exist, the nearly nude body cannot be considered as an alternative form of presenting oneself.⁴⁴ There is also a universal desire to alter the natural appearance of naked bodies.⁴⁵ So what

is likely to be the origin of the clothed body? There are several theories by many scholars who aim to illustrate the reasons for why human beings first started to cover their bodies. Hiler presented several possible theories that show different perspectives: The Economic Theory states that the origin of clothing would be to protect oneself against wind and cold; The Mosaic theory suggests that people wear clothes because of an inherent human instinct of modesty and what is decent, like the realisation that Adam and Eve were naked; The Theory of Possession implies that body covering was the invention of a man wanting to decrease his wife's sex appeal; The Theory of Sex Attraction shows that clothing originated from the desire of men and women to conceal their bodies in order to render themselves sexually attractive; Totemistic Theories believe that the reason is to communicate one's strength by wearing trophies; The Amuletic Theory suggests that the origin of clothing was wearing amulets because of the magical properties they possessed; and An Aesthetic Theory is based on the desire to carry around things that are considered attractive without connotations.⁴⁶

Flugel presents the aforementioned modesty as a secondary reason for the existence of garments and sees it as a reaction to a more primitive flair of self-display and decoration.⁴⁷ The motives of decoration and modesty are contradictory: clothes serve to cover the body, and make the wearer appear modest, but at the same time they may enhance the beauty of the wearer.⁴⁸

Robinson notes that possibly after the invention of clothing, the emphasis

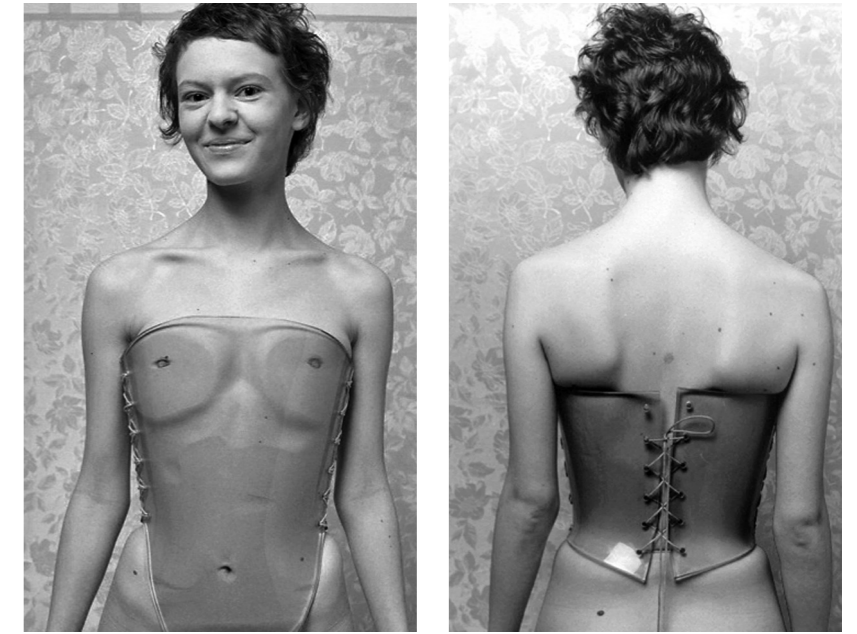


fig. 10a, 10b

fig. 10a The glass corset reveals the body, yet 10b simultaneously transforms it to differ from naked. *Foot-notes About Beauty*, Youlian Tabakov, 2005

42 Alison Lurie, *The Language of Clothes*, [New York: Vintage Books, 1983], 145.

43 Entwistle, 'The Dresser Body', 33.

44 Roach and Eicher, *The Visible Self*, 109

45 Julian Robinson, Introduction to *The Importance of Wearing Clothes*, by Laurence Langner [Los Angeles: Elysium Growth Press, 1991]: xiii.

46 Hilaire Hiler, *From Nudity to Raiment*, [New York: Gordon Press, 1974], 1-12.

47 John Carl Flugel, *The Psychology of Fashion*, [New York: Ams Press Inc, 1976], 18-19.

48 Flugel, *The Psychology of Fashion*, 21.

on concealment developed because of dissatisfaction with the evolutionary shape of human beings, and it became desirable to invent ways to correct these mistakes.⁴⁹ She views the reason for changing fashion as an effort to find the right combination.⁵⁰

The theories presented by Hiler, Flugel and Robinson, even though they concentrate on the origin and development of clothing, can also be viewed as the multiple motives for wearing clothes. The reasons why people cover or decorate their bodies derive from modesty, protection, enhancing sexual attractiveness and adornment.⁵¹ To conceal or to reveal is a basic dilemma of fashion; it refers to displaying the body's appealing physical attributes and needs while preserving modesty.⁵² These aspects serve as perspectives on traditional feelings related to nudity and the exposure of one's body. When trying on the *Brainwise* headpiece I felt completely freed from them despite feeling nude. The public versus the private or intimate is one of the common themes played on with the development of garments in new interdisciplinary fields.⁵³

4.3.3. Wearable and Fashionable Technology

Wearable technology is a wide genre that is difficult to narrow down, but as it is closely tied to this work, it is important to look for definitions. Laura Beloff highlights the variability of approaches in the field of wearable technology:

development solutions for engineering problems, development in fashion, and also conceptual approaches that she describes as having a playful attitude.⁵⁴ In the playful conceptual field it should be noted how the demands of rational functionality are rejected, and for example peculiar functionality and exaggerated forms are encouraged.⁵⁵ These works test the potential of available technological infrastructure and show new perspectives instead of designing smart devices or practical applications.⁵⁶ Beloff indicates the value of these works in how they can question traditional assumptions and expectations, as well as presenting an opportunity to re-evaluate technology and the future of human beings.⁵⁷ These playful projects with self-defined aims enable better understanding of the relationships between the body, technology and environment.⁵⁸ When technology becomes an integral part of an individual and their physiology, it alters our understanding of reality.⁵⁹ The aims of the playful attitude also define the approach for the practice-led part of this thesis. It shows how the artistic work can be part of the study and not a separate outcome.

Sabine Seymour sets another concept: fashionable technology, which refers to the intersection of design, fashion, science and technology.⁶⁰ She defines fashionable wearables as “‘designed’ garments, accessories or

54 Laura Beloff. 'Wearable artefacts as research vehicles', in *Technoetic Arts: A journal of Speculative Research Volume 8 Number 1* [2010], 47.

55 Beloff. 'Wearable artefacts as research vehicles'. 49.

56 Ibid., 50.

57 Ibid.

58 Ibid.

59 Laura Beloff, 'Wearable Worlds: Reality in a Pocket', *Making Reality Really Real*-conference proceedings, [Trondheim 2010], 3.

60 Seymour, *Fashionable Technology*, 12.

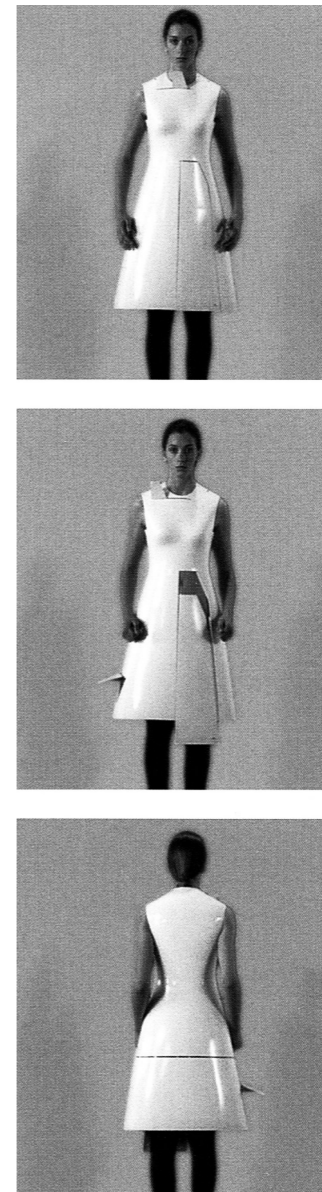


fig. 11 Marcus Tomlinson's Film stills, 1999. Hussein Chalayan's *Aeroplane Dress*' solid shape refers both to a conventional dress and to the body wearing it.

jewelry that combine aesthetics and style with functional technology.⁶¹ Since a functional design approach was needed in *Immediate Invisible*, the visual aesthetic drew inspiration also from the required functionality.

As mentioned before, digital displays of harvested physiological data are already widely used in sports and in medicine. The emphasis in this work is not common healthcare or wellness, but the gentle curiosity towards one's body that is so close, and yet so distant and unknown. This new type of nudity of displaying physiological data is a phenomenon which I find very much related to fashion and art.

4.3.4. Interactive and Responsive Systems

The required interaction defines the input and output: a wearer can consciously control active inputs, while passive inputs can be biometric data or automatic data feeds.⁶² The term interactive is used to describe the technologies and the logic of the user experience, but it often refers to mechanisms that include conscious decision-making.⁶³ Within a conventional fashion collection, as well as in the collection of this thesis, the interactive conscious decision that the wearer can make is related to getting dressed and undressed.

As the conscious interactive decision-making when wearing the outfits is not related to the chosen technology, and the relationship between the outfit and the wearer is rather passive, the electronic system in *Immediate Invisible* could be defined as responsive. If the electronic reactions within the outfits were interactive and therefore consciously and actively played, the items of the collection

61 Ibid.

62 Seymour, *Fashionable Technology*, 11.

63 Kozel, *CloseE*, 182.

could be evaluated as musical instruments.

