SMELLS:
OLFACTIVE DIMENSION
IN DESIGNING TEXTILE ARCHITECTURE

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ABSTRACT
Designing with non-visual attributes challenges ways of representation. This research explores methods for designing with invisible materiality within the research practice, as well as ways of representation through textiles when designing spaces. Exploring textiles and smells within a space, the research program investigates spatial interactions.

This research focuses on designing embodied experiences using tangible materials as expressions of smells. Through the spatial installations and performances Sight of smell, Touch of smell, and Smell, space, and body movement, haptics were explored as one of the methods of interaction with smells through textiles.

Through the sense of touch, this research also investigates ways of revealing, activating, and disseminating smells within a space. Smells were purposely added through the methods of dyeing, coating, and printing to the textile materials that did not inherently embody any smells. As a result, tactile surfaces create non-visual expressions of smell. Further ideas of research in this area would explore another perspective of designing with smells in spaces. As an example, by designing textiles being smell absorbers, dividers, and reflectors, could compliment the spatial concepts and deals with the already existing smells in a living environment.

In this licentiate thesis thinking through the olfactive dimension to design textiles is not only novel for the textile design field; but also, its proposal for application in the spatial design is quite unique, and offers a new dimension for spatial design.

Keywords: smells, touch, movement, textiles, architecture
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INTRODUCTION
'I like air structures because the major structural element you can breathe and it smells of violets and you can't draw it'. Cedric Price, 1984

According to Lucas Feireiss there is an essentially a need to think of spaces not only in relation to taste and beauty of forms, but also to new concepts of life that emerge within changing environments and societies. He insists on understanding of the quality and relevance of environmental values with its consequences for the design of space to live in (Feireiss 2013). The questions that we ask today relate to how we interact with our immediate environment, and how our living environments, spaces, and buildings interact with us. Kengo Kuma in his book, reminiscent upon his inspirations from the work of Bruno Taut. His philosophy, still very valid and advanced than modernism. Taut insists that there has to be more than designing buildings than just formal aesthetics and that architecture has to relate itself to the world, by making the buildings a medium of interaction with the world (Kuma 2014). Due to technological developments, our ways of living are constantly in flux; existing part virtually and part in our physical environments, the boundaries are becoming even more blurred than those between private and public spaces, as Annett Zinsmeister reflects on the spaces and ways of designing the future environment. She calls for new concepts for this changing society, wherein the quality and relevance of distinctions between private and public, mobility and immobility, distance and closeness, environmental value and significance of identity are questioned. In her approach to deal with the environmental questions, there have to be design strategies that are not one solution to all; rather based on individual understanding of space and are innovative design solutions (Zinsmeister 2013).

Feelings of security, closeness, and comfort are quite intangible and difficult to directly relate to architectural materials, elements, and forms. In her book, Anastasia Karandino questions the practice of architects in relation to the ephemeral: Why do architects primarily design, draw, and map the visual, as opposed to other sensations of space? (Karandinou 2013). Architecture is not only about the solid, material elements of space; it is also about the invisible, immaterial, intangible qualities, but also about the in-between; the volatile qualities between the solid and the fluid, the ambiguous materiality such as sound and smell. Jun Aoki recounts his approach to designing a space, by asking himself a question of what he wants to do in terms of the atmosphere of a space rather than the structural element of architecture. His emphasis is always on the atmospheric value that is felt, rather than the visual qualities of the architecture. Aoki uses decoration as an element that creates atmosphere in explana-
tion to modern architecture that did not deal with the textures and spatial ambience (Brownell 2011).

Today, ephemerality and dematerialisation have become not only parts of the design process, but necessities within the design field, prerequisites for making a significant change in the context of global changes. The designs of Kenya Hara, who coined the term ‘senseware’, have a strong connection to the tactility of materials, and explore feeling and experience. For him the material per say is not interesting if its natural or man-made, it’s the multisensorial engagement that intensifies the experience and the human touch (Brownell 2011). Relationship of the materials around us to our senses, validates our being. Textiles are, in essence, everywhere – on us and around us – and yet at times we are surprised to feel a tactile sensation when we touch a textile. In the context of living environment, engaging through textiles and the sense of touch may be one of the areas for exploring the responsiveness of materials and their materialities.

How might sensory-sensitive thinking apply to the already developed spaces and be a part in process of designing?

Sean Lally envisions two distinct areas of research in the near future that will work closely together – increased human body sensory sensitivity and material energy for architectural applications. He insists that human bodies would be understood as ‘sensorial envelopes that are intertwined with the new shapes of architecture made of material energy’ (pg.29). The human body lacks the ability to sense the information present around and act on it. For different energies in the environment to be useful, there has to be receivers of this energy, which is human body. Though, Lally questions about the strategies that can be made available for the humans to gather information through their additional or heightened senses and be able to respond rapidly to these environmental conditions (Lally 2013).

With our given senses, including the skin for temperature, pressure and pain and our kinaesthetic senses, being in any space is already a process of adjustment and calibration for the body, without being consciously aware of it. According to Horshi Ota, an elevated sense of consciousness, leading to a multisensorial experience, is only possible when an awareness and presence of physicality and ephemerality exists in one’s work (Brownell 2011). Textiles in their physical and tactile nature mediating in between body and space offers an opportunity to create multisensory experiences. The
in-between ambiguous states of smells and sounds in a space when mediated with the
body through textiles, would bring the interior space and tectonic structure together
as one, though Winton questions about the implications of when this happens, would
the conventional structure become redundant? (Winton 2016).

So how do architects map and examine the spatial qualities that these elements
create? How do such elements inform the design processes and design decisions?

Over time, computational design has become synonymous with many design tools
that designers have used, and have complemented the selection of analogue methods
and tools. Application of these new tools has been overwhelming while achieving
the almost impossible terrains for human beings, from conception and designing of
the complex geometries to the construction tools and methods. The possibilities of
using augmented reality (AR) and virtual reality (VR) works as sophisticated tools
for visualizations, real-time design decisions and shortening the time as opposed
to the real physical drawings and models. However, according to Sachiko Kodama,
digital computing is sequential, and therefore cannot match a human response that is
developed in a simultaneous and dynamic way through all the senses. So, her works
explore parallel computing that could have the potential to imitate human response to
the natural world (Brownell 2011).

Existing architectural spaces reflect an understanding of the human body’s shape and
movement and therefore in terms of dimensions, the design reflects depths, forms and
functions. As Sean Lally affirms the construction of building envelopes today relies
on vision and touch by creating visually perceivable edges and tactile boundaries,
which represent an abstraction of the human body. However, he sees the potential in
human body’s sensory perception which can be increased, as the gradient boundaries
of material energy can be perceived at varied ranges, intensities and concentrations.
If this information through the human body be calibrated, it could be used to inform
and change the shape of architecture (Lally 2013). Heightening the sense of smell, for
instance, could increase a person’s perception of the environment, meaning greater
acuity of not just nearby objects but those at a distance. Interestingly, in human phy-
siology, it has been recently found out that the olfactory-like chemosensory signalling
occurs outside of the olfactory epithelium. In other words, we smell through our body
and not just nose (Jennifer L. Pluznick 2008). Our internal organs use olfactory sub-
stances to process and react to the information about the internal environment. This
is particularly interesting, knowing that our organs including skin have sense of smell,
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highlights the importance of this sense and reminds us of the potential of sensory-sensitive information that is receptive and adaptive to the environment.

Questioning the intangible materiality – specifically, smells – this research focuses on the olfactive dimension in spatial design and architecture. What would it mean to be able to include smell as a design material for architecture? More importantly what can smell do to create a space? How does smell transform a space? These were the starting questions that formed the starting point for this research.

Sense of smell from the perspective of living and working spaces has been relatively less researched. This research is however, questioning and at the same time begin the dialogue for thinking spaces in relation to smells. To present day, architects and construction engineers are focusing largely on combating few unpleasant smells within the designed spaces through smart ventilation systems. Whereas humans are capable of distinguishing millions of different smells through the smell receptors in the nose alone. Thus, including smells in a spatial design process is an interesting proposition. Smells per say are not visually representable, nor is the value of being in another space and time embodied in smells could be illustrated, and yet these are important elements in a space that makes us feel comfortable, relaxed, calm, at home and at ease. The opposite feelings – of fear, anger, disturbance and alienation – can sometimes be blamed on the smells present in an environment. These sensitive and rather ambiguous issues are rarely included in design processes when thinking and designing spaces. Although, vision is the most relied-upon sense in architecture – far more than any other sense – and there is a perception that not catering to the visual risks losing critical judgement and awareness. Sean Lally agrees with Dominque Janicaud with regards to sensory enhancement, that might be required for other than visual senses either through intensive engagement or training (Lally 2013). However, the idea of increased sensitivity of the sensory perception other than vision, is to understand the relationship of the design materials to the body and the responsiveness of the same.

Textiles, textures and their tactile behaviour stimulate the sense of touch. Using textiles as a material and method, the aim of this research is to explore ways of using smell as a design attribute in architectural spaces. Through sensory-sensitive thinking this research explores olfactive interactions in relation to the body in a space that is mediated with textiles. With a focus on understanding the materiality of smells and textiles, it focuses on the flow, intensity, time, duration, repetition, shape and scale of a smells and textiles that the human body responds to. The sensory perception of
smells varies among individuals, quite similar to an individual’s needs of an ambient and comfortable temperatures within a space vary. Given any of the three parameters of smell i.e flow, intensity or duration, being disrupted or enhanced, an individual immediately senses this information of change in the environment, although each individual subjectively perceives these and thus reacts differently. However, this research focuses on exploring changes in smell, which can be designed in the environment - in other words, spatial design through olfactive dimension in textiles at different scales and in relation to the body.

