Crafting Movement
Moving Image Collections for Interaction Design

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Abstract
This thesis conceptualises, investigates, and reflects on the moving image design space in Human-Computer Interaction (HCI). Motivated by the increasing number of videos, films, and animations produced in the field, the thesis recognizes moving image making as a designerly way of inquiry across research and practice, and argues for the importance of moving image as a research topic in interaction design.

The first contribution of this thesis is the conceptualization of the moving image design space. The growing body of moving images, varying in forms and purposes, can be held together to establish a foundation of knowledge that informs and generates new research and practice. We identify four collections of existing works and their different roles, namely moving image as design technique, design element, design exhibit, and design promotion. The second contribution is the manifestation of moving image making through concrete design studies. These exemplars empirically demonstrate how they investigate, enrich, and challenge the four established collections, and ultimately expand the moving image design space.

These contributions not only provide new knowledge on moving images for better understanding their various roles in interaction design and making works that respond to emerging design opportunities, but also foreground the discussion on the mediation aspect of moving image in HCI.

Keywords: Human-Computer Interaction, Interaction Design, Moving Image, Film, Video, Animation, Design Mediation.

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Sammanfattning

Denna avhandling undersöker, definierar och reflekterar kring designrymden för rörlig bild inom människa-data interaktion (MDI). Med utgångspunkt i det ökande antalet uttryck av rörliga bildarbeten inom fältet – såsom videos, filmer och animationer - behandlar denna avhandling skapandet av dessa som ett designmässigt förfarande för att undersöka samspelet mellan forskning och praktik och introducerar rörlig bild som ett relevant ämne inom interaktionsdesign.

Avhandlingen består av två huvudbidrag. Det första bidraget är en konceptualisering av designutrymmet kring rörlig bild inom MDI. Dessa arbeten använder rörlig bild i olika former och uttryck samt för olika ändamål, vilka tillsammans kan utgöra en kunskapsgrund som kan informera och generera ny forskning och praktisk användning. Fyra kategorier av befintliga verk framhävs som ett sätt att förstå deras olika roller inom design kopplat till rörlig bild; designteknik, designelement, designartefakt och design promotion. Det andra bidraget är att belysa exempel på tillverkning av rörlig bild genom konkreta designstudier som har genomförts under avhandlingsarbetet, vilket på ett empiriskt sätt visar hur de undersöker, berikar och omformar de fyra etablerade kategorierna och därmed utvidgar designrymden.

Dessa bidrag ger ny kunskap för att teoretiskt förstå praktiken av rörlig bild och dess olika roller inom interaktionsdesign, samt hur man engagerar sig i tillverkningen av rörliga bilduttryck som svar på de framväxande designutmaningar och möjligheter som skapar ett ständigt utökande av designrymden för rörlig bild inom människa-data interaktion.
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Stockholm, December 2017

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1 Introduction

For the past two decades, moving images, such as videos, films and animations, have gained increased attention in various research fields, marking a turn towards “more visually literate forms of research and scholarly communication” (Pauwels, 2000). This turn is reflected across different academic disciplines, natural science, social science, medicine, education and so on. In the field of HCI, although the use of videos and computer graphics to present novel designs and systems had emerged from the 70s, it only became mainstream in the last decade. A number of voices have paved the way for moving images to gradually gain a ground in HCI. MIT media lab is one the pioneers that has started using videos to present design concepts from the 90s. Since 2009, CHI conference has initiated the track Video Showcase, which encourages the researchers to engage the audience in audio-visual means. Löwgren stressed the need for videos in science communication (Löwgren, 2011), and Höök further called for videos to be upgraded in academic status (Höök, 2012). Scholars have addressed the importance of videos as a means of presenting new research results, functioning prototypes, and technology developments. But in the addition to calling for more videos and upgrading its academic status, we also need to call for more varied videos and expand its role in HCI, particularly for design.

Today, we can no longer view the moving image as merely a means for communication. Rather, we need to have a nuanced understanding of its role in HCI under the influence of multiple disciplines that comprise this field. Influenced by science and technology communication, videos are commonly seen as recordings of the facts, such as demo videos. Similarly, influenced by psychology and social science, videos recorded from user testing or field observations can act as data and evidence for research investigations. In design, on the contrary, videos and animations are often used for their capacity of portraying an imaginative space and exploring the possibilities of the future. Similarly, in the arts, different forms of moving images are seen as crucial means for creative expressions, which can often combine with digital effects and create fantastical experiences.
This thesis is situated in the rise of moving images in HCI, such as videos, films, and animations, and brings forward a nuanced understanding of moving image from the perspective of design research. Particularly, it argues that moving image making can be understood as a means of designerly inquiry (Cross, 1982). Similar to sketching or prototyping, it is a skill many designers apply through their design activities. Within HCI, there is an existing body of research utilizing moving images for various purposes. When collected together, they show similarities and differences, unveil limitations and opportunities, and form analytical lenses and generative theories.

1.1 Moving Images and their Qualities

A detailed account of moving images from theory is described in the next chapter. But first, it is important to point out what the moving image refers to in this thesis. Generally speaking, it refers to various types of media forms that use continuous images to create the sense of movement for the viewers. In HCI, it can include, but is not limited to, videos (e.g. demonstration videos, concept videos, video sketches), films (e.g. design documentaries, film scenarios and design fiction films) and animations (e.g. stop motion animation, 3D animation, and virtual prototypes). In the thesis, the term moving image is sometimes used interchangeably with video, film, and animation, in order to point to the specific design cases in question. The intention, however, is not to draw attention to their differences as media formats.

There are two main reasons for choosing the term moving image, instead of adopting perhaps more familiar and specific terms. First, moving images encapsulate multiple media formats while emphasizing their shared feature – the sense of movement enabled by continuous images. The thesis draws on the shared features rather than different types of media or techniques associated with them, in order to keep the focus on the role of moving images in interaction design. Moreover, moving images connote the artistic and creative practices that are more relevant to design, while downplaying the connection to the established and industrialised cultural products, such as films or movies. As part of a series examining contemporary art, the book Moving Image (Kholeif, 2015) has discussed various creative moving image works in experimental films, installations, and performance art, as well as the new technologies and innovations they have applied. The moving image is a more inclusive term for discussing creative works in the area of interaction design and technology.
It is important to note that this thesis is concerned with using the moving image as a designerly way of inquiry in the context of design research in HCI. Thus, other works related to moving images but not closely related to the designers’ inquiries and activities are beyond the scope of the thesis, such as graphic technologies, video production systems, user-generated video contents, and so on. Such choice moves the thesis towards the type of design oriented research and practice where designers adopt moving image making as means of mediating design thinking and knowledge.

As previously mentioned, there is an increase of the moving image works in HCI. But why are they important, particularly to design research? In other words, what are the unique qualities of moving image that are of benefit to interaction design activities?

Moving images emphasize the visual aspects of design; they depict rather than describe. Sketches, illustrations, and photos have always been crucial in traditional design disciplines. Visual aspects are gradually gaining importance in interaction design research and HCI (e.g. Blevis, Churchill, Odom, Pierce, Roedl & Wakkary, 2012). However, the most important feature of moving images is its ability to convey the sense of movement. Central to moving image making is the practice of crafting movement that enables the designers to convey important aspects of interaction design. The sense of movement is closely linked to the experience of time and rhythm, which is especially important for the depiction of interactions, dynamics, and transactions. Storyboards, for example, can, to some extent, depict the time aspect of interaction, but they largely focus on sequences of actions rather than experiences. Moreover, moving images allow storytelling; they can represent realities and facts, depict fictional events or imagined futures, as well as blur the boundary between the two and leave the viewers to wonder. Storytelling can also bring the viewers to a more reflective dimension, as well as evoke certain emotions, initiate discussions and provoke debates. Moving images can also be interactive with the help of digital technology, which makes it even more relevant to HCI and particularly for designers to explore new interactive experiences. Overall, moving images can be mixtures of various media formats. Language, image and sound can be creatively assembled in the mixture, and the combination of the different qualities enables it to become unique for interaction design and HCI.
1.2 Design Space and Collection

The unique qualities of moving images can benefit the interaction design research in many aspects. Indeed, we see a visible increase of such works especially in recent years. Although many designers and researchers are engaging in the practice of making, moving image is yet to be recognized as a research topic. Currently, these works seem to be scattered individual endeavors. There needs to be an analytical tool to understand them, so that new works can be built upon the knowledge from the peers and generate insights back to the field. Thus, this thesis proposes to use the concept of design space as a means of articulating both the practice of moving image making and the conceptual space it operates in.

Design space is a widely-adopted concept in HCI. But it lacks a clear definition. MacLean, Young, Bellotti, and Moran (1991) have proposed to systematically map out design space through the analytical model QOC that addresses Questions, Options, and Criteria of a design process as design rationales (MacLean, Young, Bellotti, & Moran, 1991). A design space can also be a collection of questions that stir the design considerations to cover different aspects (Fitzmaurice, Ishii, & Buxton, 1995). The notion of design space here is similar to what Newell and Simon (1972) phrased as “problem space”, where the so-called space is the path to create a good solution systematically (Newell & Simon, 1972). Opposed to what he views as the engineers’ approach design, Krippendorff (2005) emphasizes the importance of creativity and imagination in the design process and views various design methods as “ways to encourage the creation of spaces for design” (Krippendorff, 2005, p. 213). Grounded in practical design processes and creative methods in the industry, design space here is referred to as the possible future of design solutions, which is a view many research-oriented designers adopt today.

Alternatively, design space in design research operates in a more conceptual level. In describing design workbooks, Gaver uses design space as a metaphor for how a collection of design proposals can affect the perception of possibilities (Gaver, 2011). The similarities of design proposals connect them as an integrated collection while their differences imply a dimensionality that allows for other ideas. More importantly, Gaver emphasizes that “design creates the spaces in which it operates”. In other words, it is the very collection of design exemplars that map out a design space, rather than abstract rationales, questions or parameters that existed before the exemplars (Ibid).
This thesis adopts Gaver’s notion of design space, but goes further by proposing an intermediate concept within the design space, namely \textit{collection}, which links the abstract design space with the concrete design exemplars. Similar to collections of art, music and design pieces, moving image works within a collection share a common theme, but they occupy unique individual spaces. By comparing the collections, we make visible the variations between them, and understand why and how they vary. The different collections consist of the overall design space and have flexible boundaries. They can evolve with the new works created, and ultimately reshape the design space.

1.3 Aim and Research Questions

The aim of this thesis is to call for the recognition of the moving image as a research topic by recognizing moving image making as design practice and articulating moving image works as a design space. This aim is achieved by investigating two research questions.

- (Q1) What collections emerge from the moving image works by looking at their roles in interaction design?

Q1 intends to identify different collections of existing moving image works in HCI and to understand how they engage with design and technology by analysing the differences and commonalities in their roles and expressions. These works together form a design space that provides a foundation for further exploring moving image making for interaction design, which leads to the second research question.

- (Q2) How does moving image making engage with and expand the collections?

Through concrete exemplars, Q2 investigates how to create moving image works for interaction design in response to various challenges and opportunities. These works may consolidate or diverge from the collections, and ultimately enrich, challenge and expand the design space.

These two questions together intend to, on the one hand, articulate the moving image design space as theory, and, on the other hand, exemplify the making of moving image as practice.
1.4 Positioning the Thesis

This thesis intends to draw attention to the making of moving image as a practice, and a designerly way of inquiry, just like sketching, drawing, or prototyping. It does not focus on specific media through which moving image works are realized. This perspective is also motivated by the shift of subject away from the so-called medium-essentialism in media, art and film studies, due to its limit in addressing emerging practices of moving images, especially the new ways of moving image making through digital technologies (Noël Carroll, 1996, p. 49).

The thesis takes on a perspective of mediation in the sense that moving image making is a design practice where abstract and creative thoughts, questions, processes, phenomena, or ideas can be made visible and accessible to the viewers. Thus, different from how mediation is addressed by McLuhan (McLuhan, 1964), the content of the mediation here is not necessarily always another medium. Although highly relevant to HCI, the concept of remediation will not be dealt with in the thesis. Remediation argues that “all new media are doing exactly what their predecessors have done: presenting themselves as refashioned and improved versions of other media” (Bolter & Grusin, 1999, p. 14). Based on this perspective, interaction design can be understood as a process of remediation (i.e., using digital technology to reinvent existing media and exploring new experiences of the old media). This view diverges from the scope of the thesis, which focuses on moving image making as design practice rather than digital media as remediation.

The thesis also intends to highlight the authorship and intentionality. It emphasizes the role of designers, design teams and institutions as authors of moving image works, whose intent motivates the design decisions. It is concerned with the roles of moving images in design and technology, as well as the motivations and strategies of making. This approach provides a new angle on the existing video related research in HCI and better reflects the research investigation from a design perspective.

Lastly, the thesis emphasizes on the art of telling, rather than the effectiveness of communication. The reason is not to dismiss communicative role of moving images. Rather, communication is crucial; it exists in all the moving image works and has been recognized in design. Thus, this thesis intends to draw attention to some of the less discussed roles of moving images in design research, each of which is associated with the communicative role, but has its own emphasis and importance.
1.5 Methodology

This thesis recognizes there is a body of moving image works in HCI that can be held together to inform and generate new research and practice. It aims to articulate and engage with this moving image design space. Two research questions are raised and investigated through two methodological approaches.

Firstly, this thesis intends to conceptualize the design space of moving images and provide a theoretical understanding of their various roles and practices in HCI. The approach adopted for establishing the design space can be described as “critical analysis of designs as theory-building” (Bardzell & Bardzell, 2015, p. 40). It emphasizes the foundation of knowledge based on the analysis of existing exemplars – a tradition in various design related disciplines – from architecture and product design, to film studies and art. Based on Carroll’s accounts on critical approaches in art, including moving images (Carroll, 2009), a set of analytical lenses are developed to understand the existing works in the context of HCI. The lenses examine how the works mediates technology and design (the interaction design perspective), their forms and style (the moving image perspective), and their motivation. By analysing individual works through these lenses, it is then possible to categorize them into collections according to the different roles they play in interaction design, which, in turn, form the design space of moving images.

Secondly, this thesis investigates how to create moving images in response to new design challenges and opportunities which expands the design space. This question is investigated through concrete design studies following a Constructive Design Research approach (Koskinen, Zimmerman, Binder, Redstrom, & Wensveen, 2011). The construction – in this case, moving images – act as the key means of constructing knowledge. This approach highlights the practice-led nature of design explorations. In this thesis, moving images produced during the process, including animations, videos, films, and interactive systems, take the centre place of the investigation. These works respond to different themes and topics, while remaining an overarching “core” of moving image making. The construction of these design exemplars follows an iterative design process and adopts a mix of methods. Ethnography-informed methods are used for studying people, such as observation and interviews. Design methods are used for generating and refining design concepts, such as brainstorming, creating scenarios and conducting design workshops. The design concepts are realized collaboratively in the research team and the results are validated through qualitative research methods.
1.6 Contributions

This thesis recognizes moving image making as a means of designerly inquiry across the research and practice and argues for the moving image as an import research topic in interaction design.

It has two main contributions. The first contribution is the conceptualization of the moving image design space, which points out the importance of a theoretical understanding of moving image practice. There is a body of works utilizing moving images in various ways and for different purposes, which can be held together in forming a foundation of knowledge that inform and generate new research and practice. Four collections of existing works are identified as having different roles in design, namely moving image as design technique, design element, design exhibit, and design promotion. The four collections also differ in their motivations, expressions, and relations to technology and design.

Design Technique

Moving images are widely used by designers as a way to explore, manifest, document, communicate, evaluate, provisional design and prototypes, in order to make abstract thoughts, questions, and concepts concrete and accessible. This collection refers to the practice of moving image making with the intent of driving the design process in order to design the right thing.

Design Element

This collection refers to the type of moving images as an integrated and essential part of a design artefact. The motivation is to explore design opportunities, new forms of visual expressions, and aesthetic experiences enabled by interactive technologies. Aesthetics and interactivity of moving images are emphasized.

Design Exhibit

Moving images can also be created with the intent of speculating possible future, initiating discussions, or provoking reflections. The implication is less about what a design object or concept is, but what it means. The notion of exhibit connotes an artistic exhibition, where imaginations, experiences, and questions are more important than functions, facts, and solutions.
Design Promotion

This collection refers to the moving images created with the motivation of promoting the design visions, concepts, processes, prototypes, products and insights. Promotion here denotes to the intent of demonstrating and disseminating design results, and convincing the viewers that the proposed designs are plausible.

The second contribution is to show moving image making through concrete design studies conducted during the process of the thesis, which empirically demonstrated how the design space can expand and provide new design opportunities. These studies were conducted in different contexts, in response to different challenges and opportunities, with various goals and outcomes. Chapter 4 presents how they investigate the four established collections, and ultimately expand the design space. As design technique, Previs Animation and Cherry Blossom showed how new uses of moving images facilitate design process to deal with emerging challenges such as interactions involve life-size furniture and cherry blossoming trees. As design element, LiveNature and Watch for Figuracy are two functional systems that demonstrated how moving images could be used to explore new aesthetic experiences with the help of emerging technologies such as mobile live streaming and wearable technology. As design exhibit, the fashion film Watch for Figuracy and speculative design film Object showed how to incorporate other creativities disciplines in interaction design such as fashion film and artistic film to speculate new experiences of technology. Lastly, three demonstration videos showed how to enrich the collection by disseminating new artefacts as design promotion.

It is worth pointing out that moving image design space is programmatic and open ended. The collections should not be seen as a set of principles or guidelines, but as aspects that occupying different but sometimes overlapping design research spaces that can evolve with the future research. It contributes to the field by suggesting a new understanding of interaction design that accounts for the mediation aspect and opening up new questions, challenges and opportunities such perspective brings to HCI.

1.7 Research Activities

This section briefly describes the research activities that concretely investigate Q2 of how to engage with moving image making in interaction design. These studies are built on the result of Q1, the four collections, moving im-
age as design technique, element, exhibit, and promotion; but they also show how the design space could evolve. This thesis argues for the importance of moving imaging making as a design practice. Thus, the videos, the animations, and films produced during the thesis are the design results as important as the academic publications, with the respective roles as exemplars and articulations.