Responsivity includes the passive spectrum of human reactions and embodied constructions.⁶⁴ In responsive performances the participants are aware of their responses while they are responding to a greater system that transcends the subjective choices, thus taking away personal control.⁶⁵

4.3.5. Performing the Body

The use of sensors enable new ways to perform one's body. Interactive and responsive systems are concepts that are often used in media and performance art. In the intersection of new technologies and fashion, the outcomes often have performative qualities⁶⁶, and therefore create a new type of performing. Performance as practice and method is becoming one of the major paradigms of the 21st century, and novel aesthetic experiences with no precedent are made possible with new technologies.⁶⁷

Performing the body is also related to fashion, as fashion and dress are social phenomena related to our ability to communicate with each other. When choosing what to wear, the body is animated in a way that permits it to perform in specific desired ways.⁶⁸ "Body is always a part of the total appearance a person presents."⁶⁹ The body occupies an immediate space around it with bodily techniques such as gestures and movement, and refers to the space or context in which it performs.⁷⁰

4.4. Exquisite Corpse

On many levels, the old surrealist game *Exquisite Corpse* works as a metaphor for the design method that was utilised in the artistic process and the outcome in *Immediate Invisible*.

Between 1915 and 1930 many surrealist artists such as Wassily Kandinsky and Marcel Duchamp, believed that their images could redirect attention from The First World War towards a utopian future.⁷¹ The artists experimented with randomness as a part of creating meaningful art that would evolve from their individual and collective efforts.⁷² This exercise was titled *Exquisite Corpse*, based on the result of a word game, and it was used as a serious tool for creating new collaborative outcomes reflecting the collective personality of the group.⁷³

In *Exquisite Corpses* the task usually includes creating a character with a head, torso and legs. The first player creates a panel with any chosen technique on a paper and reveals only a part of it, allowing the next one to continue with only a few traces to follow.⁷⁴ Instructions are open-ended, and the components of the outcomes create often insightful or humorous results.⁷⁵

This technique was later used in children's books where the child can create endless new outcomes by changing pages with heads, torsos and legs. The modularity of both the collection and technology in *Immediate Invisible* works in a similar manner, when the responsive

outfits are created from three pieces that result in a new entity. The outcome of the collection is not a fixed result, but designed to allow rearrangement. The heads, torsos and legs of *Immediate Invisible* can be: sensor, processor and audio system; three garments used to make an outfit; the combination of the body, the tangible responsive outfit and the sound; the collaboration between fashion design, interaction design and sound, among many others.

The process had another, more philosophical link to the surrealist *Exquisite Corpses: Immediate Invisible* is about collaboration with other artists and randomness with unconsciously modified soundscapes. Similarly to *Immediate Invisible*, the final outcome of *Exquisite Corpses* was partly concealed from the makers until the end.

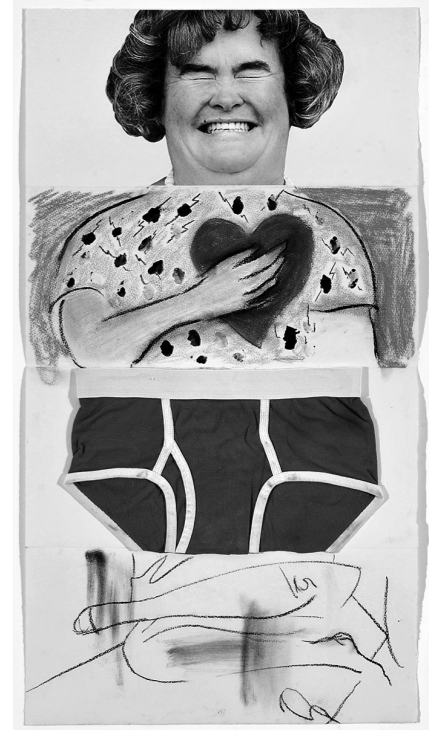


fig. 12

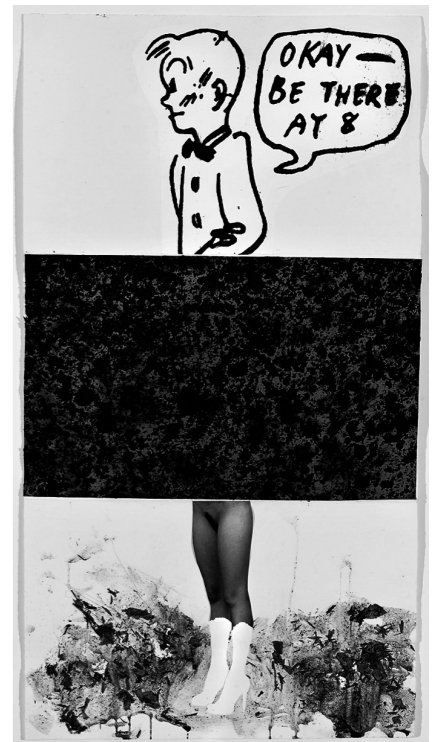


fig. 13

fig. 12 *Exquisite Corpse* made by Josephine Meckseper, Laurie Anderson, Olaf Breuning and Nick Mauss, c. 2008

fig. 13 *Exquisite Corpse* made by Donald Baechler, Richard Serra and Alec Roth, c. 2008

64 Ibid., 186.

65 Ibid., 189.

66 Pantouvaki, 'Technology-inspired Experimental New Transparencies', 174.

67 Chris Salter, *Entangled, Technology and the transformation of performance*, [USA: MIT Press, 2010], 21.

68 Craik, *Fashion*, 3.

69 Roach and Eicher, *The Visible Self*, 37.

70 Craik, *Fashion*, 137.

71 Richard Friswell, 'Surrealist Art Form, Exquisite Corpse, Still Fascinates Artists and Collectors', *Artes Magazine*, 2010. Viewed October 6, 2013. <http://www.artesmagazine.com/2010/06/surrealist-art-form-exquisite-corpse-still-fascinates-artists-and-collectors/>

72 Ibid.

73 Ibid.

74 Ibid.

75 Ibid.

5. Immediate Invisible

The Impulse for the entire thesis was the idea of the collection: to explore the possibility of revealing the body's physiology with audio having all the needed technology integrated fashionably into the outfits, and to investigate the meanings behind it.

The main research question – how do body-worn sensors enable the creation of an artistic collection, which reveals a new type of unexplored nudity, and which discusses revealing and concealing in fashion – was formatted based on this original concept. The previously investigated aspects of fashion, such as revealing and concealing and others, were an important part of the design process.

The artistic aim of the project *Immediate Invisible* was to make it possible to listen to the soundscapes transforming live based on the wearer's physiology. In this way we can observe the wearer's body with the help of garments that resemble a hearing device for the body, allowing us to listen to and concentrate on something that has been invisible and is therefore new to us. With designing artistic responsive fashion, I wanted to decorate the body with mystifying sounds, as well as to work further with my own previously mentioned assumptions about artworks using body-worn sensors, which can offer an experience of being strangely nude and present in the moment.

5.1. Modular Collection

Immediate Invisible is designed in the form of a fashion collection, although it can be perceived as an artwork. A fashion collection is a presented grouping of outfits or looks, consisting of a range of garments, accessories or products designed and produced usually for sale.⁷⁶ A fashion collection presents trends, themes and designs, and reflects the cultural and social influences in a certain season.⁷⁷

Designing a collection served as a way to study the creation of responsive garments and the manner of wearing them in order to create a cohesive modular outcome. Designing unique experimental garments can include normal design phases, such as finding inspiration, coordinating, designing novel objects, choosing materials and colours and making the unique pieces. Yet as the design is artistic and not intended for mass production, it does not need to answer the demands of the fashion industry. In a conventional fashion design process the requirements of the production process and sales must be taken into account.

Since outfits are not usually created from only one piece of clothing, but by combining several garments, jewellery, odour and other aspects, modularity is an integral part of fashion. Choosing what to wear is like the children's *Exquisite Corpse* books. The modular approach can be applied when designing a collection with electronics as a working method and as one of the aims of the outcome.

For several practical reasons, the choice of used electronics and how they were embedded to work together is also modular in *Immediate Invisible*. A modular system is needed for integrating

⁷⁶ Elinor Renfrew and Colin Renfrew, *Basics Fashion Design: Developing a Collection*, [Lausanne: Ava Publishing SA, 2009], 10.

⁷⁷ Ibid.

the needed computing components.⁷⁸ Because of possible failure in construction, or complexities in the maintenance of garments with technology, the electronic components need to be easily exchangeable or replaceable.⁷⁹ A modular approach predicts the future of commercial wearables. As Suzanne Lee points out: “A garment might become a central ‘hub’ to other portable technologies, linking personal devices such as phones as well as making connections to the external environment.”⁸⁰

Immediate Invisible was designed to be a women’s collection mainly because conceptual fashion design is often using the female body as its surface, and so women’s fashion seemed to be a better platform for discussing universal entities, rather than merely augmenting men’s attire. Thus for me it was conceptually more reasonable to create a women’s collection. As the collection is responsive and the relationship between the wearer and viewer is more passive, the term passive is also often associated with a feminine way of performing the body.⁸¹ If *Immediate Invisible* were to grow into a bigger project, it could expand to consist men’s outfits as well, especially as we all share the same physiological functions that are played with within the project.