The common logic is that once pen has been put to paper, it becomes easier to work with something tangible – and this logic can be applied to smells. One aspect is the communication of the sensorial experience of smells; another is the representation of the smells. The first steps taken in this research were to attempt to understand the various ways in which smells can be represented, and thus to create a selection of tools to work with and delve deeper in order to achieve the larger goals of this research. Smells are often represented visually, as linguistic descriptors frequently depend on the visual aspects of a material. As an example, wine writing is generally based on the visual information relating to the wine; this, according to Gil Morrot, is ‘reliable information’, as he demonstrates by altering the colour of the wine. This is described using words such as ‘lemon’ and ‘honey’ for lighter tones, and ‘cedar’ and ‘tobacco’ for darker ones, and through these descriptions the colour of the wine is fairly simple to predict (Morrot et al. 2001). In her research, Katelyn Lucas creates in-depth specifications for renovating existing places that incorporate smells into architectural plans. In addition to the detailed construction and material specifications, her work includes a vast text of specifications describing the quality of air, wind direction - including smells of the plantations around that area of the building and the effect of the warmth from the sun or the humidity onto the passing smells what one might breathe if one was standing at the specific position (Lucas 2010). This project is exemplary and strongly related to the research presented in this thesis in terms of including smells in the design process for architecture (Lucas 2010).

In reviewing and writing olfactory elements into a performance, Matthew Reason argues that smell is ineffable, comparing it – and the experience of it – to music in terms of sensuality and positing that it cannot be communicated through language. In the arts, sight and sound have advanced, shared vocabularies, that are used to communicate experiences, but these, he argues, cannot be used to communicate smell. Reason compares the difficulties experienced in articulating smells to the linguistic represen-
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tation of music, stressing the marginalised position of olfactory considerations due to the inadequacy of current vocabulary (Reason 2003). A verbal language is deeply rooted in cultural perceptions for any form of art, the reflections and descriptions are as subjective as the sensory experience. A non-verbal language that uses another semiotic system, however, may be able to express a sensory experience.

So, if we can imagine, an expression of smells that is mediated through tactility and textures, could possibly create a synesthetic experience. This experience would be vastly different to a perfume or odour being linguistically described by a simile or a poetic expression that might be designed to be evocative to the senses. When a perfume is communicated linguistically, its ingredients are generally described metaphorically, in a way that is intended to evoke sensual experience without smelling the perfume. Instead, if a perfume were to be communicated through texture, however, the expression of the smell would relate to the palette of ingredients through its sensory weight or volatility, for example. The difference between the verbal and non-verbal expression of a smell relates to cultural perception and thereby the value of smell in a society. As Reason writes, descriptions of perfumes are not necessarily extravagant; rather, the sensual experiences of a smell when it is experienced evoke both personal and subjective associations that are rooted in memory (Reason 2003).

On the aspect of communicating through smells in a performance, Hill and Paris describe using a palette of smells in a live performance and to the audience in addition to light and sound design, in order to add liveliness to the performance: “The reproducibility and malleability of sight and sound in comparison with the untamed nature of smell gives us pause for thought in relation to our experience and understanding of the senses and sensuality” (Hill 2003).

Considering smell as a material, this research explores different media, such as performance, examining smells in spaces, the sense of touch through textile haptics, the textures of non-textile materials such as clay and paper, the action of unravelling the smells present in natural objects and materials, and replicating these actions through tactile interaction with textiles in spaces. By creating a framework wherein smells and textiles are understood at an eye level, this research explores materiality from two directions in the hope that these meet in the middle and rather than contradicting each other, merge into a one fluid element in a space.
PART 1
Smell, Space, Architecture & Body

Smells are the ephemeral and intangible aspects of a space, and yet they connect to the individual in a very distinct way that the form, shape and colour of the space fail to do so. Toshiko Mori explores the ways in which sound and scent perform, inform, and transform; their impact is strongly felt even in the absence of a material artefact in the traditional sense, making them some of the most efficient ‘immaterial’ for use by designers (Mori 2002).

Smell offers several challenges for designers to work with, including its invisibility and intangibility, which directly question our visual way of understanding things. Even before one begins to research on this subject, a designer is confronted with a material that does not allow a visual representation in a conventional way. However, this has been the inspiration for this project, a motivation to delve into a new area of research that is interdisciplinary in nature and open up for new ways of designing and re-thinking design processes and materials to create adaptive architectural spaces.
Smell and space

Western culture has historically focused more on sight than on the other senses and is often reluctant to consider other dimensions that are, nevertheless, fundamental to the experience of architecture, design and habitation. Olfaction would seem to be largely extraneous to the formulation of spaces, and yet a careful reading of cognitive, perceptive, cultural, social, planning and anthropological phenomena would suggest that odours are not only profoundly inherent components of places, but at times actually essential to defining them (Barbara 2006).

One example of the invisible architecture, is SWAMP: Lacking any formal value, this is an organic system and operative laboratory that studies the ecological and environmental conditions of the Nakdong River in South Korea (Barbara 2006). In addition, there have been works of architects and practitioners that deal with smells in the area of spirituality and the sanctity of a religion and its places of worship.

In public spaces, the use of odours or artificial scents is nothing new. The consumer and retail industry has created spaces that feature olfaction, presenting potential buyers and customers with a unique shopping experience and encouraging them to make economic decisions that they otherwise may not. At the same time, there is a trend of de-odorizing the spaces to give the visitor a feeling of neutrality and this practice of creating made-to-order ‘olfactory landscapes’ means that these spaces are, in the words of Marc Augé, ‘non-places’ that have no or little personality (Barbara 2006).

The atmospheres of (or in) spaces are as ephemeral as the smells and perhaps this makes it challenging enough to articulate and is left outside the realms of architectural practices. As Juhani Pallasmaa argues, atmospheres, ambience and mood are rarely discussed among architects or in schools of architecture; instead, architectural theories, education and criticism tend to focus on space, form, structure, scale, detail and light (Pallasmaa 2014). However, within the discipline of architecture, lately there is a discourse on re-thinking on spatial definitions, focussing not only on the tangible but the intangible elements of space. Emphasising on the performative of buildings, Karandinou in her book investigates the immaterial, invisible, intangible, un-representable, ephemeral and elusive elements of space, the reasons why these notions are discussed in recent scholarly explorations, and how architects and theorists deal with them in the contemporary world. She also argues that the (re-) emergence of the notion of the ephemeral in contemporary culture and architecture
is related to the evolution of digital media, with particular reference to the new ways of thinking about space and everyday situations that new media enables (Karandinou 2013).

Pallasmaa, however, suggests that modern architectural theory and criticism has a strong tendency to regard space as an immaterial object that is delineated by material surfaces, instead of understanding space in terms of its dynamic interactions and interrelations. Japanese thinking, by contrast, is founded on a relational understanding of the concept of space (Pallasmaa 2012). Liotta et al., in discussing Japanese spatial culture, argue that the architecture of the twentieth century focused on function and form, whereas the current architectural debate centres on relationships, boundaries and energies, wherein spatial design patterns have the poetic potential to promote performances (Belfiore 2012).

As with the relationships, a space can be a nothingness: Space can be perceived in the absence of anything. Being in a space that contains things or nothings influences our movement or pattern of stillness within the contained space. Space is felt visually through movement, touch and sound (Tufnell 1993), as well as through smells that exist in the background- that are subliminal. The spatial concepts of depth, distance, openings and closing help to create a composition of a space in a metaphorical sense, according to Tufnell et al., but also do so through subliminal and past experiences, wherein smells in a space may create boundaries or open up a space, setting a stage for making relationships within that contained space.

Working with space related to improvisation and performance, Miranda Tufnell et al. discusses how space includes us yet being invisible, arguing that space is only partially visual and that it is experienced through movement, touch and sound (Tufnell 1993). From this perspective, certain smells may not create a space in themselves; rather, it is the interactions with smells within a space that make it contained. The smells and the human interactions become the containers and envelopes within a space that is constantly adapting and evolving. For a space to be adaptive, an interaction happening within that space which is in-turn detrimental to the temporality of these changes. The investigations within this research as presented in this thesis primarily explore how these spaces are created in its own ephemerality- how human interaction within these moments changes the space or rather creates a space.
Smell and architecture (to the scale of architecture)

For thirty years, the artist Ernesto Neto has created ephemeral sculptures and installations that are to the scale of a building and inspired by nature. His primary textile materials are polyamide yarns either knitted or crochet mesh of varying fineness, patterns and colours. He chooses different objects and materials, such as spices, sand and Styrofoam to fill the textile structures to create a sensory experience either through touch, sight, and sense of smell. Some of his works focus specifically on olfactory interaction in the space (Technic 2015). Through his work, Neto asks the viewer basic questions regarding how one’s body reacts and responds to different spaces. How does a body stand, walk, climb or balance through these walkable installations?

Similarly, few architects have occupied themselves exploring spaces through our senses. For Sensing Spaces, an exhibition held at the Royal Academy of Arts in London, Kengo Kuma created a pavilion ‘Scent’ that focused specifically on sense of smell. Here, Kuma questions how a minimal material can induce a maximal effect on the body. This was inspired by Japanese tea houses, which are constructed of a relatively small volume of materials, so the choice of the material used for this installation was whittled bamboo of 4mm in diameter. Two tea houses were built; one was named ‘architecture of reality’ and was related to a father figure, wherein the bamboo was treated with a smell of hinoki (the Japanese cypress tree) and the other was ‘architecture of void’ centred on a mother figure that cocoons and wraps around a body, wherein the bamboo was treated with tatami (Japanese rice straw). The delicate structure of the pavilions was achieved by bending the bamboo and joining each group of bamboo strands using thermosetting resin tubes.