Following a number of studies conducted on the topic of video interaction within our research group (Engström, Perry, & Juhlin, 2012; Juhlin, Reponen, Bentley, & Kirk, 2011; Juhlin, Zoric, Engström, & Reponen, 2014), this thesis shares the interest in video related research, but takes on an explorative design approach across the domains of home interiors, nature experiences and fashion practices. Although these research topics differ, they share the approach of moving image making and the goal of exploring new design opportunities for aesthetic experiences. The research activities were conducted between 2013 and 2016, which could be loosely divided into three phases.

The first phase started with a collaboration with newly-established IKEA Research on the subject of *Home Transformation for Small Space Living*, which investigated new design concepts for interactive furniture. Previs animation as a design technique was proposed to communicate design concepts from the user studies to the design process. We created a 3D (three dimensional) previs animation, which was shown to five designers individually before interviewing them on the design concepts and the animation. It was in this study the benefits of using the moving image as a design technique became clear, particularly due to its ability of depicting movements, dynamics and interactivity for design. The outcome of the study includes a 3D animation and a paper articulates previs animation as a design technique:

- **Previs Animation** - design technique (Paper I)

The second phase of the research was to explore the design opportunities of nature experiences, inspired by the sense of longing for a cherished place. The research started with three field visits in Swedish countrysides to interview people who regularly travelled there to revisit their cherished places. After a series of workshops, the concept of *LiveNature* emerged that could combine live video with weather sensor data and display the cherished places as an ambient artwork in the home. In order to understand what experiences this type of real-time moving images could bring in people’s daily lives, the system was deployed in the context of a concept apartment, which was an ordinary apartment in a residential building furnished and maintained by IKEA research. We interviewed four adult individuals, each of whom
lived in the apartment with their family and experienced the system for two weeks. This project enabled us to explore the features of moving images as live, ambient, and interactive with co-located weather sensor data. More importantly, this study provided an enriched understanding of liveness as a new live and ambient experience, which accounted for immediacy, unpredictability, engagement, authenticity and transcendence. The outcome includes an interactive system that uses live streaming videos as an essential design element. Two papers articulate its design process and deployment respectively, as well as two demo videos for explaining the concept and disseminating the results of the system:

- *LiveNature* Demo – design promotion

Following the interest in nature and sensory experiences, the next exemplar was the result of a workshop in the summer school UBISS¹, Oulu, Finland. Led by artist Mark Shepard, the aim of the workshop was to produce design concepts on data geography. A speculative design fiction film, *Object*, was created to explore novel ways of sensing and interacting with the environment through technology. The ambiguous relationship between human and the environment was explored through the protagonist’s interactions with a mysterious object. The film was selected for a number of art exhibitions and screenings internationally. The outcome included a speculative design film and the articulation of its concept published in the ISEA² artwork catalogue:

- *Object* – design exhibit (Related paper a)

The last study in this phase was inspired by the idea of plant dissemination (Pollan, 2001), particularly through design and digital technology. We conducted a series of field studies during the cherry blossoming seasons in Kungsträdgården (King’s Park) in central Stockholm. The moving image was used as a means of documenting how people interacted with cherry trees. The video clips were juxtaposed with cherry blossom icons and symbols appeared in contemporary design and with plant-based computer systems, in order to unpack the complex motivations among different usages of plants. Here moving image making was used as a technique for capturing the interactions to generate design implications for plant-computer interaction.

The outcome includes a series of documentary videos, and a paper articulating the perspective of plant dissemination and its design implications:

- *Cherry Blossom* videos – design technique (Paper IV)

The last phase of the research was within fashion with a particular focus on wearables. We were interested in the emergence of smart watches as fashion accessories. However, early smart watches seemed more like gadgetry than fashion, as there lacked an understanding of fashion in terms of its social and institution practices. A fieldwork study on “Sony Smart Watch 2” was conducted by investigating people’s dressing practices with these devices. We then designed and developed a system, *Watch for Figuracy*, as an exemplar. It worked as a “colour stylist” that could recommend suitable colours and make the watch face a cohesive part of the wearer’s dressed ensemble. Graphical animations for the watch faces were created that could respond to the colour of the chosen garment via predefined algorithms. Moving images act as design element that facilitated the anesthetization of the smart watches. The outcome of the research includes a smart watch application with motion graphic as design element, a paper articulating the concept, the process and the initial findings, and a demo video showing the result:

- *Watch for Figuracy* – design element (Paper V)
- *Watch for Figuracy* Demo – design promotion

Following the study of the application, we were further motivated by the question of how wearables could be made fashionable through fashion media. We produced a fashion film for a fictional wearable concept based on the idea of *Watch for Figuracy*. Then we showed the film to fashion communication experts and interviewed them afterwards in order to understand if and how a wearable concept could appear as fashion in such a film. The moving image here was used as a means of conveying the fashion experiences by telling a romantic story, establishing the characters, depicting the fictional world, and highlighting the atmosphere around the watch. The outcome includes a fashion film that exhibits the wearable concept through fashion means, as well as two papers that articulate its creative process, along with insights and learnings from fashion communication experts:

- *Fashion Film* – Design Exhibit (Paper VI, VII)
Overall, Figure 1-1 offers an overview of the research activities, including publications and moving image works, and how they connect to the research questions. Q1 deals with the conceptualization of the moving image design space through critically analysing and categorising existing works. The design exemplars investigate Q2 of how to create moving image works in response to specific challenges and opportunities in interaction design. These works investigate the four collections, but also enrich and expand them.
This chapter describes the theories that are the backdrops of the thesis, namely the theory of design mediation and the theory of moving image. This thesis takes a perspective that views moving image making as a mediation process. Here, designers articulate thoughts by making them accessible through moving images. This perspective is well-established in design history. In the following, we first look at the mediation perspective from design history before reviewing emerging discussions on this topic within HCI. As we will see, the moving image is an emerging form of design mediation. Then, we turn to the theoretical understanding of moving images more specifically in terms of what it is and how to understand it.

2.1 A Mediation Perspective in Design and HCI

John A. Walker (1989), art critic and design historian, described design as a “discourse” and designers as engaged in “a discursive practice”, in the sense that “a flow of objects, documents and talk is generated by the daily activities of designers, clients and design institutions” (Walker & Attfield, 1989, p. 23). To study and to understand design, one can conceive of a hierarchy of discourses: “level one is the discourse of design; level two is the mediating discourse of writings and photos representing design in publicity, design magazines, etc...” (Ibid, p. 24). In this regard, from the designer’s perspective, level one is focused on the design process, where the goal is to create the right design, while level two is focused on the design mediation, where the goal is to articulate the design thinking through the right means for the intended audience.

Separating these two levels of discourses is a theoretical lens, through which we can see that design research communities in HCI have extensively discussed design discourse, while little attention was paid on the mediating discourse of mediation. The role of mediation has however long been recognized in the history of design. In the book, Design History Australia, published in 1988, designer and design theorist Tony Fry pointed out the significant role of mediation in designed products.
...the history of the mediation of a product – how, for example, it has been written about, illustrated, photographed, displayed, advertised – is also not only of historical interest but embedded in the formation of meaning. There is, of course, a relation of use and mediation, for instruction in use always occurs through the mediation of an instructor, instruction book, advertisement. The place of use and the user are also partly specified by mediation. (Fry, 1988, p.12)

Thus, mediation is not merely a communicative strategy to tell something about design; rather mediation consists of the very experience of using a designed object. Mediation conveys the design thinking and assists the audience in forming the meaning of the design. And designers and institutions have always actively participated in conveying their design thinking through mediation practices, such as writing, drawing, taking photos, or making videos. As design historian Lees-Maffei pointed out, such mediation channels are also designed (Lees-Maffei, 2009).

We need to look at design in a broader sense, and acknowledge the intertwined relationship between design and mediation. The intent of the thesis is to go further and point out that in design research, the ultimate goal is the mediation of design thinking: The written articles, studio photo shoot, and even research prototypes serve as the mediation of design thinking and knowledge.

In the following, we first look back in history and briefly discuss design and mediation as a pair, and examine how mediation was used by designers and design institutions as a mean of articulating design thinking. We then discuss how design research in HCI reflects on mediation explicitly and implicitly, before pointing to the potential of moving images as mediation for design thinking.

2.1.1 Mediation in design history

The interwoven relationship between design and mediation is perhaps most visible in the field of fashion design. Fashion media, such as text, image, shop windows, advertisements, and so forth play a key role in transforming clothing items into fashion (Kawamura, 2004). Fashion scholar Yuniya Kawamura argues that it is “the use of language that transforms clothing into fashion, in particular through its articulation of concepts of ‘taste’” (Kawamura, 2004). “Language” brings people together to construe and negotiate their tastes and desires (Barthes, 1983).
No tyranny in fashion

What distinguishes this summer's styles and gives them charm is the eclecticism that pervades in toilette, mantles and hats. All styles, sizes, colours and materials are allowable. Any woman is thus free to dress according to her taste or her preferences or what is suitable to her position; but, I repeat the dominating factor is still the narrow outline or the drapery that does not give way beneath and placed either in front or at the side. There is an end to the abductions to which women once were subject. Tyranny is dead.

Figure 2-1. Illustration from art deco fashion periodical "Art-Goût-Beauté" ("No tyranny in fashion"), 1925.

Figure 2-2. Raoul Hausmann, "Fashion" G, no. 3 (June 1924): 51. Berlinische Galerie, Berlin (Doherty, 1995)
Before photography became the dominant fashion media, fashion illustration was the “noble” medium to express artistic expressions and styles, which was often viewed as avant-garde, expressionism or art deco (Söll, 2013). Figure 2-1 is an example of a fashion magazine published in 1920 where language and fashion illustration together articulated the expression of fashion. Fashion photography gradually became fashion’s “ultimate signifier”. Fashion photos promote designed garments and serve as supporting style guides for what to wear and how. Functional clothing became fashionable following the modernist style and was mediated through artistic magazines. Raoul Hausmann (Figure 2-2), the leading figure in the Dada art scene, wrote an article entitled, *Fashion* in the magazine *G*, in which he posed for his own design of a long coat (Doherty, 1995). His article and photo together articulated the ideal of functionalist reform and established the relationship between body, gender and modernity.

Interior design and the ideal of home are also heavily influenced by the mediation of design. A sofa needing to be comfortable seems unquestionable in our present days. But the concept of comfort as an important feature of the home only gradually entered domestic living from 30s-60s. Without interior magazines portraying comfort as an important feature of home to the public, the carefully crafted comfortable chairs would have not been understood or appreciated. In a study of advice guides for interior design published in Britain between 1920-1970, design historian Lees-Maffei pointed out that modernist design gained its wide acceptance through advice literature (Figure 2-3), which used images to illustrate the ideals of “comfort” in the homes while preserving the traditional preference of “dignity”, and articulated the anesthetisation of everyday life (Lees-Maffei, 2001).

*Figure 2-3. Articulating comfort and dignity as design ideal (Lees-Maffei, 2001)*
Since the arrival of home television sets, video broadcasting offered a new opportunity for mass design mediation. According to Jones, BBC joined forces with the Council of Industry Design with the aim of promoting design in its early television services. A series of programs served to articulate the “Good Design” and promote design to the public nationwide. Designer Gordon Russell, for instance, hosted a TV program What’s in a Chair (Figure 2-4) that “focused on one object, its design in relation to its use of materials, methods of manufacture, its effect on social habits and its occupational requirements” (M. Jones, 2003). This program helped articulating the design thinking embedded in the chair, as this knowledge needed to be unpacked in order to be accessible to the audience unfamiliar with furniture design thinking.

![Figure 2-4. 'What's in a Chair?' BBC television broadcast, 27 October 1947. A didactic television debate on the chair in relationship to its materials, manufacture and use. (M. Jones, 2003)](image)

This section briefly illustrated the intertwined relationships between design and mediation in traditional design fields, fashion, interior, and product design. Designers and design institutions have always taken an active role in mediating their design thinking through multiple channels in order to unpack the meaning of design to a wider audience (although not always with an intent of commercial value).
2.1.2 Design mediation in HCI

In recent years, an increasing number of scholars called for diverse means of articulating design knowledge beyond traditional academic writing. Although sometimes indirectly, a number of scholars have drawn the attention to mediation of design as a part of design. This understanding is important for us to position moving image works as a means of designer inquiry.

Since the so-called third wave HCI (Bødker, 2006), more and more design researchers argue for the importance of design practice and the design-erly ways of articulating design thinking (Binder & Redström, 2006; Gaver, 2012; Höök & Löwgren, 2012; Nelson & Stolterman, 2012; Pierce, 2014). Coined from Frayling’s article “Research in Art and Design” (Frayling, 1993), the notion of Research through Design (RtD) claims the central role of the designed artefacts, in which design thinking is embedded (Zimmerman, Forlizzi, & Evenson, 2007). This line of thought is further advanced by the call for “thingly publication” (Pierce, 2014), which gives designed artefacts a similar importance as academic publications.

The traditional academic written publications of conference papers, journal articles and books are not the only ways to make research knowledge public. *Thingly publications* suggest making design research public in ways that emphasize design articulation over verbal articulation. (Pierce, 2014)

However, Bardzell et al. pointed out that how design thinking could be made available from artefacts was not clear.

Is the knowledge outcome of an RtD object a special form of communication, one that is superior in some sense to verbal discourse? Is it these objects’ job to reveal true propositions about the world? To reveal the potential of design materials? To reify design arguments? To express emotional or subjectively felt experiences of the artificial world and its apparent trajectory? To critique assumptions imbued in everyday designs? To reveal alternative ways of being to motivate us to pursue them? (Bardzell, Bardzell, & Koefoed Hansen, 2015)

Alternatively, Bardzell and others argue for design criticism as means for unpacking and eliciting design thinking, similar to the practice of critiquing in art and literature (Bardzell et al., 2015). This approach echoes the role of language as articulating the meaning of design, such as the idea of “taste” in fashion. An example of the alternative use of language for design research, however, is the notion of "imaginary abstracts", which summarize findings of papers that have not been written about prototypes that do not exist as a way to frame concept design and research (Blythe, 2014a).

A number of scholars, however, look at the importance of combining textual account with design articulation from the perspective of design practice.
Gaver expressed the concern on the limitation of textual articulation on design thinking (Gaver, Bowers, & Boucher, 2004). “Design workbooks”, for example, consist of collections of texts, photos, sketches, and renderings that support the communication of ideas to participants and collaborators in design practice (Gaver, 2011). Similarly, the later introduced notion of “annotated portfolio” (Bowers, 2012; Gaver & Bowers, 2012) refers to a collection of design examples with brief textual annotations, which intend to communicate design research and mediate design knowledge in a “descriptive yet generative and inspirational fashion” (Bowers, 2012). Pierce further argues for the notion of “concept-things”, which can be gallery exhibition, a conference demo, and an illustrated booklet and can serve as design articulation for both academia and a wider public (Pierce, 2014). In a similar manner, Koskinen et al. draw no distinctions between designed artefacts and design concepts mediated in other forms by collectively call them “design constructs”, whose role is to generate design implications (Koskinen et al., 2011).

Among the increasing number of design scholars arguing for broadening the channels of mediating and articulating design thinking, Löwgren particularly stresses the need for more videos (Löwgren, 2011), and Höök further calls for videos to be upgraded in academic status (Höök, 2012). Indeed, we can see a growing number of conferences and venues encouraging research in design to engage with audio-visual formats. However, questions were also raised on the widely used video media as representing interactive design results within academia or towards public (Bean & Rosner, 2013; Elish, 2011).

This thesis is situated in the turn of design mediation in HCI where scholars acknowledge the unique means of design articulation in the form of alternative writing, hybrid of visual and textual account of design thinking, concept-things, and various types of design constructs. The thesis, however, takes a particular interest in the audio-visual form of such mediation, namely moving images. The thesis intends to recognize that the existing moving image works that mediate design thinking in one way or another occupy a unique design space in interaction design. When held together, such works form a foundation of knowledge that can inspire and generate new research and practice. The goal of the thesis is thus to explore such a design space from the perspective of design mediation.
2.2 Moving Image

In the following, we first look at the definition and characteristics of moving images, we then propose genre, form, and style as a set of lenses to understand them, before we review the most common types of moving image works in HCI.

2.2.1 What are moving images

The term moving picture can be traced back to the invention of motion picture cameras in the late 19th century. Image technology inventions dated from the 17th century had already paved the way for the invention of moving image media (Monaco, 2009, p. 83). Various illusion machines were invented to show successive still images to the viewers in a fast pace in order to create the impression of continuous light and movement (Bordwell & Thompson, 2008). The Zoetrope created in 1834 spun a series of images on a stripe of paper inside a rotating drum, while Mutoscope displayed images through a peephole by flipping a row of cards (Ibid). Praxinoscope (Figure 2-5) was the first device for projecting moving images on a screen which resembled the modern way of displaying a film (Monaco, 2009, p. 83). Following a line of development in image technology, especially the invention of film negative and then flexible photographic film, moving images were finally ready to take a leap to become a distinct media form (Ibid).

Figure 2-5. Praxinoscope (Tissandier, 1882)
Film was the photochemical medium on which the sequential still pictures were produced, but gradually became the term of the art form itself. Today, majority of the films were produced and shown entirely by digital equipment, and film as a physical medium of movies is no longer mainstream (Bordwell & Thompson, 2008). Digital new media further blurred the boundary of a traditionally established film and media study area. Scholars have started to return to the term moving pictures or moving images to refer to a range of practices that creates the illusion of motion by displaying a series of still images, such as film, video, animation and generative computer graphics.

In briefly tracing back its history, our intention was to illustrate the importance of understanding moving images not as a specific media format, but rather, as the perception of movement and time which enables narrative, performance, and interaction. These outcomes are, in essence, what matters for understanding moving images for interaction design.

In his book “Theorising the Moving Image”, art critic and film scholar Noël Carroll offer a thorough analysis of what moving images consist of on a theoretical level. In a nutshell, a work is considered moving images if 1) it is shown on a detached display, 2) the impression of movement is technically possible, 3) the content can be reproduced and distributed through tokens (different from e.g. theatre), and 4) the act of showing the moving images themselves is not part of the work (different from interactive performance including video projection) (Noël Carroll, 1996, p. 49). This enables us to further unpack moving images in order to understand them in the context of HCI.