5.2. Conceptual and Visual Inspiration

In order to create an artistic performative collection, it was necessary to define the concept behind the idea in-depth in a more poetic and a visual way. In the beginning of my thesis process, before looking for visual inspiration, materials or sketching,

I was determined to find relations between several issues to understand the concept. I concentrated a lot on the relationship of the visible and the invisible, revealing and concealing, the interior and the exterior, input and output, and the viewer and the wearer. These poetic concepts and pairs of opposites formed the basis for both my literal and visual conceptualising of the practice-led part. Later in the process, this served as inspiration and guidance for making design decisions.

5.2.1. Immediate and Invisible

*“What we call a visible is, we said, a quality pregnant with a texture, the surface of a depth, a cross section upon a massive being, a grain or corpuscle borne by a wave of being. Since the total visible is always behind, or after, or between the aspects we see of it, there is access to it only through an experience, which, like it, is wholly outside of itself. It is thus, and not as the bearer of knowing the subject that our body commands the visible for us, but it does not explain it, does not clarify it, it only concentrates the mystery of its scattered visibility.”*⁸²

The visible and the invisible have a reversible connection: visible exists because there is the invisible that is the ‘lining’ of the visible.⁸³ Invisible is what can become visible and so “invisible challenges the supremacy and the literality of vision.”⁸⁴ In this practice-led part the word visible and invisible are used as metaphors for phenomena that can be sensed or cannot be sensed with basic human senses. The visible is something

⁷⁸ Seymour, *Fashionable Technology*, 24.

⁷⁹ Seymour, *Fashionable Technology*, 24.

⁸⁰ Lee, *Fashioning the Future*, 48.

⁸¹ Craik, *Fashion*, 140.

⁸² Merleau-Ponty, Maurice, *The Visible and The Invisible*, [Evanston: Northwestern University Press, 1968], 136.

⁸³ Kozel, *Closer*, 41

⁸⁴ *Ibid.*, 40-41.

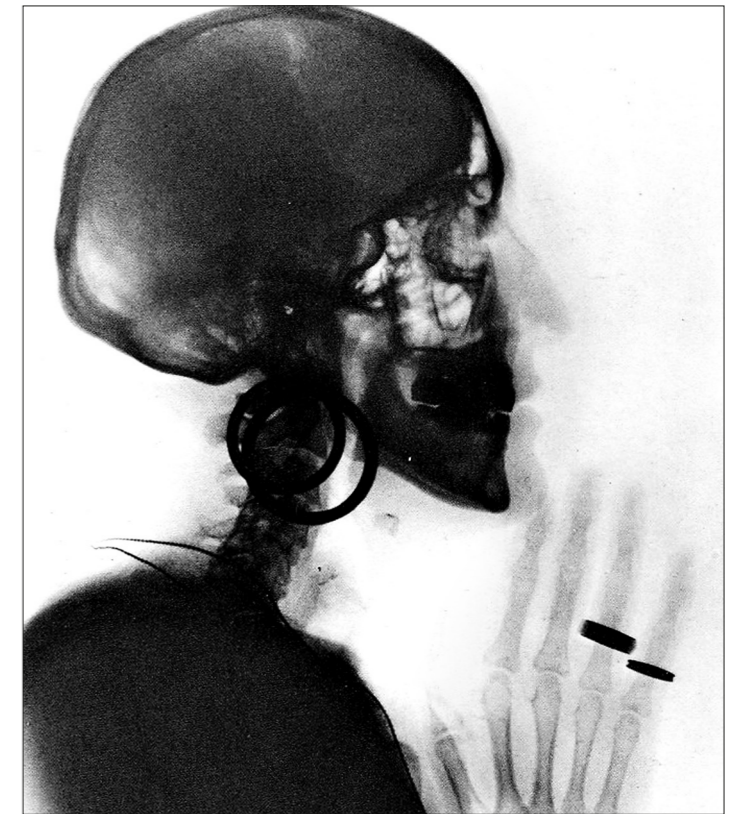


fig. 14



fig. 15

fig. 14 X-Ray of Meret Oppenheim’s Skull, 1964

fig. 15 *The Skeleton Dress*, Elsa Schiaparelli and Salvador Dalí, 1938



fig. 16



fig. 17



fig. 18

that can be evaluated by observing it with the senses, and the invisible is an abstraction that is formed with thoughts when not presented through media.

In the concept, the presenting of the wearer's body is immediate or 'live', as the responsive modification of the soundscapes occurs in real-time without recording. 'Live' means that which could be recorded.⁸⁵

Dress itself can also be defined as the individual's most immediate environment, which acts as a buffer between the physical environment and biological body and self.⁸⁶ The relationship between dress and the body varies: body and dress can merge; the dress can attempt to diverge from the body, and also to attain independent form.⁸⁷ As an immediate environment, dress draws attention and covers the wearer making the nude body invisible. Similarly the epidermis covers

our active physiological body. When layers are added, previous layers become invisible linings for the following and their existence becomes a hidden secret that can again be revealed.

When defining the concept of the project, I continuously visualised my idea and the subjects related to it as interiors and exteriors layered upon each other. More concretely the sensors can be used as tools to reveal hidden interiors, or the body within exteriors, or the skin or the outfit.

When fashions are worn, the interior and exterior become less distinct,⁸⁸ as the internal body affects the aesthetics of the observed external appearance. Clothing can "simultaneously be a portable environment and a means for intervening between the individual and environment."⁸⁹ How one dresses up influences how the surrounding space

85 Philip Auslander, *Liveness: Performance in a Mediatized Culture* (Oxon: Routledge, 2008), 56.

86 Roach and Eicher, *The Visible Self*, xxiii.

87 *Ibid.*, 109.

88 liken to Anna-Mari Raunio, 'Rajoja, reunoja, vaatteita ja tiloja', in *Vaatekirja*, ed. Ritva Koskennurmi-Sivonen & Anna-Mari Raunio, (Helsinki: Yliopistopaino, 2000), 58.

89 Roach and Eicher, *The Visible Self*, 58.

fig. 16 *Pair of Gloves*, Meret Oppenheim, 1985

fig. 17 Elsa Schiaparelli's gloves with fingernails, 1936

fig. 18 Crinoline shapes create a new interior and diverge from the body, but at the same time they enhance the waist. M. Freudenthal & Co., London, 1861

fig. 19 Cristóbal Balenciagas creation gains an independent form, surrounding the upper body. Irving Penn, 1967



fig. 19

or exterior is taken over.⁹⁰ In *Immediate Invisible* this becomes concrete in the space of a soundscape surrounding the wearer. I find it inspiring to design clothes that create exteriors able to refer to their interiors: in this case the body's physiology.

5.2.2. Responsivity

Deciding the output was also an essential issue already in the concept design phase for *Immediate Invisible*. Viewers use all senses to observe an individual's total appearance and to discern characteristics.⁹¹ Viewers can observe for example jangling bracelets, odours and textures,⁹² in addition to the obvious visual. Possible outputs can also be used to appeal to all the five senses.⁹³

It is often anticipated that the sensor output could manifest the mood of the wearer by for example changes in colour.⁹⁴ However, this was not one of the aims for *Immediate Invisible*. The original feeling of nudity that I wished to explore was not related to the display of emotions. Instead it was about the physical body and human physiology that was possible to showcase and allow to be viewed. It was desirable to display the actual immediate data in an appealing way, instead of doing the psychological interpretation on behalf of the viewer. For my artistic interest, the actual heart rate variability or the nervous system are much greater mysteries as such. With this work I wanted to emphasise their existence.

I chose to use sound as an output in the collection, because I found it related to the invisible interior of the body in

a conceptual way. Since human beings cannot hear low frequencies, it is not possible to hear the total soundscape of the body.⁹⁵ As we cannot see or otherwise usually sense the interior of our bodies, we tend to discuss our physiology as if we could 'listen' to our body. In technological applications, like echolocation or ultrasound, sound is used to allow us to see what we otherwise would not.⁹⁶ Aesthetically it was desirable to make the human physiology perceptible, and at the same time keep it invisible. Through the garments and soundscapes, the actions of physiology are exposed, but not in a visual manner.

Some practical decisions on the outcome had to be made as part of the conceptualisation. As I desired to have the output as an integral part of the outfit's total appearance and aesthetics, using external audio systems and wirelessly transmitting the data from the outfit did not appeal to me. Therefore the speakers and amplifiers had to be built into the garments along with the processors and sensors.

5.2.3. Wearer and Viewer

Since the very idea of the collection had performative qualities in it, the relationship between the viewer and the wearer was part of the conceptual inspiration from the beginning. In relation to my previous experience with the *Brainwise* project, there seemed to be a specific type of interaction between the wearer and the viewer. In my own experience, my body was displayed and viewed. In that moment it was simply fine, but especially important because of that reason. It was revealing without the

desire to conceal. These considerations made me think of several questions during the process: Is the body of the wearer the actual performer? Is the wearer also a viewer when in a passive state towards what is displayed? Should there be 'normal' soundless outfits in the collection to show a new type of modesty in comparison to the ones that display data?

According to Raunio, dressing up is an attempt to modify and control concealing and revealing both physically and psychologically: Does the person want to be seen or to disappear?⁹⁷ Is it possible that this new type of body display allows other qualities of the wearer to disappear or at least become less interesting to observe? Can the sound have concealing qualities as in the interplay of concealing and revealing?

As the initial assumption was that the experience would be the feeling of being strangely nude, it is important that the viewer who is allowed to observe the wearer will engage with empathy since it is only a small group of people that can experience the outcome by wearing the outfits. With artistic choices it is possible to distance the wearer and the viewer, or to make them closer. That relationship is not of course completely in the creator's hands. When the aim is artistic and aesthetic, it might just not appeal to the viewer's taste, thus making it an uninteresting experience in which to be immersed.