Also in the works of an artist, spaces are explored through senses. Invisible White, a pavilion designed by the architect Makato Yokomizo and olfactory artist Maki Ueda was created with a focus on sense of smell, movement and orientation. The space was designed to be dark so that visitors cannot see far ahead and slowly become conditioned to rely on other senses (touch, smell, and hearing) when navigating this dark space. Three different kinds of scent were used to guide visitors within the space. Similarly, Maki Ueda’s Olfactory Labyrinth Vol. 1, uses three different fragrant oils that are placed in small bottles with wicking yarn, hung from a ceiling to form a matrix. Using the smells, a visitor navigates from bottle to bottle, tracing their favourite fragrance of the three, creating a playful interaction within the space (Ueda 2014).
With regard to the relationship between human senses and socio-spatial relations, the late Victoria Henshaw has researched, experimented and documented the smellscape by visualizing experiential smell maps of a city, choosing to work with smells on the basis that this sense has long been neglected in urban planning. In *Urban Smellscape*, smells are a tool that allow architects to map cities for the purposes of urban design and planning, opening up for working with smells as a material and positing a rethinking of urban design and planning by questioning the role that smells and odours play in designing and planning cities and their relationship to urban design. Henshaw strongly proposes that smell-scape designing for the built environments and cities would bring in new opportunities and prospective challenges in place making practices. Rather than considering smells to be a problem in the designing of spaces and dealing with the help of ventilation systems, Henshaw raises the bar by offering opportunities for delight with the smells. She brings back the attention about the use of artificial smells since long in the retail industry like giants of fashion clothing companies for example Abercrombie & Fitch and Nike and even the bakers who pipe in the smell of freshly baked bread and theatres- which use highly sophisticated ventilation and diffusion systems to create a controlled concentration of smells. However, the role of the architect is not just limited to ventilations systems; rather, the materials used in the construction and the form of a building together play an important role in olfactory ambience. To achieve more specific atmospheres, smells can be combined with other sensory elements to create multi-sensory environments effectively. Henshaw cites the example of Moriyama and Teshima’s Multi-Faith Centre for Toronto University, which uses olfaction to create various different religious and spiritual atmospheres through the smart ventilation systems and a special choice of materials like recycled wood, onyx panels, radiance filters, luminous ceilings and a vertical garden. Rather than controlling and managing smells in the environment through separation, deodorisation, masking, scenting, and making places sterile and neutral, Henshaw’s perspective has been about preserving and celebrating smells, which are a part of any urban landscape/smellscape (Henshaw 2014).

Similarly, smells in the urban environments are explored by Kate McLean who, in *Smell Map Narratives of Place- Paris* (McLean 2014), discusses the role of the human olfactory experience and the perception of cities in the context of personal experiences. The aim of this study was to ascertain which smells, reminded people of Paris. As a result of this exploration she digitally mapped smells by choosing a multi-methodology combining, semi-structured face-to-face interviews, internet-based research, McLean’s own experiences and content analysis of a journalistic text. Based on
the responses, a number of smells was selected, which were representative of Paris spread across various locations within the city. These were marked on a map of Paris as part of an exhibition called ‘Paris Smell Map Virtual Dérive’, wherein visitors were prompted to add their own notes to the map after smelling the samples. These notes were the personal experiences of people relating back to a particular situation, event or person, rather than to a specific place.

Urbanscapes, smellscapes and smell mapping have contributed to the development of a method for smell mapping real physical spaces into a digital smell-mapping system. Combining the social media data such as images of the specific places through Flickr and Instagram and geo-referenced tweets on Twitter, a vocabulary of smells was created and a smell dictionary for Urbanscapes, based on ten categories, was drawn up by Quercia et al. This work, brings an idea close to people in communicating ‘how we smell the cities’ and most importantly these tool-sets empower the designers and city planners to think of smells in addition to lights and sounds when designing urban environments (Quercia 2015).

Although, the planning and design of gardens based on olfactory experience has been a common practice for centuries. In Dufttunnel (‘scent tunnel’), Olafur Eliasson created a seasonal installation that gives visitors a constant feeling of transformation. According to Thomas Worm, through the installation of scent-tunnel, the phenomenon of Op-Artists of past century in a two-dimensional form has been translated to a three-dimensional that is a spatial dimension, from the logical geometric treatment of surfaces to a constructive-tectonic spatial structure (Olafur Eliasson 2005). This way of designing temporal (seasonal) urbanscapes can add an olfactory value to cities.

From the urban scale to the scale of the body, smell as an art is explored by the smell artist and researcher Sissel Tolaas. In Smells of fear/fear of smell, for example, the sweat of several men was distilled, then mixed with paint and applied to walls. Her work within modern contemporary art focusses primarily on bodily odours and the smells of the city. In her works, she is often surprising and provocative, once wearing the scent of sweaty men on herself when she attended a high-society gathering. Some of her collective works, such as Smell Scapes in Kansas City (Lockard 2013) involve ‘smell walks’ through the parts of a city that many participants would not have visited ordinarily, raising awareness of smells and not being ‘smell-blinded’ (Tolaas 2011).
Smell and body (to the scale of body)

In discussing the odour of sanctity in relation to the history of belief in western Christian society during the medieval period, Constance Classen emphasises the olfactory due to the fact that smells were categorised as either natural or supernatural. Aromatic myths were a part of the ancient Christian concept, in that it was believed that the mythical liquid was the food and perfume of deities. Offering sweet scents to God occurred throughout history, although the personal use of perfumes has historically been discouraged by the Church. The value placed on and understanding of olfaction in pre-modern Europe differed drastically from that of the present. According to Classen, the association of odour with breath and with life force, made smell a source of elemental power (Classen 2006).

However, the status of smells changed at some point in history, so much so that it came to have negative connotations and associations relating to hygiene, shame, disgust and suspicion. Also, it is often related to be a seductive medium. In the Victorian period, smell, hygiene and social class were strongly linked and the turn of the nineteenth century saw the appearance of sanitary reforms which brought in the concept of cleanliness, purity and the civilized and also the complete opposite concepts of dirt, impurity and wildness. To belong to the civilised class meant supressing one’s sense of smell (Eikelboom 2014).

As quoted by many philosophers of history, Plato followed by Aristotle classified human senses into the upper - or more dignified - senses such as sight and hearing whereas sense of touch, taste and smell were classified into lower senses. Kant, however, notes that sense of smell is the only sense that cannot be voluntarily turned off (Osman 2013).

Although, Larry Shiner affirms that the wearing of perfume or cologne is intended to enhance one’s self-presentation and that the motives for this act range from indulging oneself in olfactory pleasure to incorporating it into one's grooming regime or - as is suggested by many marketing campaigns – inciting sexual attraction. However, this aesthetic criticism focuses on the ‘fine fragrances’ that set apart the discussion from the artificial flavours and ambient odours of the retail industry (L. Shiner 2015).
Within the discourse relating to smell, perfume and their associations to the social environment, it is interesting to note the fulcrum that moves between two extremes: present-day discourses regarding weather perfumery is an art and what makes a fine perfume an artwork and not simply another consumer object, an item within a circular economy that is worth trillions.

Various philosophers of art have claimed that perfumes lack the prerequisites to be considered to be art. Smell, according to Monroe Beardsley, lacks ‘the balance, climax, development or pattern’ that is required of an aesthetic object. Similarly, Roger Scruton claims that ‘smells mingle, losing their character and remain free floating and unrelated and therefore are unable to generate expectation, tension, harmony, and suspension’ (L. Shiner 2015).

However, Larry Shiner claims his viewpoint on potential of perfumes gaining a status of fine arts, in which he expresses the nature of materials that a perfume is made of, have varying volatilities. Due to this fact, he sees a parallel between perfume design and the composition of music. Similar to a music composer who does not create a single sound artefact but rather a score, a perfume designer aims to create a reproducible formula, in which the perfume carries the top, middle and base notes, each of which constitutes a number of different odorous molecules. This, over the time evokes a sensory interest relating to various olfactory experiences, which is not dissimilar from the philosophy of music.

The question, however, remains open if these olfactory experiences are an expression of certain associations and exemplification of places, events and persons. Certain perfumers though attempt to express the feelings evoked by a place, which Shiner considers to be an ambitious and complex approach of designing a perfume – as well as a complex way of representing perfume. Jean-Claude Ellena narrates the making of the perfume *Un jardin en méditerranée* as, ‘On a visit to an aromatic garden in Tunisia one day, he watched a young woman tear a fig leaf and sniff it with pleasure and on his return to France, he attempted to create an olfactory equivalent of his experience. Given current headspace technology, he could have gone back and sampled the garden to reproduce its ambient odours along with the odour of the fig’. But that kind of literalism, he remarks, would be like a tourist snapshot that missed ‘the emotional tone of the place’. A ‘poetic memory’ of the garden was created through the perfume (L. Shiner 2015).
Although, Angela Ellsworth’s Actual Odor may not be a work of perfumery, but it does span from a scale of a body to that of an architecture in its quest to capture a memory of a place. In this piece of work, the artist wore a dress that had been soaked in her own urine, simulating an experience of being on a subway, at the opening of a reception for the Token City exhibition space installation. Her intervention was site-specific and intended to bring in the idea of smells that go beyond any visual and social barriers (L. K. Y. Shiner 2007).

Further exemplifying ideas relating to smell and the body, Martynka Wawrzyniak, created a perfume, Smell me, which was based on the aromatic elements extracted from her own body; sweat, hair and tears. For diffusion purposes, this perfume was synthetically reconstituted and released in an isolated chamber designed specifically for individual experience during the installation. With this ‘self-portrait’, Wawrzyniak engaged with an audience in a visceral way (Wawrzyniak 2014).

Perfume from a body into a bottle or a perfume from a bottle into the body may seem bizarre, and yet Lucy McRae created a perfume called Swallowable Parfum. Once the digestible scented capsules are absorbed, the skin acts as a biologically enhanced second skin, with the fragrance molecules being excreted via perspiration. Based on individual’s threshold and responses to temperature, stress, exercise and sexual arousal, the scents emitted are genetically unique (McRae 2014). This work adds to the discussions of new ways of living, in that it allows a body to avoid constantly re-adjusting to environments in order to assimilate with the system and cover up various body odours using the products presented by the retail industry; rather, one is a part of the system in their own unique way.