### 2.2.2 Understanding moving images

In order to understand how moving images are practiced in interaction design, we need to introduce the notions of form and style, which are the most common ways of understanding and critiquing moving image works. Form refers to the work’s structure, while style refers to its expressions.

**Form**

A crucial aspect for understanding moving images is their form. Form represents how different parts are connected to become a whole, and the overall pattern of relationships among parts is called form (Bordwell & Thompson, 2008, p. 49). Fiction films, for example, often have a narrative form, where a story is told from the beginning to the end (Ibid). However, moving image
works can take many different forms. For example, a nature documentary can take a \textit{categorical form} (Ibid) to list different species that exist in one isolated island in parallel. And a \textit{rhetorical form} can be used for presenting an argument, which is in fact the most common form of moving images (Ibid), such as advertisements or campaign videos like Kickstarter. Many digital moving image art works may take an \textit{abstract form} where no specific stories, meanings, or opinions are conveyed (Ibid), such as exploring the visual form of music. And in HCI, we can also see many concept videos that explain a design concept or process, which we can call \textit{descriptive form}, and that focus on describing a particular artefact. In a word, the formal choices of a moving image work are made in order to support the overall idea or intention of the work. According to Carroll, Louis Sullivan’s statement, “form follows function”, also applies in the design of moving image works.

“The ordinary concept of film form seems to be functional. The form of the film is whatever functions to advance or to realize whatever the film is designed to bring about. The form of the individual film is what enables it to realize its point or purpose.” (Carroll 2008, p.343)

In design research, we have seen moving image works of different forms (examples will be discussed in Chapter 4). Due to the vast amount of moving image works available, it is impossible to list all existing forms as the works often fit a combination of forms. Perhaps, to give a full account is not even necessary, as the point is to sketch out a landscape of possibilities where designers and researchers can creatively adopt and combine, as well as generate new forms.

\textbf{Style}

Style is closely related to the notion of form in moving image. While form tells about how something is constructed, style is the “look and feel” of a moving image work. It is focused on the expressions and experiences, and also one of the most creative parts of making moving images.

Style is often associated with particular genres, time periods, schools, studios, or individuals. It is also influenced by the technical side of moving image making, for example, a video shot on mobile phone can have a different visual style than using professional cameras. Using low budget technology can be a creative choice rather than an economical one, in order to achieve a particular style. Style is also strongly associated with visual aesthetics. For example, the colour palette used in a moving image work, weather it is warm or cold, bright or dark, high or low saturation and contrast, can express very different aesthetics and provoke different emotions.
Style choices have already emerged in the moving image works produced in HCI. But it has different characteristic than film styles. There is a need to recognize and understand the styles in HCI, and more importantly how style together with form mediate thinking in the design process.

2.3 Summary

This chapter described important theories on design mediation and moving image that provide the backdrop of the thesis. Theories and related works on mediation of design motivate the recognition that designers from multiple disciplines have historically engaged with mediation in order to explain the thinking behind the designed artefacts that are not immediately available. And more importantly, there is an emerging interest among designers and researchers in HCI to discuss various means of mediating thinking and knowledge beyond academic text. Then the thesis continues to draw attention on moving image as a particular form of mediation, by describing what it is and ways to understand it through the concepts of form and style. However, the current terminology of form and style largely comes from film studies, and do not sufficiently help us to understand moving image works in HCI, particularly those related to design and digital technology. There is a need to appropriate the notions and establish their relationship in the context of design mediation. After Chapter 3 has presented the methodological approach of the thesis, Chapter 4 will further develop the understanding of moving images in HCI.
This chapter presents the methodological approaches of the thesis in order to disclose how the research questions were investigated and how the design space emerged and expanded from the research activities.

Firstly, the thesis intends to conceptualize the moving image design space and provide a theoretical understanding of its practice by identifying the primary collections within HCI (Q1). The approach taken for forming the design space can be described as “critical analysis of designs as theory-building” (Bardzell & Bardzell, 2015, p. 40). It emphasizes the foundation of knowledge based on the analysis of existing exemplars, a tradition in various design-related disciplines, from architecture, product design, to film studies, and art. Secondly, the thesis intends to exemplify how to engage with moving image making in response to new design challenges and opportunities (Q2). This question is investigated through concrete design studies that were carried out following a Constructive Design Research, in which the construction—in this case, moving image making—acts as the key means in constructing knowledge (Koskinen et al., 2011).

3.1 Forming the Collections

3.1.1 Criticism in interaction design

Although an increasing number of moving image works is produced in HCI, there lacks a methodological approach for understanding them. Moving images are often accessed through criticism in the field of film, media, and culture studies (e.g., (Monaco, 2009)). Criticism requires reasoned analysis, rather than objective measures, which aligns the ongoing discussions in design research on the topics, as it is the case for example in reflective design (Sengers, Boehner, David, & Kaye, 2005), Research through Design (Gaver, 2012; Zimmerman et al., 2007; Zimmerman, Stolterman, & Forlizzi, 2010), or design knowledge and theories (Bowers, 2012; Fällman, 2003; Gaver & Bowers, 2012; Höök & Löwgren, 2012). In fact, critical approaches as
means of analysing design in HCI are increasingly called for. An early example is provided by Bertelsen and Pold, who suggested using criticism as an approach to analyse interface aesthetics. The authors proposed a framework consisting of eight perspectives that examine interfaces from their style, standards, materiality, genre, hybridity, representation, user expectation, and development potential (Bertelsen & Pold, 2004). Similarly, an interaction criticism framework rooted in humanities is proposed to analyse the mutual influences of the interactions and cultural aspects of a design by explicating relationships among elements of an interface and the meanings, affects, moods, and intuitions they produce in the people that interact with them (Bardzell, 2011; Bardzell & Bardzell, 2008). Not only theoretical frameworks are used, but critical approaches are also used to concretely analyse different types of works in HCI. For instance, Blythe and Cairins applied psychoanalytic critical theory to analyse user generated content published on YouTube. This approach demonstrated potential in analysing data in compliment of social science based approaches (Blythe & Cairns, 2009). Following literacy criticism, Blythe later offered three approaches, namely deconstructive, psychoanalytic, and feminist readings of the same scenario, which showed the rhetoric of scientific literature, calls for a critical understanding of narrative, and argues critical theory must be incorporated to better inform design (Blythe, 2014b). Critical analysis was also applied to examine how design objects co-produce knowledge by accounting for the intentions of the object’s designer and the critical reception of objects, an approach based on the arts and humanities traditions of aesthetics. (Bardzell et al., 2015). Inspired by this small but growing number of studies, the thesis attempts to take a critical approach to develop a set of lenses for examining moving image works in HCI.

3.1.2 Establishing the collections

There are many ways to critically analyse moving images. According to art philosopher Carroll, six critical activities can form the basis for accessing or evaluating art works including moving images. Taking a moving image work as an example, these activities are: 1) description (the features of the work, such as its aesthetic and expressive qualities), 2) classification (its category, genre, or theme), 3) contextualization (its history or socio-cultural circumstances), 4) elucidation (focusing on the denotation of the semantic, iconographic, and/or iconic symbols in the work), 5) interpretation (its meanings construed more widely), and 6) analysis (broad class of critical operations that explain the work) (N Carroll, 2009, pp. 84–134). Either one or a combination of the six activities can be the basis for criticism, and all their opera-
tions are well practiced in film and media studies (Monaco, 2009). What this thesis is primarily interested in, however, is the different roles moving image can play in interaction design and how they are utilized. Thus, in Carroll’s terms, description and classification are most relevant, i.e. to describe the features of the works in the context of HCI and to categorize them according to their different roles.

Description
A set of lenses is developed during the thesis to examine the moving image works and describe their features in relation to interaction design. These lenses analyse the works from the following five perspectives.

Technology examines how a work present technology. Is there technology at all? If so, is it a hypothesized technology, a realized system, or a new technological artefact?

Design mediation examines what aspects of design are mediated through the moving image work. Is it an early idea or question? Is it a design object or process? Is the design realized, or even meant to be realized?

Form looks at how different parts of a work are connected to become a whole and at the overall pattern of relationships among the parts. Do the parts of a work tell a story, convey an abstract experience, build an argument, or list a set of facts?

Style describes the “look and feel” of the work. Is it made in a sketchy manner or crafted in high quality? Are the shots static or dynamic, factual or dramatic, objective or subjective? How is the colour temperature? What is the emotion and mood?

Motivation asks the general question of why the work is created. It is based on the analysis of the work’s form and style, as well as how the work is relevant to technology and design. It intends to give an overall description of the main function of a work, i.e. its role in the context of HCI.

These lenses derive from both interaction design and film studies, in order to understand moving image more specifically from the perspective of interaction design. Form and style, as described in Chapter 2, are well established means of analysing moving images, but not adequate to address the concerns of design. Technology and design mediation are thus added to examine them more specifically. These four lenses together form the basis for understanding the motivation and the role of the work in question.
Classification

A descriptive analysis lays on the foundation for categorizing moving image works in HCI. According to Carroll,

“Fundamental to the task of criticism is placing the artwork at hand in its proper category (or categories), because, once we know the category (or categories) to which the artwork belongs, we have a sense of the kind of expectations that it is appropriate to bring to the work—which knowledge, in turn, provides us with a basis for determining whether the work has succeeded or failed, at least on its own terms.” (N Carroll, 2009, p. 93)

Classifying the scattered moving image works into themes helps us to understand their roles in interaction design, which indicates what expectations we should have toward them, what inspirations and knowledge we can gain, and how we can create new works. The result of the classification, i.e. four collections of moving image works in HCI, is presented in the next chapter.

3.1.3 Scope of the approach

A potential critique of the approach is that not all aspects of a moving image work is considered and analysed. However, whether such a comprehensive analysis is achievable remains a question. The thesis instead tries to draw attention particularly on the role of moving image in interaction design, i.e. its motivation, function, and strategies. The lenses are therefore chosen to keep this focus. Furthermore, another contribution to HCI could be a critical review of all moving image works according to the analytical lenses. However, the thesis accounts for the main roles of moving image rather than provide such a systematic review. More importantly, such an approach intends to lay the foundation for engaging with those collections by creating concrete design exemplars that explore new design opportunities and expand the design space.
3.2 Creating the Exemplars

The second research question concretely investigates how to create moving image works in response to new design challenges and opportunities which in turn expand the design space. The type of design research conducted during the course of the thesis consists of the topics of design for home, nature, and fashion with a focus on new experiences and enjoyment in daily lives. The design approach is explorative rather than problem-solution driven. These different design cases, processes and knowledge contributions are presented in the included papers. In the following, the general design research methodology is presented, and the design research process described.

3.2.1 Constructive design research

The general design research methodology adopted in the thesis is Constructive Design Research. It refers to the type of design research in which the construction - can be product, prototype, system, space, or media - acts as the key means in constructing knowledge (Koskinen et al., 2011). According to Koskinen et al., this construction, the “thing” in the middle, is often a prototype, but can also be a scenario, a mock-up, or a concept that could be constructed (Ibid).

The most important reason for following constructive design research is its emphasis on the construction of design things that reflect the practice-led nature of design explorations. In the case of this thesis, moving image works produced during the process and the learnings from these works take the centre place of exploring the research questions.

Another important reason for following constructive design research methodology is that it is programmatic. A programmatic design research approach emphasizes the dialectic relationship between the (abstract) design program as conceptual framing and the (concrete) design exemplars as probing (Binder & Redström, 2006). A design program starts with an initial formation of a program. This program is then realized by designing, implementing, and evaluating design exemplars. By reflecting on the learnings, the initial design program is evolved and reformulated (Binder & Redström, 2006; Redström, 2011). Learnings from previous works provide foundation for the generation of new research questions, which in turn lead to new works. This approach enables the research explorations to be carried out from different aspects and develop certain ideas while drifting from others. Such an approach is beneficial for the type of research with the goal of ex-
ploring a design space, as it enables a series of studies to map out an area of interests from different collections while maintaining their connection.

### 3.2.2 Design and research process

This section synthesises the methodological approaches and general research activities conducted during the thesis. Some included works and publications focus on individual design cases, while others refer to various phases of an evolving design study. These studies were conducted in different contexts, with different visions and outcomes, in response to different challenges and opportunities. Thus, different methods are adopted in these design studies for their respective research questions. This section offers an overview of the design and research process, which is led by practice rather than by a set of strict methodological steps.

The works included in this thesis respond to different themes and topics, while remaining an overarching “core” (Koskinen et al., 2011). The thesis is based on a series of research activities led by the design practice of constructing “things” in three different but sometimes overlapping topics—Home, Nature, and Fashion—while following an overarching approach of moving image design. The design things, as referred to as moving image works, include animations, videos, prototypes, and fully functioning systems. The individual case of designing a moving image work often follows an iterative process and adopts a mix of methods, due to the nature of design exploration (Krippendorff, 2005; Löwgren & Stolterman, 2004). Ethnography-informed methods are used for studying people, such as observation and interviews. Design methods are used for generating and eliminating design concepts, such as brainstorming, creating scenarios, and conducting design workshops. The design concepts are realized collaboratively by the research team and the results are validated through qualitative research methods. In all, the research activities have their particular contexts, goals, and challenges, and their methods are described in each individual paper. The general process includes the following steps where a mix of methods is adopted.

**Grounding**

The starting point of each study is often to frame the design vision, which is grounded in a mix of different sources in parallel. Exploratory design lacks clearly defined problems; rather, a multi-grounding approach is needed to scope the design from many different aspects. Nelson and Stolterman have described such an approach using the metaphor of a colour palette: Similarly
to artists who mix different colours to create a painting, designers mix different approaches, perspectives, and contexts to form design decisions (Nelson & Stolterman, 2012, p. 85). In a similar approach, the design research conducted during the thesis typically frames the design vision from a combination of three perspectives, i.e. emerging digital technology, existing theories and research, and the understanding of people’s practices.

Figure 3-2. Perspectives for framing and grounding

As the thesis is concerned with designing new technology and services, the research has been centred around emerging digital technologies that are often not mature or widely utilized. Additionally, the research focuses on technologies and applications for home interior, nature, and fashion, due to the interest of the thesis. From a methodological point of view, this approach could be described as a survey in emerging technologies from various academic (e.g., ACM digital library and SIGCHI conferences) and non-academic channels (technology news outlets). But it can also be described simply as technological inspirations for design. In each paper, an outline of the relevant technological landscape is described.

Another important grounding source is theories and concepts. In some cases, theories and concept no longer best describe the emerging practices that evolve with technology, such as the concept of “liveness” from media studies. In other cases, the theories, concepts and approaches from other disciplines are valuable but under recognition, thus introduced to advance the research investigations in HCI. Such is the case with the concept of “dissemination” from ecology, and the approaches such as previs animation and
fashion film from film and fashion studies. The theories and concepts adopted are described in individual papers.

The last and arguably the most important source for framing design vision is the understanding of people’s daily lives, social interactions, and experiences. This understanding is grounded in qualitative research methods such as interviews and observations.

This research includes two types of interviews. The first type involves experts in their professions. The focus is placed on the expertise of the interviewees who participate in certain processes in their occupations. In the case of Previs Animation, we interviewed the designers in IKEA on their means of bridging design research to practice in the organization. In the Fashion Film study, the fashion communication experts were interviewed in order to articulate the concept of fashion from the mediation point of view based on their own professional practice. These interviewees were selected due to their occupation and professional roles. The second type of interview conducted focuses on the lived experiences of the individuals. In the case of the Nature project, the research started with a series of interviews in three different locations in Swedish countryside in order to understand people’s experiences in nature, their sense of a place and the views in their mind’s eye. Thus, the interviewees volunteered while we walked around looking for participants. In the case of designing for Watch for Figuracy, the interviewees were selected by recommendations of their friends who viewed them as “fashion conscious”, in order to understand their dressing practice.

Observation is an important research method in the Cherry Blossom study for understanding people’s interactions with the cherry trees, as most of these interactions are based on their bodily actions, such as how people walk around, stop, look, talk to other people and take photos. This observation method was chosen because it provides the evidence on how people interact with trees in order to rethink the concept of interaction.

In all, a multi-grounding approach has enabled the research to be framed in relevance with the emerging technology and existing research, theories, and concept, as well as people’s social practices, in order to generate robust implications for designing technology.

**Exploration and realisation**

Once the design study starts forming a clearer picture grounded in multiple sources and inputs, the research enters the next phase of design exploration.
Various design explorations such as brainstorming, workshops, sketching, and lo-fi prototyping were adopted in all projects.

Design workshop is an important design exploration method especially for collaborative projects. Such workshops enable different expertise and concerns to be brought up in the early stage of design. Brainstorming in such workshops helped to generate as many concepts as possible and provided the team with a rich foundation of possible routes to explore. Then, by juxtaposing the initial concepts with learnings from the field studies of people’s practices and emerging technologies, the team could quickly synthesize, combine, and eliminate the ideas to retain just a few key concepts for further development.

Sketching and lo-fi prototyping are often used interchangeably as a thinking process and to try out initial concepts. In fact, sketching is not only used for the overall concept development, but in all aspects of the design process: from the initial concepts, interfaces, and system architecture to graphic elements, film scenes, and watch faces. As various scholars pointed out, sketching is the most crucial method in the early design process (Buxton, 2007; Löwgren & Stolterman, 2004; Schön, 1983).

Both LiveNature and Watch for Figuracy are working systems. They were realized through an interactive process of trying out technologies, taking things apart, building working prototypes, testing with initial users, and eventually building fully functional systems in order to deploy them for long terms. In the case of LiveNature, the system was realized through the building of both software and hardware. Customized stands were built for the system input side to use mobile phone cameras to capture live videos, and customized picture frames were built for the ambient displays to blend in the home environment as photos or paintings. At the same time, software development was necessary for the back-end interface to mix the live videos with weather data, and for the front-end interface to allow the users to control the live streaming videos and effects. On the other hand, software development was most crucial in the case Watch for Figuracy, where a traditional colour wheel was translated into an algorithm that could change the colour of watch faces according to established colour combination rules. The development thus focused on the software, database, as well as the watch faces and the mobile application.
Moving image making

Moving image making methods are a crucial part of this thesis. However, they may not be considered as research methods in a scientific manner. Rather, moving image making is a practice similar to sketching, prototyping, or coding. It is utilized in the process of the design research, has its own ways of doing and has a unique contribution to the research. These methods are used in different phases of design for different purposes, which will be described in details in Chapter 4. Below is a brief description of the different methods of making moving images.