One of my aims that came from *Immediate Invisible* was to dress the body with sound: firstly to decorate it with this space that is perceptible even when viewers close their eyes; secondly, to diminish the importance of visibility in the person's total appearance. When sound is in a responsive relationship with the wearer's body, the collection acts as a hearing



fig. 20 Ear trumpets from the
21 Victorian Era

device that aids to expose the wearer's body for the viewer. This thought also worked as a visual theme when some of the ideas were sought from Victorian hearing aids and acoustic listening devices from the World War Era.

⁹⁰ Raunio, 'Rajoja, reunoja, vaatteita ja tiloja', 63.

⁹¹ Kawamura, *Doing Research in Fashion and Dress*, 10.

⁹² Roach and Eicher, *The Visible Self*, 92.

⁹³ Seymour, *Fashionable Technology*, 18.

⁹⁴ Lee, *Fashioning the Future*, 17.

⁹⁵ Diane Ackerman, *A Natural History of the Senses* [New York: Random House inc, 1990], 189.

⁹⁶ Ackerman, *A Natural History of the Senses*, 189.

⁹⁷ Raunio, 'Rajoja, reunoja, vaatteita ja tiloja', 67.

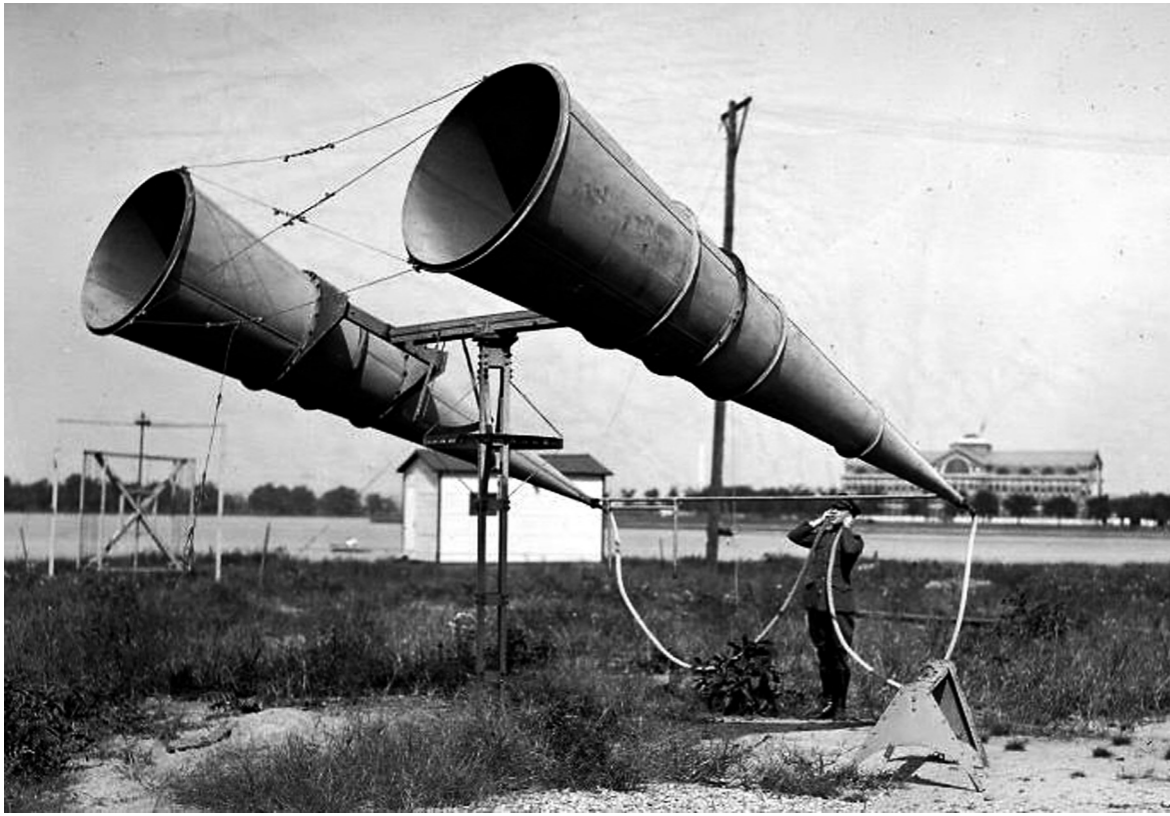


fig. 22



fig. 23



fig. 24

fig. 25



fig. 22-25 Dutch Army's Acoustic Listening Devices from the World War Era [Telovation, 'Outrageous Listening Devices', Accessed October 8, <http://www.telovation.com/articles/outrageous-listening-devices.html>].

6. Process

It is hard to distinguish the design process from the research of this study, when the form and content of the visual and conceptual inspiration, design process and the literal research were so intricately affected by one another. The beginning of the design process – the freest period with sketching – occurred simultaneously with the search for references and inspiration, as well as with the quest for finding rational electronic solutions for the collection. Nonetheless, in this chapter I have attempted to focus on elaborating the practice-led part of the project with a process description, and by analysing the decisions made. The collaboration with the other artists involved is also described.

The outcome of *Immediate Invisible* is a modular artistic women's fashion collection. This outcome consists of garments that have been designed to exist either as biofeedback sensors, processors or audio systems. It is possible to compose six looks at a time from 18 separate functional fragments of the collection. Because of the modularity, it is possible to create several compositions, similar to *Exquisite Corpse* children's books. These outfits can be assembled for performative use, demonstrations or exhibitions, for a seminar, or for other possibilities that serve the concept.

The visual character of the collection was created during the process and based on the concept design, the functional requirements and my own artistic and aesthetics ambition.

6.1. Creative Collaboration

From the beginning of the project, it was evident that *Immediate Invisible* required interdisciplinary collaboration. With the contribution of other artists, it was possible to expand the artistic value beyond my capabilities. For the outcome to exist as more than just a mere concept design, it was vital to invite a media artist and a musician to work within the project.

Since the idea for *Immediate Invisible* first started to form when I tried on the *Brainwise* headpiece, I was delighted to have Valtteri Wikström – co-creator of *Brainwise* – to join my project as an electronics and interaction designer, as part of his studies at Aalto University Media Lab. For several years Samuli Tanner's music had inspired me, and he got involved in the project when it was just a potential idea for a thesis, in the spring 2012.

Valtteri Wikström's input for the project was both abstract and tangible. He had worked previously with biofeedback sensors, and so he was able to offer valuable contributions, on the execution of the concept: which sensors and processors should be used, among many other technological solutions. In *Immediate Invisible* he designed the systems and how the electronics work according to the needs and requirements within the collection. He also did programming and electronics assembly. Our work together was intense throughout the process from early conceptualisation until the finishing of the collection. Numerous working hours together and separately were required for us to be able to define and merge the needed electronic responsiveness. Often, when referring to us in this process description I mean the cooperation between Wikström and myself.

As mentioned, Samuli Tanner was also involved from the very beginning. Tanner composes, produces and performs

in ensembles such as *Clouds* and *Tiiu Helinä*, and he had previously collaborated with artists like Jimi Tenor and Samuli Kosminen. His first contribution to *Immediate Invisible* was in the form of insights into audio systems and the possible responsive sounds, and later in composing the soundscapes for each sensor.

6.2. Fragmented Design Process

The design process of the collection included visual inspirational research, drawing, exploration and manipulation of materials, and also pattern-making, designing constructions, adjusting the original ideas, and finally sewing most of the collection with the help of faculty and friends.

In the beginning of the project I had a clear schedule for all the phases necessary to complete the workload: starting with artistic research and defining the concept; followed by sketching and material choices; continuing with the pattern-making and production of garments with embedded technology. A linear process with sequential phases would have been practical for managing the project, but this was ultimately not possible. All the different aspects started to overlap quite soon, and it became inevitable to do multiple tasks simultaneously. In fact this type of process offered a better alternative for identifying the possible result, as I was able to for example work with a seamstress to sew the first prototypes of the collection while still sketching new garments to serve the modular entity. It was possible to test what type of structures could be done to develop the design options further, already knowing what the result could be. Many of the concrete design decisions were made

in an open artistic process, where nothing was fixed at the beginning, and alterations and redefining the concept was possible.

The design process started with multiple sketches based on the idea for the collection. Drawing the collection began in November 2012 and it was most intensive in December and January 2013. Hundreds of sketches of separate garments and silhouettes of outfits were drawn by hand, and at first the silhouettes were not fixed with specific electronics. Later I wanted to design the garments to exist as certain electronic items. Sketches were divided according to the garment's use: as sensors, processors or audio systems.

When drawing outfits and choosing materials, I wanted to keep the body and how it can be presented in relation to dress in mind: how the garments should fit the wearer and have space for all the electronics, and also how to layer the outfits. It was necessary to design how the electronics would be used within the collection based on functional requirements, while drawing three-dimensional forms. The possibilities for placing the electronics on the body were investigated. Because of the design schedule, it was necessary to constantly look for materials in order to take them into consideration in the sketching, and to be able to start constructing as soon as the designs were ready. At the same time my design ideas affected the development of the conceptual thinking and research of this study.