The above examples related to smells in urban spaces constitute attempts to increase awareness of the odours that are present in the proximate surroundings and the ways in which taking these into consideration can affect a space by changing ways of interaction. The works explore and suggest alternative approaches to spatial organisation on the scale of urban districts and cities. At the same time, architects, urban designers and planners can use the qualitative data collected on smells as mediators in an urban lifestyle to adjust planning methods and policies. Either to the scale of body, architecture or beyond, smells do not have boundaries, even if we see the (visual) edges and boundaries that exist between bodies, architectural elements and buildings. However, the fluid and dynamic nature of the smells make them an interesting material for creating temporal spaces. For one moment, the scales and containers of
these smells become trivial, as the smells unfold and the interaction between people and the space takes over. Even when the perception of a smell is ambiguous and different for each person, it engages attention in the subliminal. Through bodies, a multi-sensory perception of our environment is possible, and this relatively unexplored sense of smell, becomes the motivation for this design research.
Toshiko Mori, on the discourse of materiality writes ‘how material characteristics are perceived through the human senses, is an inevitable subject for research. In a world of virtual reality and simulation, desensitization is depriving us of a wealth of information that lies beyond surface, visual and verbal cognition. We predict that the development of innovative materials must take place in parallel with new approaches to engaging human senses. Targeted appeals to the tactile, auditory, and olfactory senses, as well as to vision, will provide increased awareness of the many subtle messages that surround us’ (Mori 2002).

Designing with smells would provide a palette of smells to choose from, just like the palettes of colours, patterns, textures, sounds, and images that are used to design materials and products. This would also mean to deal with daily or sometimes even mundane environment, that is physically present, as opposed to the via virtual reality. lead to reflection regarding holding the attention of something non-virtual that does not have any control over digital devices. Though, it is about time that digital communication be disrupted for at least a short while in order to stop and think, or to even re-think about ways of communicating in our real physical environment.

Sissel Tolaas suggests that in some parts of the world, smells are used – in ways that differ vastly from Western cultures – to define and interact with the world, due to the fact that in these cultures odours are associated with group identities. She expresses that in social environments, smells symbolically create invisible boundaries relating to social and ethnic backgrounds, on the basis that references to smells are often negative – relating to repulsion and avoidance, or even suppression. She sketches a hypothetical assertion, where the avoidance of smells in daily situations may even extend to other sensory inputs; that of sight and hearing, meaning that half of sensory reality is taken away and humans are in the process of losing the ability to experience their environment (Arning 2006). Tolaas’ s thinking is thus a postulation of a new way of living, although there is less of a chance of this happening to our sense of sight and hearing, but this is almost the case for the sense of smell. Unless we consciously and persistently include this sense of smell in our design practice and living environments.

Understanding our own bodies and the odours that emanate from our bodies and the spaces around us, we may be able to comprehend, how subliminally we interact and communicate with our near environment. Studies that have investigated communication via chemosignals or bodily sweat reveal that humans can leave contagious
emotional residue in physical spaces that linger long after the person has left the space and that anyone who subsequently enters that space, is affected by the residual volatile substances. Guen R. Semin suggests that we communicate with language and movements but unknown until now, we mysteriously communicate through chemo-signals (Semin 2014).

It is quite a challenge to obscure the smells from its near environment. Smells have the peculiar qualities of being invisible, intangible per say and can be dynamic and also static depending upon the source of a smell and the way it is disseminated and presented. In order to be able to use smell as a design material in designing spaces, we look at its materiality and which environmental conditions affect them. The intensity of a smell can vary significantly, especially with the passing time and duration at which it is presented. Intensity also varies based on the distance of the smell from its origin, which would eventually wither away with the passing time and the distance. However, there are potential ways, to make a difference to the intensity of smells. As air carries smell molecules, modulating the speed, direction and intensity of airflow, smells can be carried for different durations, distances and in various intensities. Another important element in our environment is the humidity or moisture content in the atmosphere that may vary individual's perception of smell. Temperature has almost an immediate effect on the dissemination of smells. Warmer temperatures somehow make smells more perceivable and therefore easily traceable when compared to colder temperatures.

Using the molecules of a smell that are in the air, which are fluid in nature and easily diverted from the path of their movement, how can smells be used as a material for designing adaptive spaces?

Within the scope of this research, smell when used as a material in architectural spaces is to be understood in relation to the body and human interaction. In the explorations of smell and space, scale becomes an inevitable measure and tool. When one thinks about spaces, how the spaces are created and how the scale of a space becomes relevant to the body, the perspective of Miranda Tufnell et.al (Tufnell 1993), is relevant not just in its visual language, but also when juxtaposed with the olfactive perception.
When exploring the space with smells in this research, concepts of walking, working with space, rooms, scale and quality of objects in relation to the body; how objects change us, our movement, materials, material processes and sound landscapes are re-written, with the layer of smells. These theoretical ideas become a construct in questioning the spatial concepts in practice.

Smell and time, this association has been articulated frequently in different contexts; for an example an old Japanese tradition of measuring time using an incense stick, or the idea that smells have the ability to evoke old memories so fast as if one had a time travel to past. However, in its poetic sense, Junichiro Tanizaki describes in his essays, as the time passes, the aspects of the material would come to light and the beauty of an object gets revealed in the best-suited light (Tanizaki 2001). Of course, this ‘sheen of antiquity’ of which we hear so much is in fact the glow of grime. In both Chinese and Japanese language, the words that denote this glow describe a polish that comes of being touched over and over again, a sheen produced by the oils that naturally permeate an object over long years of handling — which is to say grime (Pallasmaa 2012). Also in the essays of Juhani Pallasmaa on the sense of tactility, he says ‘the skin reads the texture, weight, density and temperature of matter. The surface of an old object, polished to perfection by the tool of the craftsman and the assiduous hands of its users, seduces the stroking of the hand. It is pleasurable to press a door handle shining from the thousands of hands that have entered the door before us; the clean shimmer of ageless wear has turned into an image of welcome and hospitality. The door handle is the handshake of the building. The tactile sense connects us with time and tradition: through impressions of touch we shake the hands of countless generations’ (Pallasmaa 2012).

Keeping the elements of space and time in mind, smells can be revealed with each passing time and reflecting on the space that the object has been occupying. Sometimes the smells of an object are obtrusive to its surrounding and does not speak true of its material therefore how to cherish these smells become a question. If the smells of a certain place or an object were to be revealed in one go, it would be rather a quick and non-explorative way to present and have every essence of the object at the first sight, touch or smell.

However, nature informs us of yet another phenomenon. When taking a walk in nature with its natural smells surrounding us, we learn to appreciate it more and more each day visiting the same favourite spot. Breathing in fresh natural air adds to our
yearning to re-visit these places and explore the depth of nature and one can neither be satiated nor become bored. Looking through nature and its creations, the ways in which smells are contained and revealed are perhaps the key to understanding how smells are designed through its objects. Seasonal changes, including temperature variations and humidity levels, help to either encapsulate or open up smells in an environment.
PART 2
Textiles, Architecture and Space

Definitions and etymologies of the term archi-textiles manifests the understanding of the same subject; tek, which give ways to the words of textile, technology, text, texture, connection and context. Also, to weave, to connect or to construct means in Latin, texere- which is the root of the words technology and textile. Similarly, ‘fabric’ originates from the Latin fabricare or fabre, which means to make (Garcia 2006; Semper 2004). The linguistic and conceptual connections between textiles and architecture are nothing new. Referencing from the historical ideas of these concepts to the projects undertaken by architects, designers and researchers today, span a big arch of multiple takes on this relationship. The interdisciplinarity of these projects is what stands out and leads to new concepts and thinking of new ways of living.
Textile and architecture (to the scale of architecture)

Harry Francis Mallgrave introduces the theoretical concept written by Gottfried Semper in his book, The Four Elements of Architecture, published in 1851. Semper associates four building motives to the four artistic techniques, in which he explains architecture based on a Caribbean bamboo hut. The four elements and techniques are hearth-making using ceramics, mounding using masonry, roof-making using scaffolding and/or carpentry, and making walls (considered to be spatial dividers) using textiles (Semper 2004). Semper’s definitions of four elements relate not only to creating an alternative to the mid-nineteenth century mainstream idea of building blocks, but he also insisted that textiles and architecture came into existence roughly the same time historically. To affirm his statement, Semper brings the focus on the textile techniques and terminology of knots and knotting that were used as a technique for the joints in the architecture. He recognizes the techniques of threading, twisting and knotting of the fibres as the ones among the ancient human arts (Ingold 2013).

Rebecca Houze investigates into the Bekleidungsprinzip (‘principle of dress’) by Gottfried Semper and the case of Vienna 1900 through textiles as a structural framework (Houze 2006). Textiles held a powerful, rich and symbolic status in Central Europe during the late nineteenth and early twentieth century and were artistically and intellectually emphasised in culture. Semper’s theories of architecture have a strong root in the textiles. He defines textiles mainly for two purposes, which is firstly, to string or to bind and secondly to cover or to enclose. Using these two purposes, linear or plan metric forms were originated. Semper articulates architectural elements using textile and dress language in terms of its form, decoration with patterns, colours and function or placement in the context of a building as compared to the human form and the dress. According to Semper, ‘no material is more ephemeral than woven fabrics’ (Semper 2004).

Though, the postmodern theories of spatial design focus on dynamic, flexible, interactive and event and process based spaces and to match this demand high performance textiles offer new material technologies that are driven by biotechnology, nanotechnology, electronics, biomimetic and shape memory alloys, to name a few directional fields that are enabling innovative material developments for architecture.

These new materials are not simply substitutes for conventional building materials; rather they allow a wide range of structural performance and functionality in a
responsive and interactive way. Thereby these materials expand the categories and definitions applied to textiles, essentially blurring the boundaries between textiles and other material groups (Garcia 2006).

Landscaping with textiles, or packaging built architecture with textiles, have been impressive works of Christo and Jean-Claude, using high performance textiles and making it part of the landscape, be it mountains, rocks, trees, parks, islands or water, demonstrating the scale of textiles in the biggest way used until now.