In its simplest form, moving image making is recording videos. The videos can be recorded to document how a prototype works. They can also be the resources for design. Such methods are widely used in design anthropology (Pink, 2014). In other scientific disciplines, video recordings are often treated as data for investigation. However, if the end goal is to design, then recording videos on particular topics can be a valuable method for gathering design materials and inspirations. Another form of moving image making approach is the artistic type. Perhaps it seems arbitrary to refer to such approaches as methods, as they do not necessarily follow a set of rules. Rather, the “rule” lies in its speculative and explorative nature, hence gives the freedom to the imagination activated by various inputs. Lastly, one of the most commonly seen process for creating moving image works in the industry, however, is to follow the steps of pre-production, production, and post-production (Bordwell & Thompson, 2008). The pre-production phase is about figuring out what to make and how to make it. In the production phase, the “shooting” part of the work is completed. In the post-production phase, raw video materials are assembled together and polished into a coherent story.

In all, we presented a short overview of common moving image making practices. In each research study, various methods are integrated in the design process based on the specific purposes of creating the works. The specific type of moving image and the method of making are presented in Chapter 4, as some of the methods are in fact part of the research results.

Validation

The contribution and validation of practice-based design research have been an important topic in HCI. Zimmerman et al. called for “a valid and recognized research approach” via “successful methodology development, research examples, theory critique, and evaluation criteria” (Zimmerman et al.,
However, Gaver suggests that “(the) design research community should be wary of impulses towards convergence and standardisation” (Gaver, 2012). Instead of seeking verifiable approaches through falsification, design theories should be characterized as “generative and suggestive” and should support “exploring and speculating, particularising and diversifying” (Ibid). Constructive design research emphasizes that design research should be socially robust, “exploring social implications of technology rather than trying to create applications or just producing knowledge” and “whether it raises debate is more important than facts and knowledge” (Koskinen et al., 2011, p. 157).

The contribution of the research in the thesis follows that of constructive design research. The goal was neither to critique hence improve the works, nor to find out how we could improve the design or its processes, but instead to open new possibilities and design spaces by examining how a design intervention could extend or challenge the current practices or understandings. This extended understanding is achieved both by validating the results with users and experts, and by critically reflecting on the design processes.

One approach to validation is to evaluate working systems with users. In the case of LiveNature the implications were generated by deployment of the system in a home environment where the participants used the system for two weeks. Post evaluation interviews were conducted in order to unpack the experiences of liveness in an ambient and sporadic way. Watch for Figuracy, on the other hand, was evaluated in a “Lab” setting with the participants, where they tried out the application in relation to their own clothes, in order to unpack the practice of dress ensemble. Another approach to validation is to show the moving image works to experts and gather their feedbacks based on their professional experience. In the case of Previs Animation, the animation was shown to the designers in order to understand how such an approach could bring benefits and challenges to their existing practices of design and research in the organization. Similarly, Fashion Film was shown to fashion communication experts in order to understand if and how fashion film as a media form could transform wearable gadgetry into fashionable garments.

Critical analysis is an important aspect of the research contribution, especially for generating design implications from empirical findings. In the case of the Cherry Blossom study, such analysis was done by drawing parallels between existing plant-based systems, people’s interaction with cherry trees, and cherry blossom included in various types of contemporary designs. The
juxtaposition and critical analysis enabled the reflection on the concept of dissemination and its implication in design.

In all, validation played a crucial role in generating the implications from the research studies and articulating the research contribution of practice-based design research.

<table>
<thead>
<tr>
<th>Grounding</th>
<th>Exploration Realisation</th>
<th>Moving Image Making</th>
<th>Validation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previs Animation</td>
<td>Social practice</td>
<td>Sketching, prototyping</td>
<td>3D animation produced in graphic software</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LiveNature</td>
<td>Theory, Technology, Social practice</td>
<td>Workshop, sketching, prototyping, development</td>
<td>Live streaming videos captured by mobile phones</td>
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<tr>
<td>Cherry Blossom</td>
<td>Theory, Technology, Social practice</td>
<td>Workshop</td>
<td>Ethnographic videos recorded on camera</td>
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<tr>
<td>Object</td>
<td>Theory, Technology</td>
<td>Sketching, prototyping, acting</td>
<td>Explorative filmmaking</td>
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<tr>
<td>Watch for Figuracy</td>
<td>Technology, Social practice</td>
<td>Workshop, sketching, prototyping, development</td>
<td>2D animation on smart watches produced by algorithms</td>
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<tr>
<td>Fashion Film</td>
<td>Social practice, Theory</td>
<td>Workshop, sketching</td>
<td>Filmmaking with a professional team</td>
</tr>
</tbody>
</table>

Table 1. Research process for each study

In summary, the studies conducted during the thesis have different topics and goals, but they share a similar process while adopting different ap-
approaches and methods. This section has described the overall processes for creating design exemplars, instead of addressing each study individually. Table 1 shows a summary of the research process for each study. More detailed accounts are described in Chapter 4, and the full details are presented in the included papers.

3.3 Ethics

Research ethics were discussed carefully throughout the projects. These ethical considerations are presented in three aspects as follows.

In all research projects, we provided the participants with thorough information on the projects in order to obtain informed their consent before their involvement in the studies. Each project description, goal, and purpose were stated in printed documents, which were handed over to the participants. Two copies of the consent form were signed by both the participant and the principle researcher, each keeping one copy. A consent form included detailed information of what data would be collected during the study (e.g., notes, photos, audio recording, or video recording), how the data would be stored, and what data would be disclosed and anonymized in the studies and future publications. Most importantly, it stated the right of the participants to withdraw from the study and request to delete all their data at any time. The name and contact details of the primary researcher were provided in support of the participant’s future actions.

In cases of field studies, most of our interviewees were contacted spontaneously on the street and the conditions for signing consents were extremely limited. We always started by presenting ourselves, the project and the purposes of the interviews. If they agreed to participate, we then asked for permission before taking notes and audio-recording the conversations. We also explained how the recorded data would be stored and used. Lastly, we handed out printed information sheets including the researcher names and contact details, which could enable the interviewees to contact the team anytime in the future to follow up on the project or to request the deletion of their data.

In the published and related articles included in the thesis, all the interviewees or study participants were anonymised by using fake names in the papers. In the case of Watch for Figuracy, the users of the systems were anonymized as only their personal experiences of using the smart watches were the concerns for the research. In the case of LiveNature system, the system was deployed in a home setting and the main participants lived to-
gether with their families. All the names were anonymized while the family relations were stated, like, for example, Robin lives with his 16-year old son, as it was important for unpacking the role of the live ambient video in their daily lives at home. In the case of employees in IKEA and fashion communication experts, their names were all anonymized while their occupation or expertise were stated, as their professional experiences played a role in their opinions on the moving image works we showed them.
This chapter presents the results of the two research questions that intend to, on the one hand, articulate the moving image design space as theory, and, on the other hand, exemplify moving image making as practice. Q1 addresses the question of what collections emerge from the works by looking at their roles in interaction design. Q2 continues to investigate how moving image making engage with and expand these collections.

In order to understanding the large number of existing moving image works in HCI, the concept of *collection* is crucial for categorizing and analysing them. By comparing the collections, it is then possible to see the variations, and compare their motivations and strategies. When held together, they reveal important insights for designers to take inspirations from. It is worth noting that there can be many ways to create collections and categorize moving image works accordingly, for example, by lengths, by topics, or by the graphic technologies applied. For example, in book “Designing with Video”, the authors focus on video for user-centred design process and further differentiates the works by their production methods (Ylirisku & Buur, 2007, p. 34), which can be a way to create collections. However, as stated in Chapter 1, this thesis is primarily concerned with designers’ practice, motivations and strategies of moving making. Thus, a collection of works shares similar motivations and roles in interaction design. Four collections are identified, namely, moving images as *design technique*, as *design element*, as *design exhibit*, and as *design promotion*. Once the collections are established and analysed, we can then present how concrete cases of moving image making for interaction design engage with and expand the collections.

It is necessary to clarify that the main concern is the role of moving image in mediating design, from the perspective of the designers, design teams or institutions. Thus, studies on, for example, systems for video production (Bartindale, Hook, & Olivier, 2009), film viewing (Stewart, Bosch, Chen, Donnelly, & D’Mello, 2016), or interactive educational videos (Kim, Glassman, Monroy-Hernández, & Morris, 2015), are beyond the scope of the investigation. This focus also delimits the thesis from discussing research using moving image from the users’ perspectives, such as user-
generated video (Blythe & Cairns, 2009), video sharing on social media (Halvey & Keane, 2007), video watching practice (Barkhuus & Brown, 2009) et cetera, all of which have important contribute to HCI. There are also countless examples left out due to the limited space. The purpose is, however, to cherry pick the emerging important collections and to recognize they are produced with various motivations, engage with interaction design and technology in different ways, and are produced in different forms and styles.

The following four sections are structured in a similar way. Firstly, a collection is presented with a selection of existing moving image works and an analysis of their common features through the lenses of: motivation, technology, design mediation, form, and style. Secondly, the design cases conducted during the thesis are presented. They showed how the collections provide the foundation of knowledge for constructing new works, which were created in response to particular design contexts. Lastly, each section ends with a reflection on how the exemplars expand the design space and how the collections and their expansions benefit HCI.

4.1 Design Technique

4.1.1 The collection

Moving image is widely used by designers as a way to explore, manifest, document, and communicate provisional design and make abstract thoughts, questions, and concepts concrete and accessible. This collection refers to the practice of creating moving image with the intent of driving the design process in order to design the “right” thing. There are numerous design methods and approaches based on making moving image, which serve various purposes in different design phases.

Videos, particularly in documentary styles, are often used in the very early stage of design in order to gain nuanced understanding social practices. Design documentaries, for example, is a type of design-oriented documentary films about the everyday lives of the future users. (Raijmakers, Gaver, & Bishay, 2006). These documentaries are presented to a design team, in order to facilitate the design process. In proposing this design technique, the researchers call for a wider range of film styles, as design benefit from “film’s capabilities to preserve ambiguities and paradoxes instead of resolving them into univocal conclusions” (Ibid). Invisible Design films are pro-
fessionally made fictional films, in which actors discuss technological features without actually showing them (Briggs et al., 2012). By inhibit the criticism around specific functions, the authors argued, these films “encourage discussion of the intangible, experiential aspects of design” (Ibid). Grounded in anthropology tradition, visual design anthropology is a method in the very early stage of design to study a phenomenon and to frame a design vision (Pink, 2014). Video is not only used as a documentation tool, it is also an evocative method “that can be used to create interventional research encounters, forms of embodied empathy, and that engages not only with what people say but with what they do, show, feel and the material, digital and sensory environments in which this takes place” (Ibid). From video documentation to fictional films, these approaches serve a similar goal of providing nuanced understanding of people and their social practices as the foundation for design inquiry.

Using video and animation for prototyping has a long history in HCI. Video prototyping, for example, was deployed in the “Starfire” project in 1994, where a high-budget drama story set in London was shot in 35mm film and then transformed to digital video (Tognazzini, 1994). It was an early attempt for HCI designers and researchers to experiment with video in the design process, which enabled them to show key specifics of the interface design, and more importantly, to communicate the overall user experience and promote discussions (Tognazzini, 1994). As Tognazzini predicted in his project, the future of making video prototypes would be much easier and affordable.

Within the next decades, there emerged many more design methods using videos or animations. Video brainstorming (Mackay & Fayard, 1999) and video artefacts (Mackay, Ratzer, & Janecek, 2000) were used in participatory design process to communicate ideas within the design team and to mediate between finding useful design abstractions and specifying the details of the user interface. By mixing of physical and digital 3D objects, virtual video prototyping expands the way of representing design ideas and enables designers to combine elements of prototypes, mock-ups, scenarios, and conventional video in new ways (Bardram, Bossen, Lykke-Olesen, Nielsen, & Madsen, 2002; Halskov & Nielsen, 2006). Video scenarios and storyboarding were introduced as designerly practice of refining design concepts in the book “Thoughtful Interaction Design” (Löwgren & Stolterman, 2004). Buxton also described the technique of using simple animation as sketching (Buxton, 2007). Stop-motion animation is used to produce low-fi prototypes for tangible interfaces (Bonanni & Ishii, 2009). Similarly, Fäll-
man and Moussette also proposed using stop motion animation as a sketching technique in the design process (Fallman & Moussette, 2011). These videos and animations are produced with the goal to communicate and reflect on the use situations and design concepts in fast and cost-effective manner. They also help to place the design ideas within a more coherent narrative context and enable viewers "to imagine the use of the intended system, or to experience it to a certain extent by proxy" (Löwgren & Stolterman, 2004).

<table>
<thead>
<tr>
<th>Lenses</th>
<th>Features of Design Technique collection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motivation</strong></td>
<td>Drive and support the design process</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>Technology as materials, options, conditions</td>
</tr>
<tr>
<td><strong>Design Mediation</strong></td>
<td>Observations, initial ideas, scenarios, or questions</td>
</tr>
<tr>
<td><strong>Form</strong></td>
<td>Categorical form</td>
</tr>
<tr>
<td><strong>Style</strong></td>
<td>Informative, sketchy, or ambiguous</td>
</tr>
</tbody>
</table>

Table 2. Unpacking moving image as design technique

As summarized in Table 2, the collection of design technique emphasizes that the moving image as a designerly technique can be used as part of methodological approaches in the design processes. The motivation is to stir the design, rather than view the works in their own rights. They are used to capture observations, sketch out initial ideas, create scenarios and storyboards, or evaluate prototypes. In most cases, technology is given materials or options for later phases of design, thus do not necessarily take the central role. These videos, animations, and films often offer a resource for design exploration, documentation, communication, but sometimes can also act as artefacts for evaluation and reflection. They are often constructed in categorical forms. For example, designers can produce a series of videos to explore different aspects of a design task, or depict many different concepts, so that the early ideas could be compared or investigated in parallel. And the style is informative, sketchy, or sometimes even ambiguous, so that the focus is on design tasks at hand rather than on the videos themselves. In the following, two design examples are presented where animation and video are utilized and appropriated as new techniques to complement other methods in the design process to deal with emerging interaction design challenges.
4.1.2 Previs Animation (Paper I)

**Background and motivations**

This study is firstly motivated by the challenges of communicating user research findings to interaction design practice in industrial settings. Concerns have been raised within HCI that the research has a limited effect on the market and on the work done by practitioners, i.e. people working in industry with the development of products (Goodman, Stolterman, & Wakkary, 2011; Rogers, 2004), which pointed to the existence of a “research-practice gap” (D. A. Norman, 2010). While the design research being conducted has the goal “to drive, inspire, and inform the design development process” (Sanders, 2008), the reality is that “in many parts of industry, investment in research is looked upon as a non-obvious step, investment in user studies a big and expensive step, and user participation a radical step into the unknown” (Sanders & Stappers, 2008). Norman (Horvath, 2008; D. A. Norman, 2010) explains the gap in terms of a mismatch between the skills and knowledge needed by the two groups. Whereas researchers explore technical boundaries, practitioners are concerned with opportunities, details, reliability, robustness and costs. Thus, we are motivated to pursue a direction inspired by Buie et al. (2013). They point to many research areas where the gap can be observed, such as medicine and organizational theory, and suggest bridging it by providing “practitioner-friendly dissemination of results”. This takes the form of “a collection of examples, principles and practices that can assist in ‘translation’ between research and practice” (Buie et al., 2013).

Secondly, the study is inspired by the uses of various animation techniques in interaction design processes. Animation is defined as “the process of generating a series of frames containing an object or objects so that each frame appears as an alteration of the previous frame in order to show motion” (Baek & Layne, 1988). It presents an abstraction of reality (Elish, 2011). And as a time-based medium, it can also account for the elements that are crucial to interaction design, such as movement, flows, transitions and timing (Fallman & Moussette, 2011). At the same time, animation has the capacity to convey context and narrative through storytelling, yet avoids the risk of portraying the projections of reality as facts. A few examples of animation applied in the interaction design processes include using simple animation in sketching (Buxton, 2007; Fallman & Moussette, 2011), and stop-motion animation to produce low-fidelity prototypes of tangible interfaces (Bonanni & Ishii, 2009).
Moving image making

This research was conducted in the context of a joint project with the newly established research department at IKEA, which was exploring novel solutions for people living in small apartments. The idea was to transform their homes to better serve the different purposes of daily lives, and to make full use of the space in the homes by designing multifunctional interactive furniture. Twenty families were invited to evaluate the initial concepts, which are life-size prototypes built in a warehouse (Figure 4-1). During the evaluation, photos and notes were taken and detailed reports were written. However, these data failed to capture and communicate the concepts to the designers.

By conducting interviews with employees within IKEA, we identified the needs for visualising these concepts and create new concepts generated from the findings of the user study. The technique previs animation is thus proposed to communicate the findings from user research to interaction design practice in industrial settings. The term “previs animation” (previsualization animation) is borrowed from the movie industry, where it refers to using 3D animation to communicate a rough version of a film, so that the elements of a scene can be designed before being built (Paquette, 2013) and critical changes can be made before the actual shooting starts (Marsella et al., 2013). Current computer graphics technology has made it possible to generate previs animations on commodity software in a low-cost and time-efficient manner (Marsella et al., 2013).
Based on what we learned from the preliminary research and the interviews with the employees, this author designed and produced a previs animation that presents a collection of plausible concepts based on the user study findings. Figure 4-2 shows the example of an extendable table and its changes of states in the animation. The motivation of the animation was for the designers to scope the concepts towards the direction preferred by the users, and to take the next step of refining some existing concepts while creating new ones that were not previously considered. Thus, design concepts were mediated with brief texts annotating their key aspects. Technology to be used was not mentioned in the animation, in order to focus the design on the experiences in this early stage. The animation was structured in categorical form including as a series of concepts. The style was kept similar to the actually prototypes made of white coloured cardboard to avoid directing the focus on other design aspects such as materials, colours, and textures.