In January 2013, I started making patterns for the collection, and to support this phase of the project, I produced flat drawings of chosen outfits. Most of the pattern making was done at the same time as the sewing of the first prototypes with Aalto University's Sewing Studio master Reetta Myllymäki. Several patterns and prototypes of the shapes had to be made in order for them to be tested and further



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I produced multiple sketches and divided the silhouettes into sensors, processors or audio systems in order to further develop them. I cut many of my sketches into pieces to test the possibilities of creating a modular collection.

developed by improving the ideas and constructions. The materials were chosen at the same time. In March 2013 the final patterns were drawn, and the construction of the collection started and continued until the end of May. Many of the chosen materials were demanding to sew, and the embedding of the electronics presented its own challenges in the construction of the collection: for example how the electronics could be attached or how the wirings could be embedded.

Since *Immediate Invisible* is a collaborative artwork as a whole, deciding on the type of electronic solutions with Wikström and Tanner was an essential part of the project. Wikström, Tanner and I had a number of meetings in the early stages of the project. We discussed what the outcome could sound like, how those

sounds could be modified with the sensors, as well as what type of requirements those decisions would impose on the designing of the collection. Therefore these meetings were an integral part of the design process. When the entity started to take form, Tanner preferred to work with some briefing on what Wikström and I thought about the sounds.

The process included a lot of testing of the possible electronic systems with Wikström. The aim was not to design completely new electronics or user interfaces, but to investigate how the existing technology could be used to achieve responsive garments. In the project, a lot of currently available technology was accessible and easily replaceable, which allowed us to make diverse alterations throughout the process.

6.3. Design Decisions

The conceptual background of the idea served as a guide when comparing concrete options in order to make decisions within a narrower array of design forms. During the design process, the style of the collection acquired a minimalistic form in its detail and colour. Several design ideas, such as finishings, were included if necessary for functionality, or inspired by functional design or concept, related to the needs of the electronics. Many details, such as materials or embroidery, were selected because they refer to sportswear or contemporary couture. As the collection is expected to be viewed as performative, too commercial a style or look might have been confusing.

When designing and coordinating the collection I did not divide the garments into jackets and trousers and so on, as one normally would in a fashion collection design process. It was natural to divide the separate garments based on their functionality: sensor garments, audio garments, processor garments, and extension cable garments for specific sensors. I drew the collection to contain six looks that would each be created out of at least three separate garments.

The modularity presented a challenge in the making of design decisions. The combining and coordinating of all the required detailing, shapes, colours, materials and electronics into dresses, jackets, skirts, shirts, pants and other garments was like playing with an *Exquisite Corpse*. During the long design process I had gathered all the required material to produce the collection. Not only the individual garments are modular, but also the computers and speakers and plug-ins are the same in all the outfits.

The modularity of the final garments was a starting point for designing, but it was not a rule without exceptions while choosing what to include

in the final collection. To have the sound responding to the wearer's body, an outfit had to include a sensor, processor and audio system. All of the garments can be connected to each other, but not all of them can be combined as outfits. As part of an outfit, the sensor garments resemble undergarments and accessories, and therefore they can be combined with the processor and audio garments quite easily. The processor and audio garments on the other hand are much more voluminous in their shape and look, and work as the outer layers of the outfits. Because of their size, shape and necessary fit, it is not possible to combine any processor garment with any audio garment. In some combinations, it is also a question of selecting visually appealing looks even if other combinations were possible.

During the project, some of the designed garments were removed from the collection when I noticed that they did not serve the entity or they were just too odd in a visual sense. Since the collection works in a modular manner, any removed details, garments or electronics had to be replaced. Therefore the *Exquisite Corpse*, like in the children's book, worked also as a metaphor for the decision-making in aspects that needed coordinating and also for the final form of the modular collection. Any removed 'head', 'torso' or 'legs' had to be replaced to have the complete selection.

As mentioned when defining terms, a fashion collection is interactive in the way that the wearer can choose to get dressed or undressed. When designing fashion, this is one of the key elements. In the collection, this permission was made clear by having all the zippers and other closures placed so that the wearer would not necessarily need help.

On the other hand, a passive responsive relationship between the wearer and the outfit was an essential part of the

desired outcome. We made the decision to not make it possible to simply switch the collection on or off when worn. The electronics, except for the plug-ins, are also not necessarily easily accessible when worn. This makes the electronic systems to be as evident part of the designed garment, similar to its form and silhouette, which are also defined by the body and do not really exist without it. When the outfit is constructed and a person starts to get dressed, all the items are plugged into each other and they begin to display the body in real-time for viewers, as does the shape of the outfit.

6.3.1. Electronics

To make *Immediate Invisible*, Wikström and I chose to use several available electronic components that needed to be assembled in order to work together on the body. From the beginning of the design process, the aim was to have the electronics as part of the aesthetics in some visual form, even though most of them were hidden under layers of fabric. Their placing around the body affected the shapes and constructions of the garments.

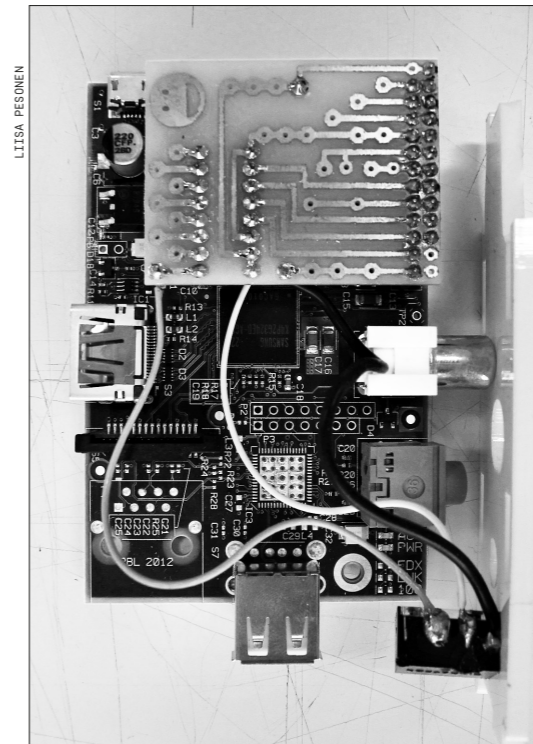
Before deciding on sensors and details on the audio systems, we chose to use *Raspberry Pis*⁹⁸ as computers in the processor garments. This decision allowed us to think quite freely about what types of sensors would be intriguing to use, as well as how complicated and versatile the soundscapes could be.

The speakers ended up being one of the key elements in defining the aesthetics of the collection, both while designing and in the outcome. Several possibilities were looked into, but many of them were found to be too impractical or inefficient to be worn on the body. Small speaker elements were chosen, and so to enhance the sound qualities, an echo box was needed. In order

to make an echo box, Jussi Mikkonen from Aalto University Embodied Interaction Lab was consulted. Mikkonen joined our collaboration by designing and making the echo boxes with 3D-printers according to the needs of the collection. The first printed test box was successful in improving the sound, but it was also necessary to design the box so that it could be attached to and detached from the garments. The shape was designed to give the audio garments a unique shape, and the boxes were very much used during drawing and pattern making. We chose to have two echo boxes in each audio garment, but not for the purpose of stereo sound.

As *Immediate Invisible* is about revealing something that cannot be otherwise seen, the use of sensors was a conceptually important decision. We chose to use only non-invasive physiological biofeedback sensors, instead of for example kinaesthetic ones. First the possibility to have six different sensors was looked into, but during the process it became clear that to find and receive so many different sensors and test them in a reasonable amount of time was not essential, since the use of biofeedback data from the sensors could vary in the programming. We chose to use a heart rate monitor⁹⁹ to measure heart rate variability, two skin conductivity response sensors to detect the activity of the sympathetic nervous system, two pulse sensors¹⁰⁰ – one for pulse and one for the blood pressure or oxygen saturation – and contradictions in the left quadriceps were measured by an EMG sensor that was built by Jussi Mikkonen.

Rechargeable batteries were used as the power source for the electronics within the outfits, to allow consistent flow of electricity in the sensors, processors and audio systems. The batteries are located



Raspberry Pi with custom made Printed Circuit Board for Analog Digital Converter



Batteries for the collection



Wires and plug-ins for a processor garment



Wires and plug-ins for an outfit

⁹⁸ *Raspberry Pi*, <http://www.raspberrypi.org/>

⁹⁹ *Sports Tracker*, <http://www.sports-tracker.com/>
¹⁰⁰ *Pulse Sensor Amped*, <http://pulsesensor.com/>

in the processor garments within the collection. Wikström chose the batteries because they had the required plug-ins and switches and they were durable. It is clear that battery powered solutions on a mobile human being are not the most sustainable option, if this way of performing ourselves through dress were to become adapted to commercial fashion. Suzanne Lee points out some options for future electricity harvesting, such as harnessing static electricity or the use of solar power in textiles.¹⁰¹

The wirings and plug-ins are part of the functional and communicative aesthetic of the collection. They were chosen to communicate that the outfit includes electronic functionality. For me they were also aesthetically appealing, working like jewellery within the outfits. For wirings we chose to use black wires, and silicon-covered wires for the softer sensor garments. Soft conductive textiles are used in some of the sensors. Big stereo plug-ins were used for combining the technology within the outfits and made it possible to have only little interference to the sensor data. The plug-ins are easy to use when getting dressed and undressed.

It was also important to decide where the garments would be plugged into each other, so that this detail would not affect the modularity of the outfits. The plug-ins were placed on the left of the waistline, since it was practical for creating an outfit. Because some of the sensors needed to be placed on hands, I needed to design additional garments to work as extension cables to combine a sensor glove with the rest of an outfit.