**Tensile structures and form-finding**

Otto Frei strived for lightweight constructions for the buildings that has minimum cFrei Otto created lightweight building structures that were energetic in their forms and economic in terms of material usage by studying the evolution of forms in nature and working with textiles and membranes as part of a framework that he derived using soap-film models (Otto 2010). The tents that were using textiles on a traditional, centuries-old wooden framework were made for temporal purposes. With this achievement of Otto, the interest within the architecture increased and so did the research and developments of various tensile materials. These structures were seen as apt for applications in the area of sport viewing venues as one of an early example. Textiles used in these applications were polyester coated with PVC and PTFE- glass coating onto textiles to increase the load bearing capacity of the overall structure. More recent developments have seen many projects employ ETFE foils for cladding (Garcia 2006).

In today’s design processes, architects use digital tools for form-finding in case of stressed textiles or membranes in the tensile structures. This is a challenging process due to the fact that stretchable textiles have more variables than static points. With the application of physical form finding methods of Frei Otto along with the computational form-finding methods that employ dynamic relaxation techniques, Symeonidou attempted to create a feedback system between the physical and computational tools for the purpose of qualitative and quantitative data collection (Symeonidou 2016). This resulted in a design process, that improved an understanding of the materiality of textiles in terms of stretch factors and tearing thresholds, allowing designers to make real-time design decisions that comes through the physical modelling, into the digital processes.
The idea of applying textile logic and textile materiality on an architectural scale has gained interest among architects and researchers. Although the tension-driven materials in tensile structures are interesting, they offer many challenges in terms of the predictability of the geometry. In their research, Ahlquist and Menges developed an architectural framework that resolves complex material interdependencies and allows for explorations of possible equilibriums in a structure using a stretch knitted textile, which is used as a parameter for form generation in a digitally iterative process. The relationship between material elasticity and the distributed forces, and curvature adds to this critical exploration. For making this work, the textile materials that work in a physical model in a pre-stressed form need to be translated for the manufacturing process, in a non-stressed form (Ahlquist 2012).

**Responsive architecture**

The concept of responsive environment is becoming a ubiquitous way of thinking in architecture, which has become as common as smart housing and building systems (Thomsen and Bech 2012). Technical textiles that are made with performance in mind are gauged on being lighter, stronger, and smarter than other materials. The applications of these textile materials, processes and constructions span diverse fields, including apparel, sports, agriculture, medicine, transportation, engineering, and aeronautics, to name a few (Garcia 2006). Technical materials with specifically designed properties have led to the smarter materials that have a ability to perform in extreme situations and with the addition of sensors and actuators, it is possible to design materials that can adapt to situations and be responsive to environments. Opportunities for creating new, responsive materials for new application areas are exponentially rising and smell-responsive spaces is an area that is ripe for exploration in the context of spatial design.

Mette Ramsgard’s *Breathing Room* and *Slow Furl* explore how smart textiles can function as a material and model for responsive architecture (Thomsen and Bech 2012). In finding new methods of interactivity between movement and temporality, the project involved embedded computation and exploring the transitive character of materials, in opposition to traditional static and permanent material practice in architecture. Conductive fibres were integrated into textiles, allowing changes in the materials to be controlled using an electronic circuit. Through touch and movement, the physical arrangement and position of the membranes of the textile were manipulated, leading to different movements and responses in the textiles.
Responsive biomimetic models that are nature inspired are increasingly appearing as an experimental design concept in architectural contexts. Weft knitted textiles that can respond to changes in moisture, for example, involve the selection of materials based on the physical and behavioural changes. The physical shape change of the textile is due to its moisture sensitivity, that act as sensors and actuators within the knitted textiles (Scott 2007). Embracing changes in natural weather conditions, *Shifting Stone* by Malu Lueking et al won second prize in ‘Material Innovations’ category at the student competition ‘Textile Structures for New Building 2017’, hosted by Techtextil. In this project, heat-resistant basalt fibres that are as strong as carbon fibre were double-woven to form an open structure that offers space in which a material can shift in response to changing weather conditions. The design includes memory-shape materials that induce this shift as part of a designed pattern.

Being responsive to weather conditions is one side of the coin, but architecture that is responsive to human presence lies in between possibility and reality. One of the future architectural spaces as explored by Philip Beesley is responsive to the human presence, to the extent that it is capable of ‘breathing’ by filtering chemicals from the environment. This work is called *hylozoism*, a term that is borrowed from a belief system that posits that all matter has life (Beesley 2013). Beesley’s works are responsive sensorial environments, which are less architectural in a classical sense and resemble tamed forest walkways that react to the touch and breath of a visitor. These systems are flexible, lightweight structures that integrate kinetic functions and are interactive. The fabrication of these structures is employing textile crafts and materiality. What puts these elements together are the chemical metabolisms learnt from nature. This is an interesting approach to designing spaces and one that may be the path to future ways of living. Smells that are released by body sweat, for example, carry chemosignals; if these chemosignals are incorporated into a design and used as sensors and actuators, within the architecture, adaptive and responsive materials would add to the spatial qualities and experience of such spaces.

**Innovative materials and hybrid constructions**

Textile materiality in terms of its look, touch and malleable behaviour has been inspiring textile designers, biotechnologists, product designers and architects equally. Creating new expressions of existing materials surprisingly leads to innovative materials either in terms of a scale, or its materiality is reshaped.
One such example is *Concrete Textile* by Anne-Kathrin Kuehner, which won first prize winner in the ‘Composites and Hybrid Structures’ category at the student competition ‘Textile Structures for New Building 2017’, hosted by Techtextil. The knitted tubes are filled with concrete and these filled tubes were knitted, woven or crocheted to create a surface. This experimental work suggests the flexibility of textiles and the form-building property of cement to a scale of a building. The interesting element though is the augmentation from a thread to a tube that is then looped either through knitting or crochet, thus changing the materiality of the textiles and of the concrete by bringing the two opposite characters of the materials in an exchanged manner somewhere in the middle.

Within hybrid constructions, textile materials are often combined with non-textile materials to be able to capture the best properties of both, with carbon and glass fibres being perfect examples of this hybrid category. As fibres, the applications and construction processes of these materials involve to many and varied methods. A composite fibrous structure using glass and carbon fibre based on biomimetic principles was created by the architectural team at the University of Stuttgart. These composite fibre materials are anisotropic and makes it an interesting material to use where the stress can be defined in a direction of maximum strength (Reichert et al. 2014).

The above examples of hybrid material structures created using textile methods and principles are interesting from the perspectives of textile materiality and architecture. This gives way to think about the materiality of smells in connection with spaces.
**Interior spaces and textiles (to the scale of interior)**

When textiles are used instead of conventional building materials, there is a shift from the architectural scale to an interior scale. This can be observed in efforts to make transparent walls, bring natural light inside, simulate textile structures or shift movements and shadows, for example. Constantly and interchangeably, works of Petra Blaisse connect interior design, landscape design and architecture with textiles while exchanging the scales within these spaces to create unexpected textures, patterns and designs. The fluid atmospheres created in the interiors and the outside are reinterpretations of either (Weinthal 2008).

Creating fluid spaces within architecture is always a design challenge. Fluidity comes from the continuity of the elements within a space. Not only, that is contained in the inside of a building but also that it connects to the outside. The elements of outside when brought in, creates a sense of balance and connectedness to the environment. The textiles developed by Reiko Sudo are conceived to be transformable fluid substances, which she uses in the interiors, as fabric to Sudo is like water and that is not rigid (Brownell 2011). Similarly, Shigeru Ban’s *Curtain Wall*, removes the boundaries of the inside and the outside. Using a large-scale textile curtain as an exterior wall, Ban created an ephemeral architecture in form of a wall, that changes its form and space, blurring the lines between openness and enclosure. The choice of using a textile as a material of construction highlights the non-decorative application of textiles within a space (Klassen 2006).

In a literal sense, bringing the forest into an interior space and creating an alternative dialogue instead of a visual language or an expression, by using textiles to create a landscape is unusual. Makoto Azuma, a flower artist from Japan, created *Terramac®,* wherein a spacer-knit textile structure supports the roots of a biodegradable carpet of moss. Polylactic acid fibres, which are bio-degradable, were used to create the knitted structure so that CO₂ that is released as part of the process of degradation and is then absorbed by the moss through the natural photosynthesis process.

The works described above all emphasise the spatial qualities of the natural and the exterior world, and explore ways of bringing similar qualities into interior living spaces or opening up the inside to the outside.
In doing so, however, spatial qualities such as smell play an important role in creating a multisensorial atmosphere that is reminiscent of the outdoors and nature. This thinking becomes one of an important concept in the investigations within this research.

Inevitably, interior textiles today, are gaining its importance as tactile expressions of architectural forms, mediating between the built environments and the natural landscapes (Quinn 2010). Textiles for interiors are not merely continuing its role as a decoration; rather, the spaces are designed to celebrate textile materiality and additionally incorporate the functional aspects of textiles that no other material could possibly replace it with. In such applications, material hybrids represent a strong step forward, as with the works of Hil Driessen, who explores the textile materiality for its construction, form or flexibility and combines with the conventional architectural building materials like, ceramics, glass and metal. These hybrid materials and surfaces are unique and are site specific for their application purposes (Quinn 2010).

Taking tactile expressions to another scale, Petra Blaisse brings aspects of textile textures and haptics to life in her wall paper series *Touch*. Experiments with these highly visually augmented textures that are scaled up, her work explores the relationships within an interior space and the elements within this space by giving the boundaries and edges of a wall an unusual haptic and visual enhancement, by using the prints of soft textile materials that are made into printed vinyl.

However, if these haptic interactions are combined with volatile qualities in space, such as smells, the spatial experience as mediated by these textile expressions has an added dimension and depth in between the visual and the haptic materiality.
RESEARCH PROGRAM
Ways of interaction between textiles and smells

**Smells and textiles (to the scale of body/interior/architecture)**

Petra Blaisse has been inspired by nature since her childhood, incorporating light, sound, smells, and textures into her work by re-inventing these phenomena and adding the element of surprise. Her work explores the boundary between the interior and exterior, and suggests that this be reconsidered by the design profession in order to encourage thinking regarding invisible and subconscious elements (Blaisse 2009). In her designs of the interior curtains, she has created the feeling of a garden from the outside to the inside through the prints of the grass and an olfactory element is added to these curtains through pocket-like structures at the bottom of the curtain that are filled with lavender buds that not only add weight to the lightweight material but also spread the smell of lavender in the space.