*Figure 4-2. Stills from Previs Animation showing the concept of an extendable table*
Insights and reflections

Previs animation as a design technique demonstrated its use for documenting and communicating life-size interactive concepts that were difficult to capture in static photos, sketches, and written notes. By showing the animation to the designers at IKEA and reflecting on process, we generated the insights as follows. Firstly, the distinctive feature of animation is its possibility to illustrate dynamic aspects of interactions, such as timing, movement, transition and flow. Various types of animation are capable of illustrating such dynamics. However, 3D animation is particularly suitable in representing interaction dynamics that unfolds in the three-dimensional space. And previs animation has its focus on the provisional stage of design and the communication of the concepts. It can reflect where in the innovation process the design is located and add to the current means of communicating research to practice, especially when dealing with hybrid interactions.

Secondly, a previs animation can provide a condensed version of information that acts as a teaser and generates interest in the organization. We cannot say the previs animation represents the whole picture of the research project, but it does point towards the direction of making research content more accessible and interesting to designers. It can also help in documenting and archiving the research, or serve as a reminder and inspiration for future design, similar to a workbook (Gaver, 2011).

Thirdly, an important issue concerning the industry is the time and cost. As the development of modern graphic software and its integration in the production process, cost of software and 3D content is already low, as companies already have such resources. The critical challenge is acquiring skilled labour. However, such expenses should be balanced against the cost of research that is not communicated to practitioners. Recognizing the potential benefits of previs animation in communicating design research, it is worthwhile to involve professionals in bridging the gap between design research and practice. Moreover, this cost will decrease over time, because more designers are becoming skilled in handling 3D animation. The cost of making a previs animation can decrease, because the production can easily integrate into ordinary practice.

The feedbacks from the employees also revealed conflicting interests in how such animations should be. Although both acknowledge its usefulness, the researchers argued for more research findings to be included, while the designers required to tailor the animation more towards production. This difference pointed to the remaining challenges that would require further investigations.
4.1.3 Cherry Blossom (Paper IV)

Background and motivations

Japanese cherry blossom trees are aesthetically appreciated. Their ornamental value has long been recognized (Fairchild, 1911). And they also are a symbol of life, as well as of love, beauty, and rebirth (Ohnuki-Tierney, 2010). Between blossoms, they are perceived as just one tree among others, discreetly experienced as background in the periphery of human lives.

In this study, cherry trees are investigated in order to unpack how plants can be conceptualized as interacting with technology. It is motivated by an ambition to re-think nonhuman species as “users”. The topic is briefly discussed in McGrath’s (McGrath, 2009) early piece on species-appropriate computer-mediated interaction. Recent advances in plant science, for example, (Maneuso & Viola, 2015), argue for focusing on plants and their many senses and ways of expressing “intelligence” in dealing with their own kinds of problems. Species from the plant kingdom, which lie even farther toward the extreme end of the human-nonhuman continuum, have been neglected as users, and including them takes this idea to an extreme. Theoretical accounts inspired by biology suggest that we can understand plants as oriented toward, or interacting through “dissemination” (Pollan, 2001). Through trial and error, plants develop ways for their species to multiply. The beauty of the blossoming and the praise it receives from humans are not then coincidental, but are a result of that orientation. In order to change the perspective of design from plants being useful to the perspective of plants as users (i.e. to support the plants’ motivation of dissemination), we employ a triangular approach to investigate the interactions with cherry blossoms from four angles, including theories, systems, ethnography and design.

Moving image making

![Figure 4-3. Kid playing with fallen petals](image)

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The moving image, in the form of recorded documentary video clips, was used as a technique and part of the triangular approach, in order to juxtapose with plant-based computer systems, contemporary designs, and the theory on plant dissemination. The intend was to generate design implications for plant-computer interaction.

The videos of people interacting with cherry trees were recorded in Kungsträdgården (“King’s Garden”), a park in central Stockholm, Sweden, where these cherry trees were the major attraction during the blossoming seasons. The setup of the video has the goal of capturing the change of interactions with time. The videos were mostly recorded from the same location (at the end of one of two parallel corridors of sixty-three cherry trees separated by a large basin), in order to draw comparisons throughout the blossoming season, from the emergence of the first buds, through their full bloom, and until the very end when the petals fall down. The focus is how people interact with the trees, such as, looking, smelling, touching and taking photos. The series of videos lasts 190 minutes; the main part of which was recorded in 2015 with thirteen visits in the park. The videos have a style of a fixed-camera observational documentary that provides the kind of fly-on-the-wall effect (e.g., Figure 4-3).

**Insights and reflections**

By analysing the videos, we learned that humans relate to the cherry blossoming in ways that visibly reveal an interest in experiencing the trees with many of our senses (vision, touch, smell). However, these findings are inadequacy for providing a symmetric understanding of what was going on between the humans and the plants; there were only one-way interactions. Thus, we turned to theoretical perspectives on the topic, which can be used as frameworks to categorize motivations for plants in computer systems, design and real life.

*Figure 4-4. Porcelain tableware and table flower from "Iittala X Issey Miyake Collection" (Iittala, 2016) and Nike Shoes with cherry blossom (Soletopia, 2016)*
After reviewing plants in computer systems, and cherry blossom in contemporary designs, we compared and categorized these system, designs and the activities captured in the videos into three different categories of motivations, namely contemplation, hedonic and utility. We argued the current computer systems that involved plants should pay more attention to the hedonic motivation, i.e. aesthetic interaction, which appeared to be the motivation of people interacting with cherry trees and cherry blossom being adopted in contemporary designs (e.g., Figure 4-4). This is in line with plants’ most successful dissemination strategy - beauty - as argued by Pollan (Pollan, 2001).

4.1.4 Initiating new approaches

After presenting the two design cases, this section reflects on the collection and the exemplars from three aspects: firstly, how the two design cases utilize knowledge from the collection; secondly, how they enrich the collection; and lastly, how it is relevant to HCI.

The collection of design technique describes the moving image works in interaction design, whose motivation is to support the design process that leads to the right design. The first exemplar is the 3D animation used as means of visualising the key concepts generated during the user studies for design practice. The second exemplar is the documentary videos used as method triangulation for changing perspective of designing plant-computer interactions to account for hedonic motivations. Both cases are in early phase of design, when the ideas and perspectives are far more important than specific technology use. They are generative and inspirational in nature, and created for a limited audience within the research and design team. They follow the categorical form where parallel concepts and observations are presented in the same (series of) works. The style is informal and sketchy. The previs animation chose to use the white cardboard texture for the concepts in order to draw attention to interactions rather than other the look and feel of design. The cherry blossom videos have low resolutions, but instead they focus on the key gestures and interactions.

With the growth of interaction design as a field, new challenges are constantly emerging. As a result, designers need to invent new methods and approaches to cope with these challenges. In the case of Previs Animation, the challenge is to document and communicate the user studies of interacting with life-size lo-fi prototypes. 3D animation was proposed when photos and textual accounts of the study clearly failed to communicate the interactional and dynamic aspects of the concepts. In the case of the Cherry Blossom
study, the challenge is to study people’s experiences of interacting with cherry trees. Thus, documentary video recording was used as a design technique and part of a triangular approach. This juxtaposition then enabled us to generate design implications of designing for aesthetic interactions. These two exemplars showed how conventional animation and video making techniques could be appropriated to create new methods, in order to cope with new challenges, which in turn, could expand the collection of works using moving images as design technique.

This collection moving images clearly benefit HCI as they facilitate the design process particularly in addressing how to cope with emerging challenges. The moving image techniques help to provide direct input to the design processes. As shown in Figure 4-5, numerous works can be produced in different design phases, but the overall role is to support the design processes. The design technique collection benefits HCI with creative approaches and methods that could be widely adopted in design practice. And the body of works act as exemplars for designers to generate new methods to cope with emerging challenges.

Figure 4-5. Moving Image as Design technique
4.2 Design Element

4.2.1 The collection

This collection refers to the type of moving images as an integrated and essential part of design artefacts. The motivation is to explore design opportunities, new forms of visual expressions, and aesthetic experiences enabled by interactive technologies. Aesthetics and interactivity of moving images are often emphasized. The possibility of dynamically changing their visual expressions with data makes this collection suitable for explorative design research oriented to visual aesthetics and art.

One early example of such work is the Informative Art (Figure 4-6). The idea is to use interactive moving images as an abstract art form driven by flows of digital information (Redström, Skog, & Hallnäs, 2000). For example, using email traffic to generate art work inspired by Dutch painter Piet Mondrian. Different from information visualisation, however, the moving image is represented through displays that act as frames of artwork on the wall. The authors argue for designing for ambient artwork as presence as appose to use. The moving image was created in support of their exploration of designing digital artworks as presence.

![Moving image as abstract information art (Redström et al., 2000)](image)

Another example the artwork A Conversation Between Trees (Figure 4-7), where interactive moving images were driven by scientific climate change data (Jacobs et al., 2013). The intent of the work is to establish a live connection between a distant tree in the Atlantic forest and a tree in the UK, where the work is located. Environmental sensor data is captured and streamed live from each tree, and visualized through abstract moving images, animated 3D graphics, on two opposing screens. Each visualisation responds to a set of data, such as colour, light, temperature, humidity, decibels.
and CO2 levels captured by mobile cameras and the sensors. The changes of environment around trees trigger changes in the moving image, causing it to blur, move, change hue, colour and shape, which allow the viewers to have an experience of standing under the tree.

Figure 4-7. The interactive artwork (left) and visualisations of the two trees from Brazil (middle) and the UK (right) (Jacobs et al., 2013)

These two exemplars illustrated the moving image utilized as design element for exploring visual aesthetics and new experiences. As summarized in Table 3, this collection emphasizes that moving image is an integral and essential part of an interactive artefact. The motivation is often to generate new experiences, which are mediated through data driven moving graphics. Digital technology plays a crucial role of enabling the interactivity and varying expressions of the moving images. Designers and engineers often need develop new systems in order to realise the design, where interactive moving images are crucial parts of the system interfaces. Works in this collection often take abstracts forms. They do not provide useful information, but instead, they visualise data as impressionistic graphics, where the data and their relationships to the works are often hidden. The style allows more creative and abstract expressions, where designers have the space to explore varied visualisations and the experiences they bring about.

<table>
<thead>
<tr>
<th>Lenses</th>
<th>Features of Design Element collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation</td>
<td>Using moving image as elements of interactive artefacts</td>
</tr>
<tr>
<td>Technology</td>
<td>Available or emerging technology</td>
</tr>
<tr>
<td>Design Mediation</td>
<td>Aesthetic experiences</td>
</tr>
<tr>
<td>Form</td>
<td>Abstract form</td>
</tr>
<tr>
<td>Style</td>
<td>Creative expressions</td>
</tr>
</tbody>
</table>

Table 3. Unpacking moving image as design element
Background and motivations

The point of departure is the idea of a cherished place, i.e. a geographical place that one has a strong emotional attachment with and revisits from time to time. Preceding the design exercises, we did a set of field visits in Sweden to interview people who might be representative of such. We conducted unstructured interviews with 20 participants about their relations to their cherished places. We learned from the interviews that they visualised their cherished places in their minds, such as views of landscapes, sunlight, and open seas. The images in the mind’s eyes inspired us to investigate the aspects of those views in order to support an enriched remote experience of a cherished place. First of all, the cherished places are highly individual but often insignificant to others (e.g., not landmarks), which requires the designed system to allow the users to customize how views are captured. Secondly, people are interested in the immediate sense of their cherished places, for example, to see if it is snowing “now”, thus the view of such place should not be static images. Lastly, as the participants went to the cherished places for the feeling of calmness, the views of such places should be unobtrusive and highlight the sense of presence.

The ambient video is already widely used in domains such as digital arts. It is a type of moving images that incorporates the expressions of slow art and is made possible by the advent of high definition displays (Bizzocchi, 2006). Its prime characteristics are to be “pleasant”, visually interesting and capable of supporting occasional close viewing. Ambient works should be both interesting and ignorable at the same time, and sustain over a great number of repeated viewings (Bizzocchi, 2005). It demands minimal attention, but sustains visual pleasure over repeated viewings. Real time videos, distributed over mobile networks, is increasingly abundant, making the combination of mobile webcasting and ambient video possible. The ubiquity of camera phones and consumer-level digital cameras have brought a great anticipation in public discourse of how new live video services and new forms of use would emerge and become everyday practice among non-professionals (Al-Ani, Mark, Chung, & Jones, 2012; Shirky, 2008). We are thus motivated to explore the design opportunities of real-time ambient videos in domestic settings, as the combination of liveness and ambience may open up new spaces for aesthetic experiences.

The triangulation of lived experiences, emerging technology and art forms motivated us to design the system that account for ambience, liveness,
individuality, hybridity and aesthetics. After an iterative design process, the system *LiveNature* is conceptualized, which uses moving images as the essential design element that presents the live streaming videos of a cherished place as ambient art in the home.

**Moving image making**

![Diagram of LiveNature system](image)

*Figure 4-8. LiveNature system*

*LiveNature* was conceived as three integrated components (Figure 4-8): a media capture device that records weather data and live video from the remote cherished place, a communication infrastructure including an interaction manager which enable the users to interact with the system, and decorative media in the home that display the live videos in their original form or mixed with weather data into a hybrid format. The interface is composed of four *small displays* and a 70-inch *large display* attached in wooden painting frames, as well as a handcraft *windmill ornament*. The four small displays (Figure 4-9) show the real-time videos streams captured by four water-resistant mobile phone cameras installed at the cherished place. The large display (Figure 4-10), connected to a server, shows a selected live stream video and allows the weather from the cherished place to influence its visual style. For example, the changing wind speed makes the video appear blurry, which mimics a camera lens trying to find its focus in the blowing wind. The weather data, such as, temperature, wind speed and direction, are captured by a weather station co-located with the mobile cameras.
Insights and reflections

The moving images in this case are live and ambient videos mixed with weather sensor data, as the essential design element of *LiveNature* system. The system combines personalized mobile webcasting and its materialization in an aesthetical and ambient way in the home. By deploying the system in the setting of a “living lab” and conducting interviews with four families who experienced the system for two weeks, we were able to gain new insights on the experiences of liveness enabled by the exploration of moving image as ambient and decorative art form.

First of all, the study underscores the experience of immediacy and appearance of the unexpected as compelling, i.e. looking at something perceived as happening “now” and the thrill of the unexpected seemed appreciated in ambient videos just as in videos of events (e.g. live sports, music, or news). Secondly, however, the participants often paid varied attentions to the
displays rather than being fully immersed during the viewing. They reported repetitive and glance-based viewing. This type of interaction seems to encourage participants to embrace the liveness experiences in the everyday life over a long term. The families and friends of the participants were often involved in the interactions and the live content became a topic of conversation. This finding indicates a new direction for designing liveness experiences, which allows for varied attentions, encourages sporadic interactions and enhanced the “low” but long-term engagement. Lastly, the participants seemed to have experienced their minds actively drifting beyond the content of the displays to different locations in time and space. This experience echoes a type of transcendence, which happens in environments that are familiar and considered with more affection or feelings of belonging. The drifting minds also indicated a sense of ease and effortless attention with less intense focus or engagement, similar to the transcendent experience when people are in nature. The moving images trigger viewers’ imagination and enable them to transcend their mind’s eye through time and space, which opens up new design opportunities for live videos.

4.2.3 Watch for Figuracy (Paper V)

**Background and motivation**

There is an on-going trend where digital devices are used in close physical proximity to our bodies, similar to clothes and accessories. It started with the success of mobile phones and continues with the emergent use of smart watches and wearables. Previous research on wearable technology has focused on allowing interaction on small screens and investigating how to provide “utility” oriented services. Inspired by sociological research that argued since mobile phones are handled and interacted with close to our bodies, the interests in beautifying the devices are increasing (Fortunati, 2005; Katz & Sugiyama, 2006), we argue for a new concern that requires introduction of fashion thinking when designing interaction for wearables. This approach is motivated for two reasons. First, it has been argued that one of the barriers to consumer acceptance of wearable technology is that the aesthetics of these devices do not fit the changing fashion trends in clothing consumption and some wearable research is rejected in user studies because the devices are unpleasant (Kindred, 2005). Second, the potential of using fashion thinking in designing wearable services is still emerging. If users of wearable technology expect to experience these devices in similar ways as their clothes and accessories, the way to design them should then be inspired by fashion design and fashion practices.
Moving image making

Motivated by the potential of adopting such fashion thinking in fashionable services, we designed and developed a system named as Watch for Figuracy which enables the users to choose a desired watch face and match its colour with the clothes he/she is wearing. It works for all Android Wear smart watches. We developed a system (Figure 4-11) that can roughly be described as consisting of three components: 1) a database where the users’ clothing items are digitally represented and stored; 2) a controlling mobile app, by which the users can choose the item they want the smart watch to match with and the desired watch face colour from the colours proposed by the app via colour matching principles and algorithm; 3) an output watch face that matches the wearer’s outfit, which the user can select from a set of designed watch faces.

![System Diagram](image)

*Figure 4-11. The system of Watch for Figuracy*

The moving image is used as part of the digital fashion system in the form of interactive motion graphics that display the chosen watch face and the matching colour of the wearer’s outfit. The moving image making follows three steps. Firstly, colour theory was utilized as the primary principle for the outfit matching as an initial step of the design exploration. Colour plays an important role in professional advice on selecting a combined outfit. The use of colour theory has a long tradition in different design fields, particularly in fashion. However, although colour theory is familiar to professional designers, smart watch users are not necessarily aware of how different colour combinations can provide interesting variations. Secondly, colour theory can be presented in simplified rules in the same way as it is done in design education, and these simplified rules then can be mathematically translated into algorithms. For the initial system, we chose three categories of colour combinations in colour theory, namely: a) Monochromatic colours that derive two new colours from the same hue i.e. different additions of black. It provides a strong sense of visual cohesion; b) Analogous
colours that are close to each other on the "wheel" and tend to look harmonious together because they are related; c) Triadic colours that are equally spaced around the circle and give a strong visual contrast, while retaining balance and richness. Thirdly, a set of black and white watch faces were designed as the "containers" of the colours that utilize the chosen colours in the lines and spaces of the watch faces and move slowly according to a pre-defined pattern. Together, the grey scale motion graphics and the colours matching the wearer's outfit create the moving image work that is the essential design element of a digital fashion service (Figure 4-12).