6.3.2. Responsive sounds

For designing responsivity and composing the soundscapes, it was necessary to decide which type of garment would

determine the soundscape. At some point of the process it was considered that the soundscapes could be fixed with the audio garments, since they had the most voluminous shapes. When testing the first prototypes, we realised that the material and construction would alter and direct the sounds. Since the audio garments had this non-electronic acoustic quality to modify the sound, it became more interesting to fix the sounds with either sensor or audio garments in order to enhance the modular approach. The separate soundscapes could just as well have been fixed to be part of the processors, but in the end they were chosen to be part of the sensor garments. This was also better for the original concept of revealing the body's physiology, when the physiological sensor inputs all have a unique soundscape that was composed for the harnessed data.

Wikström and I created a written briefing for composing as suggested by Tanner. The six sensors modify the rhythmical and melodic changes in six soundscapes in *Immediate Invisible* and if all six outfits were worn at the same time, the separate soundscapes would merge into one.

The aesthetic and artistic appeal of *Immediate Invisible* is very much related to the output. The briefing was quite abstract, leaving a lot of room for Tanner to do his own interpretation based on his style of creation. The beeping noise in a hospital or digital numbers in the screen of a sports watch display the body's physiology, but not in artistic way. In the briefing some of the sensors were thought to be more melodic and some more rhythmic. The function of each sensor was described, and what form of data it allowed us to access. We wrote poetic keywords about our impressions and associations related to the measured phenomena. As the concept was about

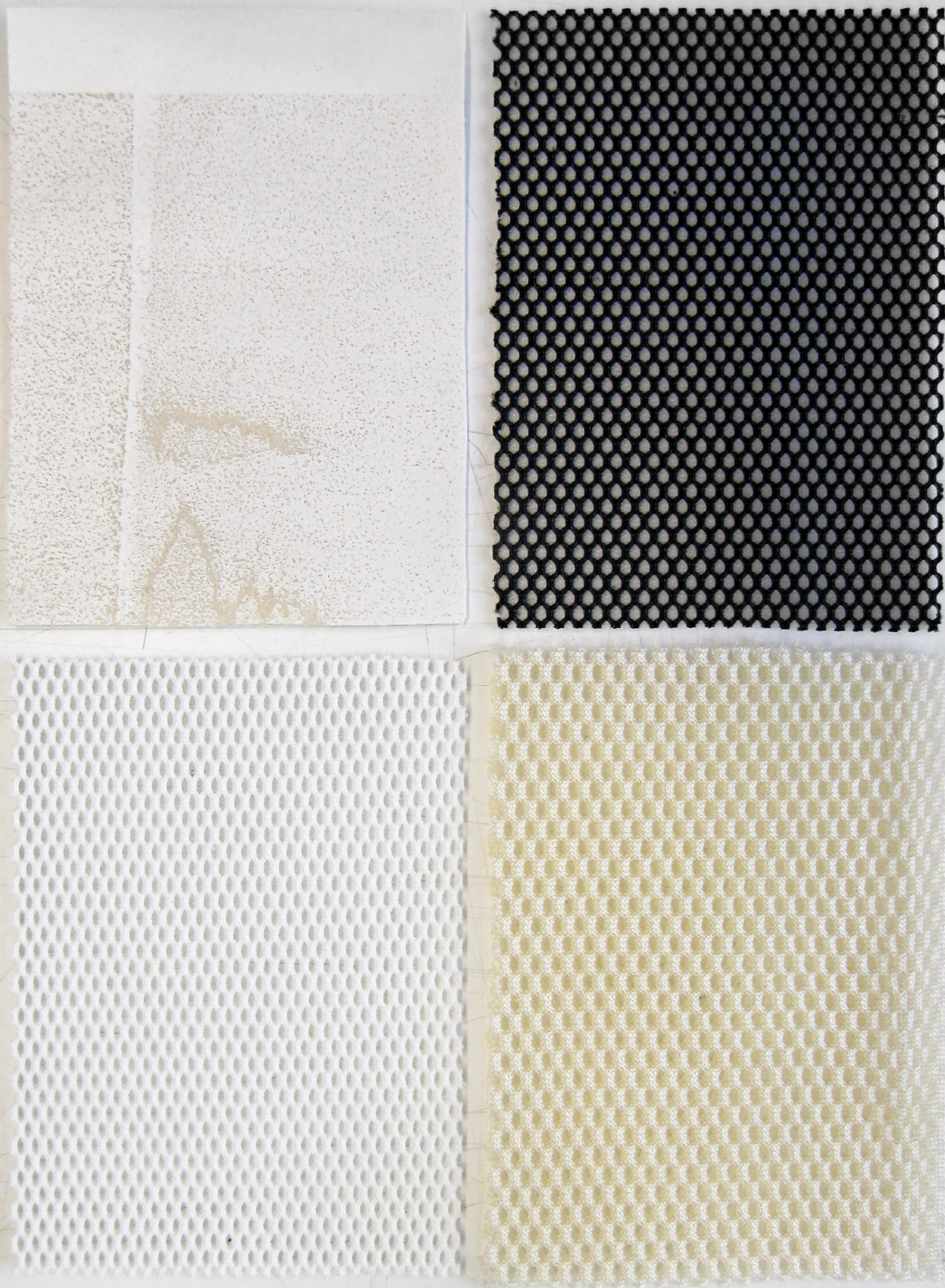


LIISA PESONEN



Jussi Mikkonen designed the 3D-printed echo box according to the collection's need of being placed inside of folds of fabrics. The shape of the echo box affected the shape of the designs.

¹⁰¹ Lee, *Fashioning the Future*, 50



Coated wool and thick 3D meshes

listening to the invisible interior of the body, we suggested that some sounds could be as if circulating in some inner space like a bottle. Based on the briefing Tanner composed the soundscapes and allowed Wikström to create their real-time modification with sensor input quite freely using *Pure Data*.¹⁰²

The soundscapes mystify the source, but it was necessary to keep one of the soundscapes simple in order to communicate the concept with as little explanation as possible. The sensor garment that measures pulse reveals the rhythm quite accurately. Pulse is probably the most familiar physiological phenomenon for anyone *via* our own bodies, and due to its use in art and cinema to present for example moods. Even though this sensor garment as part of an outfit is not able to achieve that similar feeling of nudity free from connotations, as was the aim, I found it important to give it this other explanatory purpose to fulfil.

6.3.3. Materials and Colourings

The material choices were largely inspired by the conceptual functional thinking related to the technology. The main visually expressive materials represent for example protection, water-repellency, ventilation and acoustics. I was drawn to use fabrics that were designed for some functional use or for sports, because they visually responded to the conceptual functionality. Many of these materials were only available in black and white. Most of the materials used are synthetic. I chose different types of polyester knits such as 3D meshes for their shaping qualities, as well as functional design, and because their look resembles the solid netting used in speakers. In certain processor and audio garments I used see-through PVC in the details. Sensor

garments were mainly made out of power nets and jerseys. Felted wool was used because of its look and interesting sound properties: it can be used to direct the sound as a functional material. To make the wool fit better with the more technical materials, it was coated with melting base through open silkscreen. As the coating increased the thickness, the material was able to evolve into more interesting shapes. Silk satin organza and some other more conventional fashion materials were used for draping qualities and look.

When I first started designing the collection I wanted to use vibrant colours. They stayed in the process until realising those bright colours did not serve a specific function in the collection, and that they might carry too much meaning as symbols or signs within the artistic outcome. Because of the concept of a collection with responsive sounds, it was more suitable to be visually minimalistic. In my mind black, different shades of white and brown refer to traditional musical instruments like pianos, cellos or guitars usually made out of natural materials like wood and detailed with bones and mother of pearl.

During my research I also discovered a conceptual reason for the choice of colour palette: black and white are technically not colours but representations of the total absence or presence of light.¹⁰³ When considering symbolic meanings, white often stands for innocence, while black suggests a sophistication that includes a consciousness of the darker side of life.¹⁰⁴

6.3.4. Shaping, Pattern-making and Construction

A functional and body-centric approach was necessary for making the patterns and designing how to construct the garments.

¹⁰² *Pure Data*, <http://puredata.fi>

¹⁰³ Lurie, *The Language of Clothes*, 184.

¹⁰⁴ *Ibid.*, 185-188.

A basic problem in conventional fashion design and construction of garments is that the body is three-dimensional form and often fitted by flat materials such as fabrics.¹⁰⁵ Another problem is that the body is constantly changing its shape through movement and the garments should not be too restricting. These otherwise obvious design problems emerge when embedding three-dimensional electronics around the body. Many of them need to be in immediate contact with the body inside of the garments, making these problems an even more noticeable part of the design process.

I wanted to achieve a modest look to contrast the exposing of the body with sound. This is visible in the chosen details when the collection contains for example turtleneck collars and gloves. While designing the collection, I had drawn a lot of silhouettes that expand away from the body, distracting the viewer from recognising the outlines of the wearer. These shapes were inspired by the images of acoustic listening devices and ear trumpets. The interpretation of those shapes by draping and pattern making was challenging and great fun, because the materials and necessary construction required as few seams as possible.

The electronics had an essential role in the process during the designing and testing of ideas by drawing and draping. The designed echo boxes defined many of the design and pattern-making decisions for the audio garments. The echo boxes worked to suggest silhouettes and I shaped large cavity-like folds on a doll. The designed audio garments needed to be somewhat well-fitted because of the weight, and they needed to have extra spaces for the echo boxes. Not all the possibilities for placing the echo boxes were appealing. I did not want to

place them on the lower back, as it was misleading when thinking of the body's activity as sounds heard from the outside.