Not only the interior textiles but also clothing is explored for adding smells, as in Jenny Tillotson’s *Scentsory Design Project* integrates smell technology into clothing to make it multisensorial. Using the technology of scents being formulated into fibres, she designed a *Smart Second Skin dress*, which acts as an alternative communication system for the body. The fabric of the dress, upon interaction with the body of the wearer assesses the wearer’s emotional state and emits a scent that corresponds to their mood, allowing the wearer to create a ‘wellness bubble’ around themselves through the release of scent molecules within the dress. In this application, technology enhances the well-being of the wearer, as a study by scientists from the University of California, Berkley confirms. This study also supports multi-functionality of the skin beyond insulation, sensation and synthesis of Vitamin D (Quinn 2010), opening up for further fields of research and investigation of textile technology in relation to synthetic sensory skins.

Negotiating the smells of body sweat collected in between the clothing is presented in a performance, *Sweat*, by Peter de Cupere. This performance was done by five dancers who were dressed in special full body costumes made of plastic which were connected to tubes. Each dancer received a separate dish to eat prior to the performance and so the sweat of each smelled different when it was distilled for the audience. The collected sweat was sprayed onto the wall of a dance lab, which was protected by a glass box and visitors were invited to sniff the smell of the sweat through a small hole (Cupere 2014). Although this performance is conducted on the scale of the body
and presented in a very intimate space between the plastic costume and the body, the smell of the sweat was sprayed onto a wall of a room, scaling up the effect of the smell and the interactions within the space.

Although some researches show the works that are de-activating body smells through the textiles. Scent-eliminating apparel adds activated carbon to the fibres directly and this helps to dampen the smells generated by the bacteria on the body. However, dealing with the smell producing bacteria, Kanebo has done research on embedding antimicrobial substances within the fibre for destroying the bacteria itself that are responsible for the odour (Quinn 2010).

Linking in to the commercial trend of decorating living spaces with scents, some of the fragrance companies and interior decorators apply scents to the carpets, upholstery and curtains. These scents are sometimes tailor-made to the needs of the customers or can be picked up off-the shelf offered by the company. The commerce of these olfactory add-ons creates and markets the atmosphere that consumers desire (Szabo 2001).

This, however, raises the question of whether an olfactive dimension for designing private and public spaces will also adds value to life.

In the tech-savvy, highly visual and auditorily-stimulated world of today, interactions in the real physical world could be enhanced through olfaction. By exploring the potentials of smell as a design material, this practice based design research focusses on finding ways and methods of including smells in textiles for spatial designing.
The Research Programme

Exploring the materiality of textiles and smells within a space, the research programme of the work presented in this thesis investigated spatial interactions. This research focuses on designing embodied experiences using tangible materials as expressions of smells. Investigating textiles and architectural spaces as containers of smells, the design explorations examined the material as a matter and performance in relation to the body and space. Textiles were considered to be tangible expressions, that unfolds the smells through interaction; this interaction is through the body at different scales, either through touch and gestures of hand through the textures of the textiles, or the movement of the body in space, both explore the qualities of smell.
Intersections of Smells with Textiles

In the explorations of the design materials of this research, smells and textiles were considered on two different scales; near-to-body, and far-from-body. The methodology of these investigations included additive and subtractive methods of smells in relation to textiles and spaces.

By establishing the relationship between textiles and smells, the initial investigations explored the materials within the textile hierarchy that are notable for their inherent smell, including jute, hemp, silk, rubber, and leather. Working with materials with strong inherent smells within a spatial context, a speculative approach was used in order to explore the value of smells in our daily environments and ascertain whether the inherent smells of materials affect the users of spaces and materials positively or negatively. Having created scenarios in order to investigate this, it was interesting to explore the presence and absence of the materials and related smells. In one of these, which involved designing a workspace for a leather designer, the space was designed so that the inherent smells of leather, resins, glues, nails, polish, creams, and tools were absent or somehow camouflaged, so that each of these elements smelled of something else. It was interesting to observe the reactions of the actors/workers with regard to whether they connected with these materials as they did before. By changing the materiality of the working tools, would the participants work as normal to create the objects using materials that were visually identical but had unfamiliar smells?

The reality within the fashion retail industry is that products are designed digitally, sometimes without the real materials as starting points. Speculating on giving back the feeling of being in ‘touch’ with the materials even in physical absentia and through the smells would have an effect on design processes. What if fashion designers who work using digital media when sketching or designing clothes were surrounded with the smell of raw materials such as wool, silk and cotton, and the tools including weaving looms, knitting and sewing machines, graphite pencils and paper? Would this sensorial experience be just passed as a nostalgia or would the smells have an effect on ways of working?

Investigating textile materials to be potential smell absorbers and reflectors, the term ‘absorber’ refers here to materials that can absorb smells until a saturation point by a simple technique of wicking. Different materials such as cotton, flax, linen, wool, po-
lyamide, polyester and viscose in various thicknesses in the form of a yarn were used to explore these qualities. ‘Reflector’ is a term referred here to the smell absorption of textile materials up to their respective saturation points. These materials with their own strong inherent smells which, in addition of external smells, reflected sometimes totally different and unidentifiable smells. This investigation led to further in-depth research on the area of enhancing the properties of textiles that could be designed to have heightened absorption and adsorption levels. With the help of nanotechnology these functions of absorption and adsorption can be designed to the textile materials. With an aim of using subtractive methods of absorbing the smells and modifying the smells or ‘reflecting the smells’ from near environments using textiles as a medium, these textiles would be used for designing spatial environments.

Further investigations were performed exploring textile methods like coating and printing and adding smells to textile substrates and designing with these ‘smelled-textiles’ in a spatial context. Micro-encapsulated synthetic smells, which can be scratched off or rubbed between the fingers to activate the smells, were coated and printed onto a textile substrate. The results of this exploration are planned to be scaled up in terms of disseminating of smells being responsive to the change in environmental conditions. This could be achieved by coating and printing nanoparticles that can react to the designed changes like temperature, moisture or mechanical interaction, for opening and releasing of smells. Based on the latest research of Leal Et. Al (Leal et al. 2016), smells were injected through hollow yarns that can be used as a singular/modular elements for creating spatial objects or used for making textile structures. Further collaborative and interdisciplinary research in this field is planned to design the response of the material so that the smells can be opened up and released in response to stimuli such as temperature, moisture and light. This could be done by varying the polymers that are responsive to these stimuli in the melt-spinning process of the fibres.
Intersection of smells with architectural spaces

In conventional design practices, spatial concepts exist within the realm of visual studies. Architecture essentially involves thinking in scales from a detail to a global level, as well as about spatial relations and relational space, physical materials and environmental considerations (Barbara 2006). This research, however, explores design methods for understanding spatial concepts through the sense of smell. A building is encountered; it is approached, confronted, related to one’s body, moved through, utilised as a condition for other things. Architecture initiates, directs and organises behaviour and movement (Karandinou 2013).

The investigations within this research are questioning these concepts from a non-visual sense. How can smells re-define the concepts of space in terms of spatial continuity, enclosures and openings? How can smells affect the spatial relationships within spaces or adjacent. How can movements through the space be dynamic or inactive when explored through the sense of smell? How can the concepts of windows, doors, pillars, ceilings and floors be understood and translated using the sense of smell? When these spatial concepts are juxtaposed with the olfactive perception of a space, there is an understanding of the boundaries that are invisible within a space and yet significant to either open up the spaces or hinder the continuity of the movement.

Turner quotes Classen in his writings ‘Regarded as the sense of intuition, smell contains a whole world of uncultivated olfactory imagery and meaning which never has been and is not meant for the perfume bottle…if our perceptions of olfaction were expanded could we apprehend the world as a landscape of smell, as a spatial dimension through non-visual experience?’ (Turner 2014). Performance as a design method is used to investigate spatial elements in a space and the movement of the body in relation to the smells in a space is used for exploring spatial concepts. Concepts from dancer’s choreographies of walking the space, or working with the objects in relation to body and space are re-written keeping smells in the focus. This method of performance brings in the elements of everyday routines and everyday objects in an interesting context where the interactions in the space with these routines and objects are questioned with regard to smells.
Intersection of smells with interactions

How can smells be activated in a space? How can they be represented and interacted with? In this research, haptics are explored as one of the methods of interaction with smells through textiles. While exploring olfactive interactions in relation to the body in space, this research focusses at the tactile sense as a way of representation. This is also referred to in this research as spatially near to body scale explorations. Through the sense of touch, this research also investigated ways to reveal, activate, and disseminate the smells in a space. The textiles and textile objects were designed for interaction. The smells have been purposely added to textile materials that did not possess any inherent smells. Through physical interaction of these textiles, smells are activated, released and diffused in a space. Through the action of touching, for example either by pressing, rubbing, crushing, pealing, folding or unfolding, ways of activating and disseminating smells were investigated. These methods of activating smells were derived through the explorations of various actions.