![Watch faces designs without and colours: Classic, Analogue and Digital (from left to right)](image)

**Figure 4-12. Watch faces designs without and colours: Classic, Analogue and Digital (from left to right)**

**Insights and reflections**

The moving image as design element of the smart watch application enabled us to gain some important insights on the new design opportunities in fashionable services. First of all, it provides an example of software that varies the visual presentation on wearables' displays in ways driven by fashion mechanisms. The fashion mechanism accounted for in this design concerns colour matching in dressing practices, which is a concrete and important issue to consider. Furthermore, by investigating the users' experiences in the fashion service, we can see the potentials of moving image that offer public aesthetic expressions in the form of wearables, which indicates an interesting opportunity for designing wearable interfaces that account for and interact with dressed ensembles. Last but not least, deploying such a system that
emphasises the aesthetic expressions of wearables also reveals some critical issues, such as how the more complex fashion institution practice is at play, how should fashion “intelligence” influence the emerging services, and how customisation should be optimized in order to gain the benefit of digital technology while allowing other visual expressions. Although, our approach is limited in that the singular design parameter, the exploration of using such motion graphics as fashion anesthetization opens up new design opportunities in between of the digital technology and fashion practice.

4.2.4 Investigating new opportunities

This section reflects on how these design cases exemplify the design element collection, how they expand the collection, how such works benefit HCI.

The collection of design element describes the use of moving image as part of an interactive artefact with the motivation of exploring new experiences. The first exemplar LiveNature system visually combines the live streaming videos with its co-located weather sensors as ambient art in the home that also evokes one’s connection with a cherished place. The second exemplar, Watch for Figuracy, is a mobile application that allows the wearers to match the colour of smart watch face with their outfits in order to explore digitalized fashion experiences. LiveNature engages with mobile webcasting and weather sensors, while Watch for Figuracy investigates the emerging design opportunities of smart watches. Different from the design technique where the moving image drives the design process, it is here the result of design process, as shown in Figure 4-13. These artefacts focus on visual aesthetics and experiences, moving images thus play the crucial role of expressing what is considered as beautiful. They are created in abstract forms, in the sense they do not represent a thing, a story, or a piece of information, but they provide pleasing visual experiences. The style emphasises on the dynamics, variations, and interactions of the visual expressions.

The collection of design element expands through new interactive systems and artefacts that utilize emerging technologies to explore new experiences and design opportunities. Technology is an important inspiration for design. At the same time, innovative designs can also drive the development of new systems. In the case of LiveNature, the technological inspiration came from the ubiquitous use of live video streamed through mobile phones. But our intention was to explore novel uses of live streaming videos, particularly in ambient forms, in order to understand new types of liveness experiences beyond such as, broadcasts of live events, news, and instant video sharing. This design vision drove the development of LiveNature system
which embodied both the design thinking and system solution. This exemplar expands the collection of design element to include the experiences of live and ambient interactive moving images. In the case of Watch for Figuracy, the technological inspiration came from the emergence of the so-called “smart watch”. We started exploring the uses of such wearable technology for fashion practices, particularly, how smart watches could be part of the wear’s dress ensemble. This design vision led us to design and develop the Watch for Figuracy system, in which we created an algorithm based on colour theory that could recommend different colour combinations on the watch face to match the wearer’s outfit. This exemplar expands the collection by suggesting the direction of wearable screens as new design venues for moving images, and considering fashion-oriented thinking in interaction design. In all, the collection of design element expands with exemplars that utilize emerging technologies as design materials to explore new aesthetic experiences and open up new design opportunities.

Figure 4-13. Moving Image as Design Element
Both design cases exemplify novel uses of moving images enabled by emerging technology, where moving image are the essential parts of the design artefacts and act as the key interfaces interacting with the users (Figure 4-13). The expansion of this collection benefits HCI as it constantly explores new design opportunities of emerging technologies, inventing new systems, and technical solutions for innovative designs, as well as producing new insights on people’s experiences of interacting with novel artefacts. And diverse exemplars can inspire designers to generate new ideas and explore new design spaces that utilize emerging technology in HCI.

4.3 Design Exhibit

4.3.1 The collection
Moving images are also created with the intent of speculating possible future, initiating discussions, or provoking reflections, such as in design fiction, critical and speculative design films. Filmmaking techniques can add fantastical visual or narrative elements to portray fictional worlds. The implication is less about what a design object or concept is, but what it means. The notion of “exhibit” connotes to our common perception of an artistic exhibition, where imaginations, experiences, and questions are more important than functions, facts, and solutions.

Sol LeWitt’s claim that “idea alone can be works of art” marked the starting point of what is now known as conceptual art in 1969 (Bürdek, 2015, p. 220). Its premise was to stimulate creative thought processes in the viewers, an idea coined with the Italian design and architecture scene of the 60s which made reputations as “radical design”, “counterdesign”, or “antidesign” (Ibid). These design pieces are often produced as exhibition pieces to engage with wider discussion and debates around the concepts and the implications. Such a design philosophy has only been more relevant with the rapid development of modern digital technology. And its exhibition venue also extends from the gallerias to the Internet. Dunne and Raby, as the advocates and scholars of contemporary critical and speculative design scene, had engaged with well-crafted moving image works to exhibit their concepts online (Dunne & Raby).

In contrast to video as a means to locate design concepts within a specific context, fictional videos open the possibilities to both drive design thinking per se as well as shift the perspective on the content of the design (Reeves,
2012). Lately, we have also seen attempts to generate design fiction where the experience is designed through the video. Wong and Mulligan analyzed two corporate concept videos, as design fictions that embed a vision about the future of computing (Wong & Mulligan 2016). Instead of showing actual functions and technologies, they argued the value of these videos resides in their narrative features and ability to elicit multiple interpretations, reflections, and questions (Ibid). Such moving images can stand alone as products and results of conceptual designs with or without designed objects, and open up a wider possibility for design to manifest itself to a wider audience expanding to science fiction and art.

![Image](image.png)

Figure 4-14. Still Image from “Corner Convenience” © Near Future Laboratory

A notable example is the design fiction film “corner convenience”, which depicts a set of fictional prototypes situated in a convenience store, where the cultural implications of their functions were explored through a series of short film vignettes (Near Future Laboratory, 2012). Each short video tells a story of a customer browsing and purchasing some fictional products among ordinary groceries. Figure 4-14 is an example of such products, which enables the customers to win social media followers in a lottery, showing the viewers how followers can become commodity for purchase. The series of stories illustrate a future world where technology-enabled products provide indication of its social norms. They depict the mundaneness of the everyday shopping and the ordinariness of the “diegetic prototypes” as a way to suspend the disbelief (Bleecker, 2009; Sterling, 2009), and engage in wider discussions and reflections the social implications of future technologies.
Another example, Menstruation machine (Ozaki, 2010), is a critical design piece realized in the form of a popular music video. The menstruation machine is a device that simulates menstruation pain and allows men to "feel" like women through the experiences of such pain. The concept is presented through the character’s (not a user) experiences and emotions during his one night out (Figure 4-15). The story focuses on one character, his motivation, and experiences. It evokes a sense of empathy in the viewers through the performance of the character, and contextualizes the controversy and complexity of the concept. Such a work touches multiple aspects of a conceptual design and future technology, while providing multi-layered social and cultural implications. The story and the performance are crucial for encouraging reflections and initiating discussions.

<table>
<thead>
<tr>
<th>Lenses</th>
<th>Features of Design Exhibit collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation</td>
<td>Initiate discussion, reflection, debate</td>
</tr>
<tr>
<td>Technology</td>
<td>Not realized future technology</td>
</tr>
<tr>
<td>Design Mediation</td>
<td>Future scenarios, critical thinking, speculations</td>
</tr>
<tr>
<td>Form</td>
<td>Narrative form</td>
</tr>
<tr>
<td>Style</td>
<td>Details on plot, characters, experiences and emotions</td>
</tr>
</tbody>
</table>

Table 4. Unpacking moving image as design exhibit

As summarized in Table 4, the collection of design exhibit emphasizes that the moving image is one of the end results of the design process and can be seen as the design artefact itself. The motivation is often to initiate dis-
cussions, reflections and debates by asking “what if”. The technology is often not realized, or perhaps never will. Having influences from critical theories of science fiction, this collection of works is interested in human experiences in technological futures and offer the viewers with an imaginative world through storytelling. The moving image mediates such critical thinking and design speculations through visual storytelling, and contextualizes the design where story, characters, their experiences, and emotions are crucial for the concept. Thus, narrative form is most often used, in order to evoke connection and empathy from the viewers. It is worth noting, an object cannot be understood or experienced outside of the context of the fictional world, in which it resides. Rather, the object and its mediation through the moving image together make the design concept and the critical thinking behind it accessible to the viewers.

4.3.2 Fashion Film (Paper VI, VII)

Background and motivations

There is a growing interest in designing fashion related digital services and technologies within HCI. Wearable technologies offer great potentials in creating new products that are both interactive and fashionable. However, well-designed objects are not necessarily fashionable. Technology-oriented fashion design lacks in addressing research within the area of fashion studies, which points to the role of media in shaping and defining what fashion is. A wearable garment alone cannot become fashionable, until it is mediated as a fashionable item by specific institutional practices (Kawamura, 2004). Thus, this study is motivated to mediate wearable design concepts through fashion means, with a focus on a particular new media form i.e. online fashion film (Khan, 2012; Skjulstad & Morrison, 2016; Uhlirova, 2013).

Fashion film has emerged as one of the most influential fashion media since 2000s. Similar to design fiction, fashion film depicts a fictional world where design concepts are situated and contextualized. Both use narratives to explore the felt experiences rather than demonstrate functionalities. Its fictional component motivates our interest in fashion film as a way to mediate wearable design concepts. We suggest it as a vehicle for aesthetics, experiences, style, narrative and emotions, which can transform technical gadgets to fashionable wearables. Thus, this study intends to explore the moving image situated in the overlapping area of fashion film and design fiction, in order to understand the if and how wearable concepts can be mediated as fashionable garments.
Moving image making

The moving image in this case is created as a design exhibit. Here design refers to the practice-led process of producing the fashion film that mediates the wearable concept; the wearable concept itself is not part of the process of this study. The fashion film is the result of the design process, while the smart watch appeared in the film is based on the concept of Watch for Figuracy (Paper V). Figure 4-16 shows how the smart watch faces change and adapt to the colours and patterns of the wear’s outfit, as well as to the environments and his activities.

The short film tells a story of the protagonist, a wealthy and stylish man, who goes to a stud farm to purchase a horse, but encounters with the horse master lady, whom he falls for. The smartwatch catches her interest and facilitates their romance to develop. The watch can be considered as a diegetic prototype (Kirby, 2009), which embodies the fictional technology and drives the plot of the film.

Figure 4-16. Three sets of still images. Representing the patterns and colours of the smart watch in relation to the wearer’s outfits and activities
Figure 4-17. Still images. The settings of the film, e.g. the stud farm (top), the garden of the castle (middle) and the chess game inside of the dining room (bottom)

The production of the film follows a general process of preproduction, production and postproduction. In the preproduction phase, we conducted a workshop with filmmakers to communicate the goal of the research and the
concept of the watch. In a series of brainstorming sessions, we established the characters and the narrative of the film. Then, we continued the process with script writing, location scouting, production design and recruitment. In the meantime, we outlined the storyboard and a detailed production plan. The production phase included the shooting of the film, which took two days in multiple locations in south England in July 2015. The post-production phase was consisted of film editing, music scoring, colour grading and watch face animations, as well as adding sound effects and visual effects for the final film.

We choose to target on the traditional fashion audience, as they are not necessarily the earlier adopters of wearable technology. We also decide to focus on a male audience, since watches are seen as “man’s most prominent accessory” (Wilson, 2003). In order to speak to the intended audience, the style of the film has to fulfill the aesthetics of a classic fashion line, in order to make a piece of wearable garment relevant to a classic dressing style. This combination creates an interesting contrast between the classic men’s fashion and the technical gadget. Thus, the style of the film has to highlight this contrast by reinforcing the conventions of classic men’s fashion. For example, the protagonist is established to symbolize the so-called style of “the conventional English” (Hall, Evans, & Nixon, 2013). The general settings and the details in the interiors (e.g., Figure 4-17) also provide the context in which the story develops and the fashion style fits. The objects that appeared in the settings, such as the car, chess board, and fireplace, help to build up the mood and atmosphere. And the visual style of the film, such as colour themes and camera movements, is also aligned with the style choice.

Through the practice-led process of making the film, we conceptualized a framework as a means of guiding the balance between different but related elements in the film (Figure 4-18). The framework is simply named as FFF (Fashion-Fiction-Function), which indicates these three aspects should be considered as a set of complementary and dynamic relations. Each aspect includes a list of relevant components for the film, which will be created for its own goals with the considerations of other components. Function represents the most important aspects of technology and design, i.e. the functionalities and their means of interactions. Fashion aspect encapsulates a set of qualities that are crucial for fashion communication, such as style, aesthetics, expression, beauty ideals, gender, eroticism, culture, identity and so on. Fiction aspect emphasizes on the world where the design concepts are situated in, the settings, characters in that world, as well as their relationships and emotions.
Insights and reflections

The resulting fashion film was intended to fit in an established “eco system” of fashion practices. In order to learn whether the film conveyed such an experience, it was shown to and discussed with six fashion communication experts, in the form of semi-structured interviews. Based on the experts’ feedbacks and our own reflections, we gained valuable insights on the complementary yet conflicting relationship between fashion and technology mediation.

Firstly, fashion style is the most important consideration in fashion films. A defined fashion style, however, may limit the application of the wearable’s functions to a smaller user group. Clothing fashion and technology driven wearables have very different ways of grouping their audiences. This difference may be driven by complex institution practices due to business models, economies and traditions. Recognizing this paradox will support the HCI wearable design community to find the balance between reaching out the intended fashion audience while retaining technology’s scalability.

Secondly, fashion film speaks to people’s aspirational experiences, rather than representing who they “really” are. Conventional technology concept videos often display broader display of demography and functionality. Instead of erasing genders and portraying people who use technology as personas or dummies, we chose to bring personalities, comedy, romance, countryside, luxury, style, culture, history, and power into play, in order to prob-
lematize technology mediation conventions and raise the questions of how we could position fashionable wearables that are both relevant to technology and fashion audience.

Thirdly, fashion is as fascinated by the idea of the past as it is of the future. Fashion films depict a diverse range of times or eras, even though its goal is always the next collection in the near future. Incorporating fashion film challenges our presumption of how to depict a near future for the fashionable wearables, thus also open up more possibilities to create films that depict alternative futures.

Last but not least, a fashion film requires high production aesthetics and craftsmanship which may seem contradictory with the speculative intention of design fiction. The production quality could be interpreted as persuasive thus less critical. Even though our intention is critical, the glossy impression of the film is liable for misinterpretation. This reflection opens up the discussion on the power of mediation. As media channels such as fashion films are in a way also designed, it requires designers to consider designing both things and their mediation, as well as to include a wider spectrum of culture and communication in the process of design.

4.3.3 Object

Background and motivations
This short film is influenced by critical design and design fiction films. Theoretically, the film is inspired and motivated by post humanism thoughts which indicates the traditional bi-polarities of the body and the world beyond it are collapsing, i.e. “the human is always intermeshed with the more-than-human world” (Alaimo, 2010). Finite human bodies are embedded in flowing, unbounded ‘non-human’ processes; water, air and food molecules we ingest, have passed not only through the Earth but further reaches of time and space. Yet the intimate experiential knowledge of such phenomena is unperceivable through our naked senses.

Object is thus created as a creative exploration to speculate: can future technologies that fuse (wet) biological process and (dry) computational systems, enable us to access a dynamic flow of data-energy, between inner (body) and outer (environment) worlds?
Moving image making

The moving image is created as design exhibit in the form of a speculative short film that explores novel ways of sensing and interacting with the environment through a technological object. In the film, the protagonist's enhanced environmental interactions, enabled by a mysterious object, illustrate the tactile potential of interacting with technological objects, through touching, tuning and turning. We explored the how the designer’s acting can be part of the design process, and how to reimagine meaningful environmental interaction through physical movements and interactions with the design object. By following the protagonist journey, we also questioned our relationship with technological objects and their roles in co-shaping our relationship with the world.

The film was made in three days as part of a design fiction workshop in the city of Oulu, Finland. We sought to envision a digital artefact capable of enhancing the experiences of a place, in this case, a new city. The design process begun with a field trip around the city with an Arduino Smart Citizen kit to capture environmental data, including air composition (CO and NO2), temperature, light intensity, sound levels, and humidity. This data was initially used to brainstorm speculative design ideas. But we quickly realized that our conceptual scope was compromised by limited data and a given technology. We thus reconsidered the design vision to enable a far more explorative approach.

We imagined a mysterious technological artefact that enables a flowing information exchange between internal somatic and external material environments. Rather than design an object that looked overtly technological, we used an architectural model with a double Mobius strip design (See Figure 4-19). This enabled a broader scope of possible interactions by offering a subtler, more metaphorical means of gathering ‘data’. A second field trip with this object shifted our focus towards more personal experiences of the environment, which enabled us to attend to working with our sense of place as a design resource and the aesthetic experiences as design focus. Changing the ways of working with data geographies, enabled us to further explore our interactions with the object by performing it, such as, turning, tuning, holding up, looking through, etc. Filmmaking hence became a process of documenting, shaping and representing our explorative journey with the object into a more imaginative dimension.
Figure 4-19. Holding, tuning and listening to the Object. Still image from Object
Insights and reflections

The film was selected to different art and design venues for exhibitions and screenings. We conducted a series of informal interviews at various venues and took notes. Due to the context of the interviews, the comments were from people with artistic practice and humanistic research background. Such approaches were not considered as rigorous research methods and were not originally intended for written publications, yet some comments offered insights on multiple interpretations which may bring some insights in relation to the topic of moving images in this thesis.

Many noted a melancholy tone akin to dystopian Sci-Fi, and thought the glitch sonic processed through generative algorithms implied her revelation came at a price, and she now shoulders a burden of great responsibility. One artistic commented the film as dystopia, “...if you gaze long into an abyss, the abyss also gazes into you”. On the contrary, an Australian curator took a more optimistic tone, “The film made me feel strangely optimistic for the future of the human race... Looking deeper, I suppose it’s an optimistic representation of the relationship between human and ancient mystery / new technology... I thought it showed a sort of idealised and beautiful relationship, similar to how I feel about my laptop”. One of most informative interpretations came from a writer, who enriched our perceptions when he read the object as both shell and womb, “The sound of the cosmos is still in our ears in the womb as is the sound of the sea in a shell” and then made the connection between the experiences of our living days with the conflicting longing of death.