Although *Immediate Invisible* is an artistic work, the choices for sewing techniques and detailing were based on the functional needs of the electronics and materials. These functional design choices became visual elements with specific roles in defining the aesthetics of the collection. The construction techniques included for example sewing by machine and by hand as well as bonding and laminating. To enhance this visual functionality I used water-repellent zippers as closures in the collection.¹⁰⁶ I decided to sew by hand many of the required structures in order to exhibit a specific style of finishing. The impracticality of the handwork was also a conscious choice to add contrast towards all the functional design and technical materials. To give the collection a more appealing look, I embroidered details with seed pearls. Some of them were merely decorative while others, such as the pearl nails in the gloves with pulse sensors, were also referring to the body underneath as in Schiaparelli's gloves.

In order to integrate the *Raspberry Pis* and batteries, I made small pocket-like constructions and integrated magnet strips to keep them in place. The echo boxes hang inside of the folds, and they required velcro in addition to magnets. The sensors were embedded in the garments and they are not easily accessible within the construction. The sensors are supposed to be worn next to the skin, and many of them are bonded, laminated, or attached in other manners similar to the soft textiles.

The choice to guide the wiring on the inside or outside of each garment depended on the materials and pattern-making. During the pattern-making and

¹⁰⁵ Roach and Eicher, *The Visible Self*, 46

¹⁰⁶ Aqua Guard zippers from YKK.



sewing, holes and other constructions were made to allow all the pieces to be plugged in with the others that would be layered on top of or underneath in an outfit.

While constructing, I made small functional inventions with respect to necessary technology. One of the inventions developed during this project related to stress relief for the wires. Metal stereo plug-ins were chosen because of their quality and style, but they also contain a spring that protects the wire and could be attached to the garment. When the wire is pulled on due to for example movement, the spring yields and protects the fragile soldering.

Sensor gloves with sequins and embroidery:
4/6 Pulse, 3/6 Oxygen Saturation, 6/6
Parasympathetic Nervous System



KERTTU MALINEN

6.3.5. Headpiece

The process for designing the headpiece was more detached from the rest of the design process. The idea for the headpieces to be worn with the outfits was purely about emphasising *Immediate Invisible* as a hearing device for the body. I designed it for styling, to clarify the sound as part of the overall look. Acoustic listening devices from the World War Era acted as inspiration for the headpiece, and the idea for the shape came from playing with a piece of paper. The main pieces are cut from transparent plastic and then bent into shape. Wearing the headpiece for the first time was thrilling. It was collecting sounds and from specific

directions. The paper versions were never acoustic, and I had assumed that the shape would not direct sound towards the ears. Coincidentally the headpiece had turned out to be a functioning hearing device. This detail rendered the headpiece a more essential part of the outcome.

6.4. Challenges

During the practice-led part, I had to overcome several challenges that came about while designing and coordinating the collection. As mentioned previously, there were also many challenges in the project related to time management and the construction of the collection.

Before I started designing, I hoped that the electronics would serve as visual inspiration and suggest forms, constructions, decorations and patterns. It was disappointing that albeit quite bulky, the electronics were not expressive in such a way that could be transformed into fashion statements. This was later overcome with the choice of plug-ins and the invention of the wearable echo box. The technology is also present as it has given a lot of inspirational input.

The chosen materials turned out to be more demanding than expected. The thick materials like 3D meshes and coated wool made it possible to have big shapes that stand on their own without any extra supporting structures, but they were demanding to sew. I had to be creative with making seam allowances to be thinner or to turn in the desired direction. Some of the cut edges of materials produced a lot of dust. Therefore almost all the seam allowances had to be taped in order to avoid the static dust to interfere with the computers and sensors.

Before settling with the chosen sensors, several tests were made on finding ways to measure breath ratio. We conducted tests with stretching sensors, but the input was too random and required exaggerated expansion of the chest. We then tried using a stethoscope for this purpose, but as it amplifies sound, it detected the sounds from the outside of the body as well, making it impossible to use in a garment that would also play out the soundscape in real-time.

Next spread
 Photographer
 Hair & Make-up
 Model

Kerttu Malinen
 Heidi Klaavuniemi
 Heta Saukkonen

Sensors



1/6 EMG



2/6 Heart Rate Variability



3/6 Oxygen Saturation



4/6 Pulse



5/6 Sympathetic Nervous System



6/6 Sympathetic Nervous System

Processors



1/6



2/6



3/6



4/6



5/6



6/6

Audios



1/6



2/6



3/6



4/6



5/6



6/6



7. Performing Through Camera

The photoshoot and the making of the demo film of *Immediate Invisible* were an important part of the final phases of the project. It offered a chance for myself as a creator, but also for other collaborators involved, to view and reflect the performative qualities of *Immediate Invisible* in action with sounds, and as worn by a model. Works in the intersection of art and technology share a common characteristic in that they are often shown to a wider public through video because of their performative qualities.¹⁰⁷ In these demonstrative films the created garments are presented based on their concept.¹⁰⁸

For purposes of presenting and documenting, it was necessary to shoot two different sets of images, as well as to make a demo film to present the expressive outcome of the collaboration with a musician and an interaction designer. One set of images shows the individual pieces in 18 pictures to emphasise the modularity. The other more important set presents six possible functional outfits in a more expressive way.

When combining the outfits for the photoshoot, the metaphor of *Exquisite Corpse* in relation to the outcome became concrete. I wanted to style the collection in an appealing way while having all

the pieces at least partly visible, and not completely covered by other garments.

The aim of the photographing of the outfits was to portray the collection as a hearing device that enables us to listen to the wearer's body. Although the printed images could not contain the sound, they could have a meditative feeling, humour or the essence of concentrating on something that was not in the possible properties of a picture. Most of the images were shot in a studio space and a few on location. With the choice of location it was possible to highlight the concept.

An anechoic chamber is a space where the walls or other surfaces do not reflect sounds. The visuality of anechoic chambers is often highly graphic and minimal with a feeling of unfamiliar three-dimensionality. We were able to use one that is located in Otaniemi in Aalto University Department of Signal Processing and Acoustics.

In the photo shoot and the filmmaking sessions, it was possible to view the entity on a model. This was manifested even more when we were in a space with no external sounds. We were able to listen to the outfits in possibly the most ideal space, and the very aspect, that the sound was played by the audio system worn by the model, was indeed very present. When the model moved around the space the sound moved and transformed with her as she turned around or came closer. There was nothing that would have distracted our experience in this first 'concert' of *Immediate Invisible*.

The demo film is attached to the printed version of this thesis and forms a part of the documentation of this thesis: in the film, it is possible to present the sounds and responsive qualities of the outfits to highlight the result of the interdisciplinary collaboration. It is also an individual artwork generated from the outcome of this thesis.

Pages 54-71

Photographer

Kerttu Malinen

Hair & Make-up

Heidi Klaavuniemi

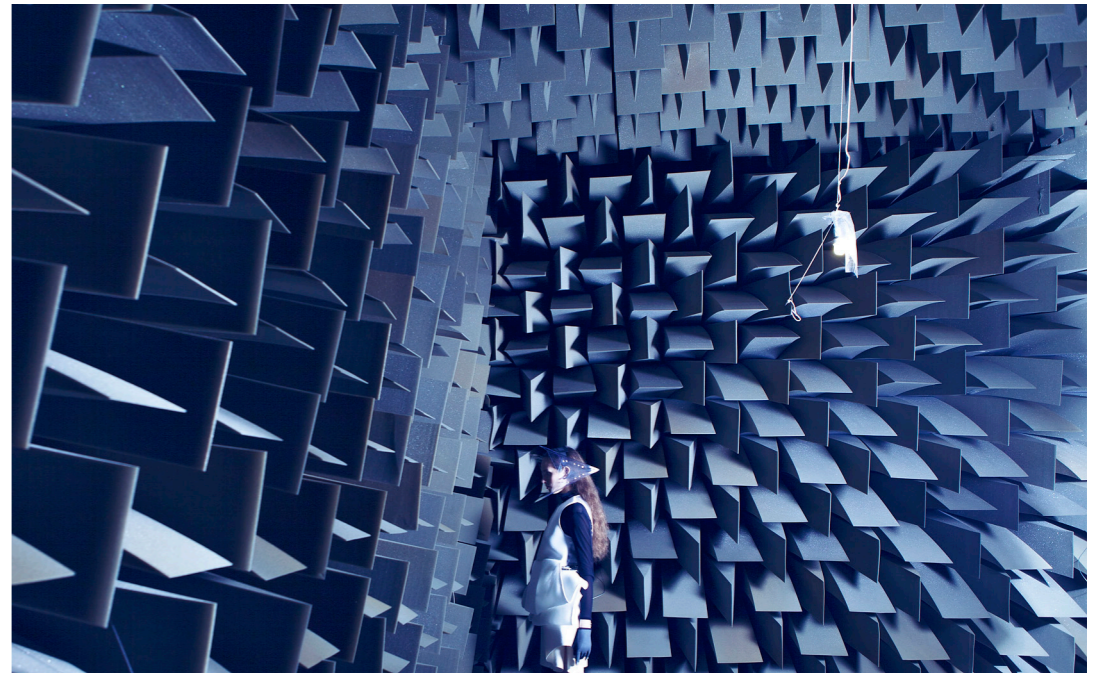
Model

Heta Saukkonen

¹⁰⁷ Pantouvaki, 'Technology-inspired Experimental New Transparencies', 174.

¹⁰⁸ Ibid.

