As another method for activating smells in a space, the movement of the body is investigated. Interaction through a body movement in a space promotes dissemination of the smells. This is explored in collaboration with a dancer, who improvises her movements with the textile objects that become the source of smell in the space. These movements are similar to smells in space, as both are ephemeral and exist in time in similar ways. When compared, the dimension of time does not exist in visual arts. Changes in the flow and intensity of smells and movements over time adds another layer and depth to a multi-sensorial experience. Interaction with smells in a space is like being a spectator in a state of being and tracking the movements of smells in its duration as a passing time. Through the improvisations of movement, created expressions of smells in a space bring in the conscious dynamic state of smells into being.
Textile carrying smells

Textiles become a medium to transport smells through its tactility for designing expressions of smell. The design explorations in this research are focussing on the fluid and dynamic character of the material. At the same time, the ambiguity and dynamic nature of smells through its free form in the space makes it a challenging material for designing. However, when juxtaposed with textiles, the materiality of smells in certain ways corresponds in some ways with textiles. Alexa Griffith Winton suggests that the textiles have direct communicative and symbolic powers (Winton 2016), based on the references like Madame de Farge, a professional knitter and devoted revolutionary spy, who encoded the names of the future victims of the Terror and Rozsika Parker’s Subversive Stitch: Embroidery and the Making of the Feminine. Although smells unlike the textiles remain intangible and invisible, they are relatively impactful and communicative as materials. The presence of smells in a space can make it feel cozy and metaphorically a home, for example, if the associations of the smells in that moment takes one to own memory lane and connected people and events. On the contrary, we are culturally and socially conditioned to the smells in its positive and negative sense. The smells present in urban spaces, especially in any metropolitan city of the world, often calls for mixed reactions. Due to the associated social meanings, we as humans create ‘boundaries’ for spaces fairly quickly. However, within this research, the spatial qualities that smells can offer in terms of creating corridors, windows and doors in addition to the boundaries have been explored.

Understanding the existence of smells within nature, different smells are present in interesting ways all around at the same time, yet without being annoying and intrusive. In the plants, certain smells are contained within the flowers and seedpods, and it takes a natural process or an interaction of insects, bees or birds to unveil these smells. Also due to changing levels of humidity, smells in plants gets released (Fratzl and Barth 2009). From the perspective of natural processes, systems and environmental conditions, smells could be designed for the indoors that emulate these natural methods for release of smells. Rather than using technology to eliminate smells from our workplaces and living environments, these could instead be embraced and designed through textile haptics that actuate the opening and the release of smells.
Textiles and smells in dialectic interaction

The ambiguousness of textiles leads to their having almost no form, although these are generally present in certain measurable dimensions - texture, colour, pattern, weight, hand feel and drape and these are the qualities that a designer can design with. However, the materiality of a textile is transformative not only in its tangible and physical presence, but also in the language of textiles; verbal, visual and auditory. Through colours and yarns, a pattern is designed. Conventionally, this textile is then attributed with certain qualities that relates to its purpose, and these do not go beyond this purpose and are classified by textile language in relation to it. However, if the materiality is taken as a method or approach (Olsen 2016), this textile could be imagined interchangeably to be something else, opening up the possibilities of what its character could be. As suggested by Bogart et al. knowing what a door is and what it can do limits oneself and the possibilities of a door. Upon being open to its texture, colour, size and shape, it can become anything and everything (Bogart 2012).

Although, references to the olfactory language of textiles is missing. Yet this section, tries to bridge this gap through dialectic interactions between textiles and smells.

The dynamic nature of smells can be related to the lightweight materials. Smells are volatile without any particular form of moving molecules, constantly changing the intensity and flow of smells with the passing time, flow of air and forms of space. What would smells feel like if they had the textures of textiles? How would textiles unfold if they have the dimension of smells? The transparency in textiles gives a space a soft boundary, although this can be overridden while one walks through the soft and fluid textile, tactility of the material is rather alluring. Through the touch, material unfolds the smells. Transparency becomes the texture of the smell. Smells surround and envelops the body as a textile would, creating a feeling of familiarity and therefore the comfort of being surrounded with smells. ‘Smell is the sense that interrupts the progress of rational thought; it stands in ambiguous relationship to the tactile proof offered by touch’ (Arning 2006).

Within a social context, however, smells may not be transparent; rather, there are layers of interpretations that are varied and strong but contain certain ambiguities. The social fabric is a complex structure of norms, behaviours and interactions. Textiles as a material ‘dis’- connects within the social context. Embracing the materiality, however for textiles and smells in this context is quite subjective.
Borrowing from the viewpoints (Bogart 2012), but with a perspective on textiles and
smells, it is an interesting juxta positioning of these materials in relation to body,
space and movement.

**Textiles and smells in a time scape**

Within the perfumery art until the 70’s, compositions were made out of natural
materials which changed over time. The intensities varied which were quite immea-
surable, quiet similar to the classical music, playing on variations in intensity (Ellena
2011). Ellena suggests to treat time as an integral part of a perfume.

Theoretically, smell could be represented by time, yet another dimension to design
spaces with. Notions as timeframe, temporality, timing, tempo, duration and se-
quence are the key concepts in designing spaces (Adam 1998).

Tempo – the rate at which a smell appears depends on what speed it is confronted
with. Textiles on a body in a space experience momentum, speed with generated
energy, sweat and smells at different tempo.

Duration – How long a smell can hold strong at a place before it moves on. How long
will a textile hold its threads together before they start to wither away. What is the
drag and what is the residual, as it meets the body in the space, creates an interesting
contiguity.

Repetition – textiles have a visual repeat, in colour, in pattern, in texture. Each time
smells are dissipated, the hidden repeat in its composition comes to life and is felt
in a space. Perceivable sometimes through the nose directly as a smell, sometimes
through the associations and thoughts from the memory, ‘virtually’ making the event
repeat now; in the present.

**Textiles and smells in spatial relationship and fluid movements**

Shuhei Endo conceives buildings not as isolated entities, but as spatial episodes
within an urban continuum. Inspired by the traditional calligraphic technique
Renmentai, in which the brush remains in contact with the page, Endo inscribes
architecture with seamless material surfaces that intertwine and blur interior and
exterior environments (Brownell 2011).
Shape and scale – do smells floating in a space respond to shapes; where they gather up or get scattered? Do smells move in shapes, and if so which? Textiles in space are used on different scales, that of the body and to the scale of architecture, though the shapes of these textiles are usually fluid.

Topography – changing the landscape, patterns and textures of space, such as walls, ceilings and floors - textile expressions can create not only the movements through space but also adds conversation to the spatial relationship. Smells with their rhythms, volatility and patterns, intrigue the inhabitants of a space through its dynamic nature and changing intensities. Through smells, the distance in-between spaces and to the elements of architecture changes. The interaction of the body with smells changes spaces; by either opening them up to movement or creating an invisible wall.

Ephemerality – both movements and smells are ephemeral (Hill 2003). Fluid and yet untamed character of smells define the movements in a space. Smells create openings in a space to walk through. Smells can be a barrier like walls and compels to change the direction, even though this is a temporal state, it is impactful and unexpected. Textiles in different material qualities creates distinctive movements and sounds which are certainly ephemeral and have rhythmic patterns and repeats which are almost predictable.

Travelling – smells being dynamic, moves in space randomly or perhaps within clusters to form a certain shape depending on the architectural elements and forms. These travel through the space, drifting or being pushed by the flow of air and varying in intensities and shape each time they encounter a surface. A cluster gets separated and then collate at some later point of time. Smells by itself give an illusion of travel back in time. Textiles travel through times, changing their materiality with the time and conditions they are exposed to. Surface changes bear witness to the journey of a textile are either reversible or irreversible (Dumitrescu 2016; Talman 2015; Worbin 2017). These fluid changes in a textile create an imprint on its surface and interior.
DESIGNING
WITH SMELLS
& TEXTILES
Within the field of smart textiles, the self-actuating textiles by Aurélie Mossé distinguish themselves from traditional materials through the ways in which they change their materialities in response to the environment. She asserts that the ‘performative power’ of these textiles is due to the internal transformations that are caused by external factors. The designers are using this passive substance as a substrate that initiates a smart behaviour and is applied on both micro and macro scales in various fields, including medicine, fashion and architecture (Schneiderman 2016).

This research is investigating methods to design textiles with smells. These include additive methods of incorporating smells on/in the textiles and subtractive methods for reducing smells in a near space through the textiles. In addition, this research investigates ways of activating smells in a spatial environment through both additive and subtractive methods. Having investigated smells in nature, it is clear that actuating conditions regulate the activation, opening and dissemination of smells around us. These actuating conditions are natural seasonal changes, temperature, humidity levels, wind and changes in wind direction, light and time; time for ripening of fruits and plants attracting birds and insects using smell /chemo signals to collect and disperse the seeds. Smells change over time and the lifecycles of seed, plants and insects.
Tactile interaction was investigated as one of the methods of activating smells. Designing textiles by embedding the actions of interaction through touch that activates the smells at spatially near to body scale. ‘Gravity is measured by the bottom of the foot; we trace the density and texture of the ground through our soles. Standing barefoot on a smooth glacial rock by the sea at sunset, and sensing the warmth of the sun-heated stone through one’s soles, is an extraordinarily healing experience, making one part of the eternal cycle of nature. One senses the slow breathing of the earth’ (Tanizaki 2001). As Pallasmaa describes all sensory experiences are modes of touching and thus related to tactility. He affirms that haptic architecture as contrasted with retinal architecture, promotes slowness and intimacy, and is appreciated and comprehended gradually as images of the body and the skin (Pallasmaa 2012). Designing a space or spatial experience, that is articulated through its smells, would induce or encourage human interaction at different levels. Activating a smell through the touch of skin would not just be interactive but would also create an individual envelope or space to relate to.

Other actuation methods are through light, temperature and moisture change. Through airflow and movement, smells can be disseminated at different intensities and intervals. To designing a space with smells as an ambient material is, in essence, to design an experience. The performers Leslie Hill and Helen Paris designed a performance in a real home instead of an art space. The rooms of the house were used to create different smellscape with related narratives. Here, smell was a medium for the performers, who saw the performance and smells as being equally ephemeral; ‘the reproducibility and malleability of sight and sound in comparison with the untamed nature of smell gives us pause for thought in relation to our experience and understanding of the senses and sensuality’ (Hill 2003).