The film was also picked up by an art critique, who made connection between species extinction and planetary aesthetics through analysing the film, and saw Object as an artistic attempt of imagining and describing “what we do not yet know” (Ballard, 2017). “We hold onto our vague, unverifiable and iterable tools because these are the things that make us responsible, responsive and answerable. In...Object nothing is verifiable, but what is clear is the relationship the woman forms with the object. She takes responsibility for its care, and in return it offers something vague, unverifiable and iterable back.” (Ibid)

Making this film and gathering the feedbacks from others have opened a door for us to reimagine future technology and its implications. This collection of moving images can open up new possibilities of engaging with technology and design, particularly through imaginative, critical and reflective dimensions.
4.3.4 Exploring new expressions

This section reflects on how these two design cases exemplify the collection of design exhibit, how they expand the collection, and how they benefit HCI.

Moving image as design exhibit describes the type of works that intend to initiate discussions and debates by asking the question of “what if”. Such works often depict fictional designs, scenarios and concepts that explore possible or alternative futures through storytelling. As shown in Figure 4-5, these films are conceptual works and the end results of the design processes.
The first exemplar, the fashion film, was created to question the mediation rhetoric of digital technology and to investigate what makes a gadget fashionable by presenting a smart watch concept through fashion means. The second exemplar is the short film Object created to explore the future technology that blurs the boundary between the human body and its immediate environment. In order to depict the design concepts, these films adopt narrative form and engage with the audience by portraying a more complex or ambiguous experience. Their film styles focus on the characters, their encounters, experiences and emotions, so that they can evoke thoughts and reflections in the audience. For example, the fashion film explores the problematics of technology mediation by portraying a dominant male character and his game of power. In Object, on the contrary, the protagonist is filled with uncertainty and a sense of alienation, but gradually grows a closer relationship with the mysterious technology object.

The collection of moving image as design exhibit expands through new videos and films that engage with other creative disciplines and explore new expressions. In the case of Fashion Film, we brought in the perspective of fashion mediation to depict wearable concepts, considering how fashion media, particularly fashion film, plays a crucial role in articulating what is fashion in contemporary fashion industry. This exemplar challenges and expands the collection by learning from the fashion mediation and bringing a new form of moving images that highlights aesthetics, style, characters, plot, as well as power and desire. The second exemplar, Object, on the other hand, expands the collection by bring in artistic filmmaking. Instead of starting from a well written script, the film was made through the process of the designer (this author) exploring the physical properties and interactions with the object. The film invited the viewers to go on a journey with the protagonist and to reimagine how we could interact with the environment through technology.

The collection of moving image as design exhibit has a humanistic concern, which is an emergent and important topic in HCI (Bardzell & Bardzell, 2015). It can expand with works that bringing in new forms of moving image making inspired and influenced by other creative disciplines. Its expansion not only creates new expressions, but also brings in new perspectives and concerns to HCI. They significantly broaden the scope of interaction design, particularly towards imaginative, critical and reflective dimensions.
4.4 Design Promotion

4.4.1 The collection

This collection refers to the moving image created with the motivation of promoting the design visions, concepts, processes, prototypes, products and insights. “Promotion” here refers to the intent of demonstrating and disseminating results in a persuasive way, in order to convince the audience that the proposed designs are plausible and interesting. These moving images can represent designs ranging from early concepts to commercially available products, depending on the purposes and the intended audience.

Traditional design disciplines have established this practice, for example, architecture walkthrough animations, or a product’s demonstration videos. In HCI, a concept representation is often mixed with technology demonstration. The primary purpose of demo is to show that a technology innovation or a system prototype is working and to explain how it works. This tradition of using video as demonstration has its root in science and technology communication where experiments are shown as proof. Moving images, in the form of videos or computer graphics, have been a common way of computer science communication. In recent years, numerous science and technology conferences have opened venues for representing research through videos, as an attempt to increase audience and public engagement.

A notable example in HCI is the video “IllumiRoom” (Figure 4-21) by Microsoft Research, which gained broad recognition within and outside academia (Microsoft Research, 2013a). The video demonstrated a proof-of-concept system that augments the interior area surrounding a traditional TV with projected visualizations around it to enhance TV viewing and gaming experiences (B. R. Jones, Benko, Ofek, & Wilson, 2013). The video combined recorded video and animation to show the concept through a set of use scenarios, as well as the technology and its limitations (Microsoft Research, 2013b). This video is clearly intended for a research audience, as it is 5:28 minutes long, presented in a factual and objective tone. It promises some intriguing features while stating the current state of the system as a prototype. The video also focuses on the system rather than users, whom can only be seen vaguely in the dark. Such video demonstrations are often characterized by their purpose to show and to prove technology. Thus, they are not expected to be manipulated and polished by filmmaking techniques. Rather, they appear to be recorded while the technology is demonstrated uninterruptedly, offering the audience the fact than fantasy.
On the contrary, another video of the same concept seems to present it as a new way of gaming that is already on its way to become a commercial available product (Microsoft Research, 2013c). This video is significantly shorter (1.17 minutes), with Microsoft logo and slogan dominantly presented in the beginning and the end. It is cast by actors with emphasis on their engaged expressions while showcasing the features. It didn’t explain technology behind the presented gaming scenarios and didn’t credit any of the researchers involved in the project; it is tailored for mass audience (see stills from the video, Figure 4-22). This type of videos emphasizes the high-quality craftsmanship of video production, in a way that implies the technology is already there and the product is ready to make a huge impact. The features and functionalities are often embedded in short use scenarios, where a better future is promised. The potential users, depicted as personas in the videos, show the interactions with the system and their contentment thereafter, to justify the usefulness of the concepts.

These two videos have different styles while representing the same concept, quoting Elish, the fact (to the research community) versus the rhetoric of a better future (to the public) (Elish, 2011). One focuses on the technolo-
gy and process behind the system, while the other highlight the enjoyment it promises to bring about. The content and style are tailored differently in these videos, but they share the same goal of promoting the design to their own intended audiences.

<table>
<thead>
<tr>
<th>Lenses</th>
<th>Features of Design Promotion collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation</td>
<td>To represent and demonstrate concepts and systems</td>
</tr>
<tr>
<td>Technology</td>
<td>Realized or upcoming technology</td>
</tr>
<tr>
<td>Design Mediation</td>
<td>Concepts, systems, processes</td>
</tr>
<tr>
<td>Form</td>
<td>Rhetorical form</td>
</tr>
<tr>
<td>Style</td>
<td>Descriptive, factual, objective</td>
</tr>
</tbody>
</table>

Table 5. Unpacking moving image as design promotion

As summarized in Table 5, the last collection, design promotion, intends to disseminate the design concepts, systems, or technologies, to various audiences, such as, juries of design competitions, academic peers, or just general public with a design interest. These videos do not directly participate in design and research process, but act as an outreach. The technology shown in these videos are often realized or at least plausible. And rhetorical form is used as a means to describe the concept, present an argument, or disclose its process. The style is descriptive and factual, and displays a sense of objectivity with positivity. The design process and the moving image making can be separated, especially in the case of corporate design research where the communication is handled by dedicated groups. In academia, researchers and designers are often involved in creating these videos for their own designs.

4.4.2 LiveNature and Watch for Figuracy demos

Due to the focus on design research of the thesis, this section is considered as having less weight. As making moving images for design promotion is in service of research, but has no direct effects on it. However, given the large number of such works produced in HCI, their importance as research outreach, and the scholars’ calls for more videos discussed previously, this collection has its unique importance and should be dealt with in the articulation of the design space.
The first exemplar (Figure 4-23) is the demo video of *LiveNature* that was created for a conference exhibition oriented towards an academic and technical audience (Related paper g). The focus is on showcasing the functions, as well as explaining the installations on both input and output sides of the system. The video is made in a documentary style that simply follows our process of installing the system, from configuring the livestream cameras, to the installation of mobile cameras with self-built stands, then to connecting the system in the server, and, lastly, to showing the working prototype. The whole video was produced in our office without paying much attention to the environment, while making sure to illustrate a clear picture of how the prototype would look like at the conference exhibition.

To the contrary, the second exemplar (Figure 4-24, 25) is an introduction video of the *LiveNature* system created to show the concept of the system and how it works to the families who agreed to participate in the user study. The video is thus made in the “living lab”, in the same environment where the participants stayed during the study. This choice made it clear the functions of the displays distributed in different rooms of the apartment, and encouraged the participants to engage with the system. The environment of the home is highlighted in the video, and the prototypes are situated among other decorative items, such as, picture frames, plants, books and candles. The video itself is noticeably more polished than the first example.
Figure 4-24. Still image showing the displays of live videos in the form of ambient paintings placed in different locations of the living lab.

Figure 4-25. Still image showing how the weather data can change the visual expressions of the large display controlled by the mobile application.

The third example is a demonstration video of the Watch for Figuracy application that shows how the application works in a step-by-step manner, from selecting the colour of the garment, to generating matching colour options, to changing watch faces and, lastly, to showing the final result of a watch face with a matching colour with part of the outfit (Figure 4-26). The video was created as supplemental material in support of the standard aca-
emic paper. Thus, it also follows a factual style with the focus only on the application and its functions, with minimum distractions. And in order to show the concept of colour matching, the video is produced against white background, so that subtle colour changes on the watch face and mobile phones are clearly visible.

Figure 4-26. Still images, demonstrating the Watch for Figuraey application that can change the watch face to match the wearer's red sweater

4.4.3 Creating new artefacts

This section reflects on how the moving image works exemplify the design promotion collection, how they enrich the collection, and how the collection benefits HCI.

Design promotion describes the moving images with the motivation to promote and disseminate design by visualizing the concept, explaining the process, or representing the outcome. The technology presented is either realized or plausible. As shown in Figure 4-27, promotion videos are not directly involved in the design process. Rather, they are used to capture snapshots through the process for various purposes and audiences, such as the two videos of LiveNature. These videos take rhetorical forms by constructing arguments, such as the design is interesting, or the functionalities
are useful. The styles are thus descriptive, factual, or persuasive, in order to present the audience with a sense of “reality”.

The three demo videos produced during the thesis enriched the collection of design promotion by adding new exemplars. As the promotion has little direct effect on design and research process, this section has less weight in the thesis. Nevertheless, design promotion as a collection is an important topic in HCI and it contributes to the field by visualizing, documenting, and disseminating design for the research community as well as the wider audience. This collection will keep expanding thanks to the emerging new designs, artefacts, systems, technologies and the moving image works that make them available to the viewers. And its expansion will inspire more innovations in design and technology within the HCI and beyond.

*Figure 4-27. Moving Image as Design Promotion*
4.5 Summary

This chapter described the four collections of moving image works in HCI, and presented how the design cases conducted during the thesis exemplified the collections and expanded them. *Previs Animation* and *Cherry Blossom videos* showed how new uses of existing moving image making techniques could be appropriated as new methods in order to deal with emerging design challenges, which enriched the collection of design technique. *LiveNature* system and *Watch for Figuracy* application utilized emerging technologies to explore new design opportunities, which expand the collection of design element. The *Fashion Film* and artistic film *Object* brought in creative practices from other disciplines, which expanded the collection of design exhibit by widening its scopes. Lastly, demonstrations of novel systems add new exemplars to the collection of design promotion which can inspire new designs. In all, we should recognize moving image as an evolving design space in HCI, with new works constantly challenging and enriching the existing collections, and ultimately, reshaping the space.
5 Summary and Discussion

As the number of moving image works increases within HCI, particularly in design, few studies have attempted to establish the relationship between moving images and interaction design. The thesis argues for the importance of moving images as a research topic in HCI by providing an understanding of their roles in existing research and practice of interaction design, and investigating how this design space can be expanded through concrete design cases. In the following, we firstly reflect on how these contributions have been achieved, then elaborate on the mediation aspect, and lastly propose future directions for research on moving images.

5.1 How the Contributions Have Been Achieved

5.1.1 Conceptualizing moving image design space (Q1)

The thesis’ first contribution is the conceptualization of the moving image design space, which points out the importance of a theoretical understanding of moving image practice in HCI. The growing body of works utilizing moving image in various forms and for different purposes can be held together in forming a foundation of knowledge that can inform and generate new research and practice.

Chapter 2 established the importance of design mediation in traditional design and then presented the ongoing discussion of mediation of design particularly in interaction design research. Situated in a visual turn of research, moving image is particularly highlighted as a means of design mediation. The notions of form and style were introduced as lenses for understanding moving image, while motivation, technology, and design mediation were added to form a set of lenses to examine the existing works. In Chapter 4, we identified four collections based on their different roles in interaction design, namely moving image as design promotion, design technique, design element, and design exhibit. These collections play a crucial role in linking the individual works scattered in existing research and their conceptualiza-
tions as occupying a unique design space. *Space, collections, and works,* were proposed as key words to articulate the design space as theory and exemplify the making of moving image works as practice and a designerly way of inquiry. Figure 5-1 depicts the design space and shows the relationship between the three parts, which are dynamically linked rather than following a top-down or bottom-up flow.

![Figure 5-1. Moving Image Design Space](image-url)
Moving image works are always conditioned by the particular design context at hand. Some key questions to ask include the what, who, and why. What are the concepts and processes to be presented? What are the questions or new technology to explore? What are the aspects of technology and design to reflect on? And who the audience is also plays a crucial role in making design decisions. The audience could be oneself, the collaborative team, the potential users, the stakeholders, the academic community, or the wider public. Similar to how the sites of “the lab”, “the field”, and “the showroom” can define different design methodological approach (Koskinen et al., 2011), the site of audience has a strong influence on the approach of moving image making. Lastly, the motivation is the most important question that sits in the background of every design decision. Why is this moving image work created, to demonstrate, to describe, to inspire, or to provoke? Once these questions are answered, the collection can provide a rich body of knowledge to explore the “how”.

Collections are divisions within the space and collections of works that share similarities after examining them through the analytical lenses. As mentioned before, there are multiple ways of categorizing moving image into collections. This thesis utilizes the design mediation perspective as the basis of the collection, which emphasizes the motivation, the relationship with technology, and the interaction design process. Each collection provides the designers with a body of related works, guidelines, and inspirations. It also indicates novel approaches and new opportunities, and expands its boundaries with the new works created therein.

All the moving image works together create the design space in which they operate. This thesis further argues that it is not enough to merely collect the existing works, but it is important to categorize them into collections through a set of analytical lenses in order to understand the variations in their motivations or strategies. As individual works are created under a particular design context and with the designer’s own creative inputs, they are ultimate particulars that occupy a unique space in the collective body of works. They take inspirations and conventions from the existing works, but never repeat them. This divergence allows the collection to expand. The space takes new shape with the new works created and the knowledge they bring in. It constantly changes and evolves, as well as it generates new works and indicates new opportunities.

In the next section, we summarize and discuss how the design exemplars in the thesis expand the design space as the empirical contribution.
5.1.2 Expanding moving image design space (Q2)

The thesis’ second contribution is to show moving image making through concrete design studies conducted during the process of the thesis. These individual works were created with various motivations and in different phases of design. What they share is the use of moving image making as a designerly way of inquiry. Built on existing collections, these exemplars empirically demonstrate how the design space can expand by initiating new approaches in response to new design challenges, investigating new opportunities enabled by emerging technologies, exploring new design inspired by other disciplines and creative practices, and creating new artefacts and systems (See Table 6).

<table>
<thead>
<tr>
<th>Collections Q1</th>
<th>Exemplars of engagement Q2</th>
<th>Expansions of collections Q2</th>
</tr>
</thead>
</table>
| Design Technique | Previs Animation  
Cherry Blossom Videos | Initiating new approaches in response to new design challenges |
| Design Element | LiveNature System  
Watch for Figuracy App | Investigating new opportunities enabled by emerging technologies |
| Design Exhibit | Fashion Film  
Artistic film Object | Exploring new design inspired by other disciplines and creative practices |
| Design Promotion | LiveNature Demos  
Watch for Figuracy Demo | Creating new artefacts |

Table 6. Summary of how the exemplars engage and expand the design space

Moving image as design technique refers to the videos, films, and animations created by designers and researchers as a tool to drive design processes. The notion of technique highlights the practical skills of moving image making as a craft or practice. It also points to its flexibility of combining with other techniques in response to new design challenges, as opposed to a systematic way of creating moving image in order to solve design problems. This flexibility allows new approaches and methods involving moving im-
age to transform and cope with emerging challenges in HCI. In the case of *Previs Animation*, a 3D animation was created to depict life-size interactive furniture prototypes tested with users, in response to the challenge of documenting and communicating the movement, interactions, and dynamics of the prototypes, as well as new concepts generated during the test. The second exemplar is a series of ethnographic videos captured in response of the challenges of understanding people’s interaction with plants. These videos enabled a methodology juxtaposition between people’s sensory experiences with cherry blossom and their use in design and computer systems. This approach enables us to explore new directions of designing for plants-computer systems to shift towards aesthetic interactions. Both cases of 3D animation and ethnographic videos are established moving image making techniques in interaction design, but the novelty lies in the new uses and appropriations of existing techniques to cope with new design challenges, which is how the collection of design technique expands.

*Design element* refers to the type of moving image created as part of interactive systems to explore new visual expressions and aesthetic experiences. The notion of element emphasizes the role of moving image as a crucial component of a design artefact, which generates new experiences with the help of emerging digital technology. *LiveNature* system creates live moving image works that combine personalized mobile webcasting with real time weather data in an aesthetical way as ambient art works in the homes. This work explores the design implication of liveness experiences and points to directions for new forms of moving image works that are live and ambient, and support sporadic interactions and customizations. *Watch for Figuracy* is particularly interested in how small display of moving image could be considered as a design element for fashion dress-ensemble. The system combines abstract graphics and algorithmic colour matching principles in order to provide the users with varied expressions for matching their smart watch with their outfit. Abstract motion graphics works driven by fashion principles and wearable technology expand the collection of moving image works as design element. Both design exemplars are inspired by new technologies and the design opportunities they indicate. They demonstrate how this collection can expand with emerging technologies and design exemplars created to open up new design opportunities.