8. Reflection and Conclusions

My recent studies on wearable technology and functionality, as well as the project *Immediate Invisible*, have made me more body-centric and more aware of the wearer interacting and moving with garments. While working with interaction designers and other artists, I have created a better relationship with and a more holistic understanding of the human body. When designing interactive and responsive functional pieces that work close to the skin, ignoring the communication between a garment and the wearer is impossible. Technology problems force me to relate with the body while designing. It is crucial to look for ways to set sensors, processors and other non-traditional objects of fashion into the outfits. I believe that this experience will have an effect on my approach towards fashion design also in the future.

8.1. Reflection

Since the design and research process continued through the making of the single pieces, until the assembly of the very last plug-ins, it caused the shape and construction of the outcome to be more experimental rather than entirely perfected. Even though many of the design choices in the collection were inspired by functionality or functional constructions, the aim of the collection was not to be functional design. The outfits are

sculptural and expand away from the body in contrast to all the functionality with appealing impracticality. This was a way to manifest the passive relationship of the wearer with the responsivity of the outfit; the responsive outfits were designed to be worn passively, like the shape of an otherwise flat garment is determined by input of the wearer's physical shape. In the outcome, technical materials collide with the handwork and pattern-making related more to dressmaking.

In the introduction it was stated that the wordless communication between human beings is limited to only a narrow area of our visible existence. As the emphasis on the outcome is to concentrate on the invisible, I created a more minimalistic visuality for the collection with a functional design approach to diminish the importance of visible. The visuality of the collection was not predefined, but it was created during the artistic design process and it was not only defined by the concept but also by the requirements related to the technology. Designing the garments to exist as sensors, computers or audio systems caused all the pieces in the collection to be equally important in building the appearance of an outfit. This also allowed me to explore what kind of issues should be taken into account when designing fashion and coordinating a collection.

The contradictions between concealing and revealing are played with visually in the outcome of *Immediate Invisible*. By doing narrow necklines, turtleneck collars and gloves, it was possible to achieve a modest concealing look, which stood in contrast with the presence of the displayed body. The 3D meshes and some other materials are partly or completely see-through when viewed from the correct angle. The materials merge with the ones that are worn as layers underneath, or with

the wearer's skin. The outcome of the practice-led part is filled with armour like materials and solid shapes that obstruct the viewer from evaluating the physical body underneath. Instead the body can be viewed by listening.

Revealing something new makes the revealed issue appear concealed by others. In order to have the concealment of non-revealing as a part of performativity within the collection, it would have been possible to design soundless outfits to be in contrast to the responsive outfits. During the process I realised that in performative use, the viewers and their own garments would fill this role.

The most exciting parts of the project were the moments when all the elements started to come together and transform into an entity, as if revealing an *Exquisite Corpse*. For example, when we first tested a prototype that displayed pulse and blood pressure, Wikström's output was completely different from mine. When testing the prototype, I was simply horrified by how melodic and random my blood flow sounded, and it made me question the whole objective of this thesis. I overcame this problem realising that I had just experienced what my thesis was really about. Furthermore, by making the physiology perceptible, it was possible to show the unique differences that we are not able to sense. If everyone were the same, sensor-responsivity would not be needed. Any physiological pre-recorded data could have been broadcasted as part of the outfits.

Throughout the *Immediate Invisible* project, I have been amazed by the commitment shown by everyone involved. It allowed me to concentrate on my own role in the interdisciplinary collaboration: designing and producing the artistic collection has been a great task to accomplish.

8.2. Conclusions

The focus of this written part was to verbally express the central idea for *Immediate Invisible*, and to frame how it could be interpreted and understood through a joint perspective, which combines literature research, conceptualising and practice-led work, into a modular artistic collection with performative responsive qualities. The core of the project involved investigating the novel feeling of nudity that I had previously experienced with body-worn sensors.

The main research question of this thesis was based on the artistic fashion collection idea that was the impulse for the entire thesis: how do body-worn sensors enable the creation of an artistic collection, which reveals a new type of unexplored nudity, and which discusses revealing and concealing in fashion?

In order to answer this question, this written study entwined the thoughts, concepts and theories with artistic practice to create a holistic entity, as well as to elaborate the interdisciplinary collaboration and the decisions made in an artistic process. As fashion was found to be an interdisciplinary field, the literature references were drawn from several areas of knowledge, such as psychology and sociology. Literature was specifically used to define terms in order to answer the question and to later define the concept around the original idea for the thesis.

Fashion was defined as social phenomena for individuals to present themselves through time and in relation to the space and situation. Fashion was found to reveal and conceal things other than just the body. Dress has the possibility to reveal fragments of the wearer's identity, background, preferences and age, among many other things, adding meaning to the body that would not otherwise be there. The modesty of dress is coloured with

the diverse expectations set by ourselves and our surroundings. The expectations towards dress were often found to be defined by external and social forms like society and cultural norms.

The nearly nude or naked body was discovered not to be an alternative form of displaying oneself in normal social encounters. Therefore, to understand feeling nude while not naked, the origin and development of clothing was looked into as the beginning of revealing and concealing in dress. These theories, many of them related to protection, communication or social behaviour, opened perspectives on dress and the related kinds of connotations and expectations that are able to reveal something other than the body for viewers. This results in the possibility to feel nude in front of others even when fully dressed. Fashion's task is to reveal the body and at the same time preserve modesty. This juxtaposition of motives becomes a game that is a basic dilemma in fashion. These connotations and expectations were discussed, because albeit unrelated to the feeling of nudity that I experienced when wearing the *Brainwise* headpiece, they were important for understanding nudity and dress in relation to the feeling of being nude.

There were also several terms and phenomena that were necessary to address in order to locate the conceptual idea within the diverse fields that exist at the intersection of art, technology and fashion. The conceptual idea was related to a playful attitude as an approach, with self-defined aims within the field of wearable technology. Since the outcome is very much about aesthetics, the idea of the collection is also contributing to the area of fashionable technology.

The research question was mainly answered through practice-based art and therefore the design project *Immediate*

Invisible combines fashion, responsivity and sound.

The idea of using sensors, processors and audio systems was found to form a responsive system when it is not in conscious control of the wearer. This aspect is related to the passivity of experiencing this new type of nudity *via* body-worn sensors. The body was found to be part of the total appearance of an outfit. This becomes more concrete when the outfit responds to the body by displaying a soundscape modified by the sensors, thus making the wearer feel nude.

The concept for the practice-led part required both a literal and practical interdisciplinary approach in order to provide an artistic outcome as an answer to the research question. The conceptualisation started by returning to the idea that initiated this thesis: the possibility of revealing the body's physiology with audio, having all the necessary technology integrated fashionably into the outfits, and investigating its meanings. Visual inspiration and references were collected to guide the artistic design process. The original idea included the collection as a final form of the artwork.

The artistic practice-led approach towards the research question was to make a collection that works as a hearing device for the body, which would allow viewers to listen and concentrate on something that is invisible, unfamiliar and therefore new. The surrealists' method *Exquisite Corpse* was used as a metaphor for describing the method within the collaborative process and the design process of the collection. The interdisciplinary collaboration was vital for the artistic outcome and when the three parts – fashion, responsive systems and sound – were brought together, the outcome was like unfolding an *Exquisite Corpse*.

In this manner, the body can be

decorated by adding sound to the total appearance of an outfit, causing the body to be exposed even when fully dressed. The responsivity of the collection was designed to mystify the source, not attempting to communicate emotions, but to display the body's physiology, since the display of interpreted emotions was found to be unrelated to the studied nudity.

Exquisite Corpse is also a metaphor for the collection's modular outcome and open-ended result. The collection was designed to include sensor garments, processor garments and audio garments; functional expressive outfits are combined from these three elements.

As I immersed myself in the study of the various aspects related to my idea and worked further in the artistic process of the practice-led part, I realised the beauty of the nudity that I was studying. When the body is always adapting to the needs of the human being, there cannot be any external expectations or connotations towards the displayed data. Similarly there is no connotation of displaying oneself except with respect to phenomena such as pulse which is familiar and much used in art. Our relationship with our body's physiology is mainly unconscious or passive, and hence the question of presenting oneself in a right or wrong manner is absurd. The conscious wearer is also the viewer of the dressed body, and is not able to affect its performance by direct choice. When wearing the sensor-responsive outfits of *Immediate Invisible*, it is possible to be displayed and viewed without connotations or expectations for oneself. The viewers are allowed to observe and engage with the artwork in a similar manner. This is a feeling not conventionally related to one's appearance in social encounters, which is what makes it so valuable.

8.3. Further Consideration

The thought of revealing one's body as in *Immediate Invisible* within normal social encounters raises questions about the future. Could there be an ideal physiology similar to the ideal body when we become more familiarised with it? It is curious to think that maybe in the future, displaying the body's physiology is a daily means to mediate beauty through worn fashions. As beauty is also related to norms, would we perhaps begin altering and modifying our physiology? Would we rehearse conscious control over heart rate to achieve a desirable look?

There are also ethical concerns related to the use of sensors in garments and in the possibilities to record the harvested data. Lee points out a credible risk involved in the collection of an individual's data through garments: there might be a third party, like an insurance company demanding access to this information. Would people happily reveal their personal data for decision making?²¹⁰⁹

Even so, with artistic fashion design we can mirror our own perceptions of the world. Through artworks like *Immediate Invisible*, it is possible to offer experiences related to new technologies, and to cause people to halt and experience something new in this day, and to think of their own relationship towards information technology and the possible future. This allows them to make their own conclusions on whether they see it as a dystopia or utopia.

109 Lee, *Fashioning the Future*, 159



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