Moving image works created as *design exhibit* highlight fiction and experiences rather than function and facts, in order to bring out other dimensions of technology design that are often more speculative and reflective. As the notion of exhibit indicates, these works are more similar to artistic videos
exhibited in galleries that intend to explore ideas, ask questions, and initiate discussions. The two short films created as exemplars of this collections were in fact both selected to different art, film, and design venues for exhibitions and screenings. The fashion film was produced to explore how to make wearables fashionable by mediating a smart watch concept through fashion means. It expands the collection by bringing in a new form of moving image widely accepted in the fashion eco-system and emphasizing the importance of fantastical and symbolic aspects of fashion experiences for designing wearable technology. The second exemplar Object is a speculative fiction film that explores novel ways of sensing and interacting with the environment through technology, which is inspired by the discussions on the close-ness of human body and nature from feminist theory and environmental studies. The protagonist's enhanced environmental interactions, enabled by the object, illustrate the tactile potential of interacting with technological objects through touching, tuning, and turning. It also indicates a more complex relationship with such technology in a mixture of curiosity, comfort, fascination, and addiction. Both exemplars expand the collection by drawing on perspectives from other research disciplines and incorporating new creative practices to HCI.

Lastly, Design promotion is one of the most commonly seen type of moving images in HCI, which disseminates design results by representing concepts, processes, prototypes, products and insights. In this dissertation, three videos were created for two systems, LiveNature and Watch for Figuracy. These demos are not directly involved with the interaction design process. Rather, they show snapshots of the process in different stages that focus on the concepts, functionalities, processes and outcomes. They do not necessarily expand the existing collection beyond its conceptual space, but enrich it by bringing in novel designs and systems that are exemplars in their own rights.

In all, the design exemplars produced during the thesis showed how moving image making engage with the collections and support interaction design, and demonstrated how the collections could expand by 1) initiating new approaches in response to new design challenges, 2) investigating new opportunities enabled by emerging technologies, 3) exploring new design inspired by other disciplines and creative practices, and 4) creating new artefacts and systems. These exemplars have provided empirical contribution by engaging with the established collections, extending and enriching them, and ultimately expanding the moving image design in HCI.
5.1.3 Limitations of moving image and its design space

It is argued that moving image works are increasingly popular within HCI. However, it is not a universal approach that applies to all complex design problems. Thus, it is important for designers to reflect on the motivation and keep the “why” question in the foreground. Another limitation is the skill required to create moving image works. Although there is a learning curve, current video and animation making applications are increasingly intuitive and large amount of learning materials are available. Moving image making techniques are only going to be acquired by more and more designers. Last but not least regarding the limitation of moving image making, the current way of making, does not easily support instant editing and interactions. For example, in the case of moving image as design technique, the works created are not as disposable, editable, or annotatable as a sketch or a photo. Creating moving images as design elements, however, leaves more room for creating interactive experiences with seemingly linear moving image elements.

The conceptual space also has its limitations. First of all, the space can be criticized for being too narrow, as it excludes many different types of moving image related works in HCI in order to keep its focus on design research. Examples of overlooked works include new technologies to produce high quality videos, mobile videos circulated in social media, or people’s experience of watching 360 films. Studies as such are important for HCI, but are excluded from the conceptual space. At the same time, the space can also be criticized as being too broad as it includes many different types of works that are not conventionally associated together. For example, animations are often considered as a different technique from video. Promotional videos are not analysed together with research videos. Factual videos such as demos are not compared with design fiction films. If such associations may make the conceptual space seem too general, it provides nevertheless a new perspective on the recognition of moving image making as design practice across different types of media formats, conventions, and expressions that address different motivations, technologies and design processes. In a way, the various ways of making moving image works precisely argues for understanding it as a practice similar to, for example, sketching, that designers apply in response to different design situations. Lastly, the moving image design space may seem to suggest a generic way of making. However, the conceptual space intends to map out the structure, relationships, and dynamics between the individual works and the space. When dealing with concrete design conditions, designers need to take inspirations from most relevant examples while applying creative expressions. Such approaches were present-
5.2 Moving Image as Design Mediation

Although design mediation is traditionally recognized and practiced, the research on moving image within HCI has focused either on video methods (Ylirisku & Buur, 2007) or on research outreach (Elish, 2011; Löwgren, 2011). What is lacking is to theoretically recognize other roles of moving images and their shared mediation aspect. The collections introduced in this thesis demonstrate how moving images serve different roles in interaction design. This section further discusses this mediation aspect and its implications from three perspectives.

5.2.1 Mediation as part and parcel of design

It is important to recognize that designers engage with mediation throughout design processes. What are mediated, the “content” of the mediation, includes not only the designed objects, but all sorts of design-things that are manifestations of design thinking processes, such as vague thoughts, abandoned concepts, wild ideas from brainstorming, sketches, inspirations, questions, initial prototypes, or final designs, which are all described, depicted, communicated, represented, and materialized. Before a design object is realized, it has been mediated in many different forms. Mediating these design-things is an integral part of the design activity.

In fact, most design ideas are only mediated without becoming a realized object. Design does not always generate objects; however, it always generates some kind of mediation, which encapsulates rich design thinking and knowledge that are generative and inspirational. For example, in discussing the documentation of Research through Design process, the authors presented a case study of a 3D animation which visualized a design concept and supported the communications with stakeholders during the design process, which became a research artefact that was reused in a new design three years later (Bardzell, Bardzell, Dalsgaard, Gross, & Halskov, 2016). Similarly, the short film Object was originally created as a design fiction, but it was then selected as video art screened in multiple venues, reviewed in an art journal article, and presented in different symposiums related to art and humanity.
Such moving image works live beyond its immediate design task and have the opportunity to broaden the scope of HCI.

These implications require designers to pay more attention on mediation throughout the process of design, i.e. how design-things are documented, represented, and distributed. This is particularly important for design research, which primary contribution is knowledge (Fällman, 2003). In a way, the purpose of design-oriented research activities can be understood as mediating design knowledge and thinking to the design research community. This perspective calls for considering mediation as part of the design research activities. The attention on design mediation is equally important for design practice, particularly for recognizing that mediation and materialization of design thinking go hand in hand throughout the design process. Mediation is part and parcel of design. And it is important to start with recognizing the design-things and the practice of mediating them throughout the design process and beyond.

5.2.2 Audience and intentionality

Creating moving images for various audience has an inherent intentionality. Design mediation is always intended for someone to perceive it. The audience can include the designer herself, the collaborative team, users, groups with particular interests, the research community, or the wider public. The audience also indicates the suitable sites for the moving image works to be accessed. Various scholars have pointed out the problematic of how research videos can be misunderstood by the public (Bean & Rosner, 2013; Elish, 2011). Similar to how different sites (e.g. the lab, the field, the showroom), shape the design methodologies (Koskinen et al., 2011), the intended audience also conditions how design-things are mediated. Thus, mediation is not an objective representation of design, but an intentionally tailored aspect of design for its audience. For example, Previs Animation is intended for the designers in a large corporation, which means the look and feel of the animation has to be recognized as aligned with their brand identity. Fashion film, on the other hand, is produced for fashion professionals, which requires paying particular attention to fashion styles and their symbolic meanings. Videos intended for academic conferences or public screenings, such as LiveNature demo and Object, also have to follow a set of practical requirements such as length, format, and resolution.

The alignment of mediation with the audience is also important when it comes to the boundary between facts and fiction. Facts are important for scientific communication and demonstrations, while fictions are crucial in
design research as the resources for inspirations, speculations, and reflections. Both are crucial for design, but confusing the two can be problematic. Designers need to pay more attention to how mediation could be misunderstood if not clearly explained (Elish, 2011). In such cases, referring to the collections could be a way to frame the audience expectations.

Mediation cannot cover all aspects of design. Its intentionality determines that certain aspects of design are emphasized and others are minimized or eliminated. Furthermore, the intentionality does not determine how design is perceived by its audience, as audiences reflect on the design-things with their own perspectives. *Previs Animation*, for example, was intended to balance between the research results from the user studies and concrete examples for design. However, after viewing the animation, the researchers demanded more findings to be communicated while the designers asked for more concrete action points to be carried out in ideation. As designers and researchers, we can carefully craft the moving image works according to our intentions, but we also need to be aware of the limitations of mediation.

5.2.3 *Mediation co-shaping meaning and experience*

Mediation is a bridge between the audience and the design-things. However, this bridge is not static, rather it actively co-shapes the meaning and experience of design. Although Research through Design argues that design thinking can be embedded in the designed objects (Zimmerman et al., 2007), how such thinking can be expressed and communicated through objects remains unclear (Bardzell et al., 2015). Many designerly approaches precisely demonstrated how mediation can help communicating the meaning of design-things to its audiences (Bowers, 2012; Gaver, 2011; Gaver & Bowers, 2012; Jarvis, Cameron, & Boucher, 2012). Others highlight how representation plays an important part of design knowledge and experience (Dykes, Blythe, Wallace, Thomas, & Regan, 2016; Pierce, 2014; Pierce & Paulos, 2015). Some researchers also discussed how the films they produced for interaction design can embed unique knowledge and experiences beyond the designed objects and academic text (Arnall & Martinussen, 2010; Chen, Clarke, Almeida, Wood, & Kirk, 2017).

With the growing number of moving image works produced within HCI, we need to recognize their value not only in terms of communication between design-things and audience, but also in terms of producing meaning and experience which are otherwise inaccessible. On the one hand, the type of design-things and the intended audience provide the conditions for creat-
ing moving image. On the other hand, the mediation actively co-shapes the meaning and experience of design.

This perspective is particularly visible in the case of design promotion where the moving image intends to explain the meaning of design. As design technique, moving images facilitate the ambiguous design things to become accessible. For instance, cherry blossom videos made it visible to us as designers how people’s interactions with cherry trees occurred and changed over time, which led us to emphasize hedonic motivations for design. This perspective is also visible in the collection of moving image as design element, where mediation of experience is in focus. In LiveNature system, the moving image mediates the experience of looking at a cherished place, while Watch for Figuracy mediates the experience of matching colours in dressing practice. In these cases, design of the system and mediation of experience are inseparable. A similar interweaving of design and experience mediation is visible in the collection of design exhibit. For example, in the case of the fashion film, the fashion experience of the wearable is the combination of the design and the mediation of fashion experience. It indicates a shifted view from a garment as designed object to the combination of a garment and its mediation as a designed experience. Such a shift indicates that experience, meaning, and knowledge are outcomes of the combination of design and its mediation.

5.3 Future Works

This thesis articulates the conceptual space of moving image design and suggests a radical shift towards the role of mediation as an integrated part of design in HCI. It indicates a blurred boundary between design and its mediation, which is a starting point for unpacking how media experiences and design experiences in HCI blend in other domains and practices. Thus, an ambition of the thesis is to raise an open question: how should we include mediation in the design research discourse? Future studies are needed to discuss and debate the role of mediation in design and its research contributions.

Furthermore, another area worth future research is the concept of remediation and its role in HCI. Remediation argues that “all new media are doing exactly what their predecessors have done: presenting themselves as refashioned and improved versions of other media” (Bolter & Grusin, 1999, p. 14). Based on this perspective, interaction design can be understood as a design process of remediation, i.e. using digital technology to reinvent existing
media and exploring new experiences of the old media. Another open question raised is then: how should we understand the role of interaction design from the perspective of mediation and remediation? Such a perspective challenges the tradition of interaction design whose influence is largely from technology and industry design, and needs further investigations.

Lastly, the thesis points to three aspects of moving image design calling for further explorations. Firstly, future investigations are needed to understand how interactional experiences are created by the combination of a design object and its mediation. In other words, in what way mediation can facilitate the experience of designed objects, and what are the critical step of incorporating media experiences into system design experiences? Secondly, just like other design activities, creativity plays a crucial role in moving image making and in design mediation in general. While interaction design occupies the intersection between the rigorous scientific community and the creative artistic community, design mediation, however, allows greater freedom for creative expressions. Lastly, aesthetics and emotion also play an important role in mediation, especially in evoking empathy, enhancing engagement, and conveying experiences. If attractive things work better (D. Norman, 2002), do aesthetically and emotionally engaging moving image works work better as design mediation? These future directions widen the scope of HCI and call for more research on moving image and design mediation both in practice and as theories of interaction design.
This thesis comprises seven papers, out of which six are published in peer-reviewed conferences and one is in submission. This chapter summarizes the papers and their most relevant contributions to the thesis. The papers are presented in the order of the three research phases on the topics of home, nature, and fashion, as described in Chapter 1. Paper I and IV investigate the moving image as design technique; Paper II, III, and V present the interactive systems utilizing it as design element; Paper VI and VII explore the moving image as design exhibit. Together with the works produced during the thesis, these papers investigate the Q2 of how to engage moving image making in interaction design.

6.1 Included Publications

**Paper I**


This paper investigates the moving image in the form of 3D animation as a design technique that can support the communication of design research to practice. An interview study was conducted at newly established IKEA research department in order to understand the established research and design processes in the organization. We then designed and produced a previs animation that depicts the key findings from the user study of the interactive furniture concepts. We suggest that previs animations should be designed to account for the interactional dynamics and provisionality of the design concepts, while at the same time supporting brevity and mobility.

This author is responsible for conducting the interview study and analysing data in order to identify the challenges in communicating research to
design practice in the organization. This author is also responsible for creating the existing physical concepts in 3D, generating new concepts based on the insights from the user study, designing and producing the previs animation, as well as the primary writing of the paper.

**Paper II**

This paper explores the moving image as design element in the form of ambient art that combines live streaming videos with weather sensor data. The goal is to enrich the understanding of the “liveness” experience and to open up a new design opportunities for live streaming videos. We designed and deployed the system TransLive (originally *LiveNature*) that exploits the experience of the “now” from a distant and cherished place. By interviewing four families, each of whom interacted with the system for two weeks in an apartment setting, we suggest a shift from accounts of liveness in “events” to liveness in ambient media for home décor; and we articulate the key concepts, including immediacy, unpredictability, authenticity, engagement and transcendence as implications for designing live and ambient media.

This author is responsible for designing the system, the mobile application, and the interfaces and displays. Together with the second author, this author shares the responsibility for the deployment of system in the apartment and at the remote cherished places chosen by the participants, as well as conducting the interview studies. This author also takes the main responsibility of analysing the data and writing the paper.

**Paper III**

This paper presents the design and development of the *LiveNature* system that explores the moving image as design element in the form of ambient art that combines live streaming videos with weather sensor data. A series of interviews were conducted in three different locations within Sweden in order to understand people’s appreciation of their cherished places, such as a
particular place one values highly and has personal attachment to, but different from where one lives. Then system of LiveNature is designed and constructed through a Research through Design process. The study indicates the new design implications of mobile webcasting for glance-based interactions, as well as the challenges for this new type of system.

This author is responsible for conducting and analysing the interview studies in all three field visits, conducting a series of design experiments, and designing the resulting system and its user interfaces. This author also shares the responsibility of writing the paper.

**Paper IV**


This paper explores moving image as design technique in the form of ethnographic videos in the process of gaining the understanding of people’s interactions with the cherry trees in order to generate implications for design of plant-computer interactions. These videos were utilized as part of the methods triangulation, which also includes theoretical readings, systematic review of plant-based computer systems, as well as a review study on how cherry blossoms are used in contemporary design and architecture. We bring these together and propose to discuss the involvement of flora in computer systems and design items through the lens of understanding plant interaction as temporally extended dissemination and agency to spread, and argue for design focus shift towards supporting aesthetic interaction rather than abstract contemplation, as has been common within Human-Computer Interaction (HCI).

This author is responsible for studying how the cherry blossom is used in contemporary design, conducting part of the ethnographic study of people’s interaction with cherry trees, and writing the relevant sections in the paper.

**Paper V**

This paper explores moving image as a design element in the form of motion graphics on a smart watch face. With the emergence of wearable devices equipped with publicly visible screens, we argue for the need to apply fashion thinking in designing their visual expressions. The screen provides endless variations of visual expressions beyond traditional clothing. We are motivated to investigate the potential of assembling “fashion thinking” with services generation, to create new forms of fashionable wearables. In the explorative design study, we firstly conducted a small study on the use of smart watches in dressing practices, then designed and implemented an Android Wear application, Watch for Figuracy, with a watch face that can change its appearance according to the wearer’s dressed ensemble, and lastly conducted an initial user study of the application. The study indicates the potential of fashion wearable hybrids and shortcomings in utilising colour theory for matching the watch face to the outfit.

This author is responsible for the design of the Watch for Figuracy service and application, design of the watch faces and their graphical animations. In the paper, the author is responsible for describing the methodology, the design process, the resulting concept and how colour theory is utilised, as well as the resulting system and the mobile application.

**Paper VI**


This paper explores the moving image as design exhibit in the form of a fashion film. Fashion technology is an expanding field, yet the question of how technology can be considered fashionable remains unexplored. According to fashion theories, mediation plays a fundamental role in transforming clothing items into fashionable garments. In this study, we investigated how fashion film, as one of the most important fashion media in the industry today, could make wearable design concepts fashionable by merging aesthetics, experience and fiction. By synthesizing research in fashion studies and HCI, we sketched out a framework for producing fashion film for wearables. We then described our own process of making a fashion film for a fictional concept, and reflected on the process and challenges of using the framework.

This author is primarily responsible for designing and producing the fashion film together with a professional filmmaking team, as well as writing the paper together with the second author.
Paper VII
Jinyi Wang, and Oskar Juhlin. “Fashionizing Wearable Experiences through Fashion Film” (Submitted to DIS 2018).

This paper continues to explore the moving image as design exhibit in the form of fashion film, with a focus on the insights provided by the experts. We investigated if and how fashion film, one of the most important medium in the fashion industry today, could make wearable design concepts fashionable. In this study, we showed the fashion film to fashion communication experts and then discussed it in interviews. The experts acknowledged that a wearable concept appeared as fashion in such a film. More importantly, through this process, we identified the key components, namely story, style, character, setting and aesthetics that could support transforming wearables to fashion garments through the film. We then reflected on how incorporating these components might inform, challenge and expand the area of design fiction in HCI.

This author is responsible for conducting the interviews, analysing the data, and writing the paper with the second author.

6.2 Related Publications


6.3 Included Moving Image Works


Arnall, T., & Martinussen, E. S. (2010). Depth of Field: Discursive design research through film. *FORMakademisk, 3*(1).


No tyranny in fashion. (1923, March). *Art-Goût-Beauté*.