The body movements in a space and through a space are fluid in nature and can be compared to the fluidity of smells, which flow through a space. As an exploration, body movements are dynamic elements in space where as smells are static; on textiles, can disseminate the smells. These movements are spatial and when these movements could be synchronized in time with haptic interactions with the textile material, smells are actuated and disseminated in a certain pattern. These patterns are perceived by our sense of smell at different scales; both near to and far from the body.
Time and movement are quintessential to design practice. These get manifested at large when designing self-actuated materials as Aurélie Mossé discusses the design-led approach to conceptualize self-actuated materials. By exploring the temporal qualities of a performative material, the designed changes through time go beyond the aesthetics of form and function. These changes are investigated for their duration, intensity, rhythm and pace that defines the movement of the change (Schneiderman 2016).
Exploring smell as a material

In the explorations as discussed further, the investigations are based on scale of space and smell in relation to the human body and interaction. On the far-from-body scale, an overall ambience of a space that is present in any enclosed or open space and smells are invisibly present all around us, without any particular form or structure. An ambience is an invisible fragrance or smell that fuses and heightens the sensory experience. It is on the contrary, where conventionally architectural images are usually expected to seek clarity rather than ephemerality and obscurity, finiteness rather than open-endedness and deliberate vagueness (Pallasmaa 2014). However, as an example of an invisible architecture, Sean Lally presents the future ways of designing architecture (Lally 2013). In his speculative projects, he has created a link from the history to the future to come. Making architecture using material energy in his proposed projects is indeed thought provoking. Lally’s methods, in using energy, can be juxtaposed to the use of smells to design speculative spaces. Further examples of invisible and speculative architectural materials include Susannah Drake’s work with ecology and Philippe Rahm’s with climates. The works of Lally, Drake and Rahm focus on designing with environment that already exists, their practice is looking at the scale of landscape architectural design.

The design experiments in this research are organised in categories of material explorations, investigations of design techniques and methods for adding smells to textile substrates, and exploring methods for actuating smells through body movements, touch and interaction with textiles. These explorations are at the intersection of smells, textiles and architectural spaces and define the scales of interaction.
Exploring natural materials for the expressions of smell through making

Natural materials with inherent and distinctive smells, such as sheep wool, red clay and mulberry tree fibres were used to explore making objects. The overall aim for these explorations was to learn through the process of making. By examining raw materials for their natural smells as they are processed in the best practice by artists and artisans. Then smells of the materials were then added or modified during the process in order to explore various expressions of smells.
DESIGNING WITH SMELLS & TEXTILES

Through Felting

Practiced at a workshop held by the Lithuanian Felting artist Eglė Ganda Bogdanienė during a design residency at Vilnius Art Academy.

Aim

Hand felting is a method of forming a material into a shape and involves tactile sense to be able to transfer the tacit knowledge to form a textile by rubbing and mixing fibres with soapy water. The aim of this exploration was to create expressions of smell using felting.

Method

In order to understand the technique of felting, a simple flat sample was created using a plastic sheet, which was 30-40% bigger than the finished piece in order to factor in shrinkage, to lay out the fibres in the desired form. Once the wool fibres had been laid out in an overlapping manner to create the form a small quantity of warm, soapy water was poured onto this arrangement. Slow, steady circular and tapping movements were then used to felt the fibres. The wool fibres smelled epidermal and this smell met the pH neutral, unscented soap. The texture of the material in the hand was slimy and the soapy liquid worked its way into the wool fibres and vanished, leaving a few tiny bubbles and a new, mixed smell. Warm soapy water was frequently poured onto the material so that it did not dry out between the stages of the process. The circular hand movements and warm, soapy water helped the fibres to become entangled with one another, forming a strong, connected textile. Following this same method, further three-dimensional iterations were created on flat and rounded surfaces. The original smells of the wool began to disappear, and there were some new and unidentifiable smells that were instead reflected. To explore the thresholds of the process of felting, essential oil drops were mixed in at various stages so as to compare the smell in terms of strength and intensity once the textile had dried.
Outcome

Making a textile by touching and thereby entangling and engaging the fibres lent an experience that relates to crafting using one’s body. The finished pieces of textile forms through the method of felting are the manifestation of this hand craft. The forms were developed in multiple iterations and at various stages of the process, the smells of the original material went through a change. Although the woollen fibres had their own distinctive smell, the added smells of soap and rattan in the first iteration, after multiple washes of the final piece, resulted in a mixed, unidentifiable residual smell. In the next iteration, the smell of rattan was added in the drying stage and this smell remained, with the intensity changing over time. These felted forms carry a mixed smell of wool and rattan at a very vague and diminished level and whenever they are touched, the smell molecules are activated – although the intensity of the smell has weakened over time. However, these crafted textiles are an expression of smell as they represent the design attributes of smells - that is, intensity, portability and change over time.
Through making paper

Practiced at a workshop conducted by the Japanese paper artist Takizawa Tetsuya during a design residency at Vilnius Art Academy.

Aim

Similar to the creation of hand-felted textiles, traditional paper-making in Japan is a hand craft. Using this method, the expression of the smell from mulberry tree fibres was explored.

Method

Mulberry tree fibres are used to make silk paper. These silk fibres are taken from the tree stalks rather than extracted from silkworms from the leaves of a mulberry tree. The process of taking these fibres from tree stalks is a time intensive process, for this exploration, however, their being provided made the process of paper making shorter than usual. The fibres were pounded with a special tool made of wood to separate them and ensure that they did not stick together. The fibres had a very distinct vegetal smell. The pounded fibres were placed into a bath of water and natural plant resin in a ratio of amount of fibres equalling 1% of water in the bath. Smells of the plant resin were very intense and distinctive. The mixture was stirred with a wooden stick using jerking motions. A wooden frame with a fine bamboo stick mat was dipped into the bath being held firmly and passed through the water bath of fibres and swinging it back on top, almost in a rhythmic, coordinated manner. This step was repeated many times without pause until the fibres are caught on the bamboo mat covering the entire frame. Once this is achieved, with extreme care the wet mass of fibres now in a form of a
soggy sheet – was laid stretched on the damp cloth which has been fixed on the wooden board. This process was repeated to create more sheets of paper which were piled up on the wooden board, each separated by a cord. The mass of wet paper soaked in the plant resin smelled, looked and felt gluey. Once the process of placing these sheets had been finished, another wooden board was used to sandwich the layers and a heavy, evenly distributed weight was added to ensure excess liquid was pressed out and left overnight. Each of the sheets of paper was carefully removed with a help of a fine-bristled brush and left to dry on a wooden board, with care taken to smooth out any bubbles, creases or stretching on the paper. At this stage, the smell of the resin had almost diminished. The sheets were left to dry at room temperature overnight, or in the sun for several hours. Once dry, the sheets were crisp and had a soft tactility, smelling faintly of the fibres. Oil based bamboo smell was added to the sheets during the drying stage.

Outcome

Silk paper that smells of bamboo creates questions and puzzlement, although the dissonance between the smell of bamboo and sight of silk and paper can sometimes go unnoticed. However, this expression of smells is beautiful. Over a period of time the smells have weakened, although they are still discernible and these faint molecules can be whiffed up once the paper is waved in the air.
Through making Ceramics

Practiced at a workshop conducted by the ceramics artist Saulius Jankauskas during a design residency at Vilnius Art Academy.

Aim

Investigating ceramics for expressions of smells. Clay is a material that is different to textiles and has a distinctive smell. Using this attribute of the material, the aim of the exploration was to investigate whether it is possible to apply the materiality and tactility of textiles to the making of ceramics and by that exploring the life of natural smells of clay through its making process.

Method

Red clay was used for these investigations. Kneading according to a specific technique is an important preparatory step when working with clay in order to ensure that there are no bubbles. As the clay was rigorously kneaded, smells began to become noticeable. Once it had been kneaded and was soft enough to work, a certain amount was used to mould a form. Various hand modelling techniques were learnt and applied: The most basic of these involved shaping the clay into a ball and using the fingers of one hand, creating the desired form while holding the mass of clay in the other. This form was either drawn on paper or imagined, then translated using the hands. The second technique for making a form consisted of connecting together multiple smaller parts to create a larger form; the clay was rolled into thin tubes and these were made into concentric circles, which were then carefully joined together using the clay that had been prepared for this purpose, which was the same clay, diluted with water until it took on the consistency of a semi-liquid paste. This was, however, not quite sufficient for fixing the parts together. To create a smooth form with no gaps between the smaller parts, the thin tubes of clay were used to extend the surface pattern of the form and simultaneously cover the joins. The third technique involved taking a much larger volume of clay and kneading it further, until it became quite soft and easy to bend. A small amount of essential oil was added during this kneading process. The fluid shape that was created during this exploration was visually similar to a textile, and its surface was covered with a monofilament knitted textile to create a textured surface. Once the desired form and texture had been achieved, the clay on the inside of the form was removed using special tools, leaving a 1 cm-thick
outer wall. The fourth technique for creating a form was to create a firm ball. The form was then made simply by poking one finger through it, cracking the outer side of the clay ball. By rotating the ball the pressure was distributed, with the hand and one finger or thumb used to hold the clay in place. This resulted in a form with an exterior cracked texture. The fifth technique involved making a geometrical, rather than round or organic, form by making flat geometrical shapes such as squares, rectangles, and triangles that were 1 cm thick or greater so that they could be joined together using the clay paste. Sharp edges and corners were formed using special cutters and rulers. These forms were then dried for a few days at room temperature, during which time the smell of clay was highly persistent. They were then fired in a clay kiln, after which they no longer smelled. Once they had been completely dried and baked, the forms were coated with a glaze that was applied using a brush or sponge on the exterior and poured into the form where necessary. Smells were added at various stages; in the third iteration, for example, the smell was added during kneading. More smells were added later, in the glazing process, by mixing the glazing liquid with liquid scents. Erfersperum eum

Outcome

When the forms had been baked, the smells that were added prior to this were no longer discernible, although those added at a later stage were still present, if quite vague. Possibly the smells could be released by crushing the hardened clay forms. This exploration could be expanded upon by looking into similar materials such as gypsum, which is applied directly onto textiles to create a softer effect, through three-dimensional additive techniques.
Designing textile expressions through additive methods of smells

Moss dyed textiles

This material was developed at the textile printing and knitting labs at the Swedish School of Textiles.

Aim

To explore natural material for ‘dyeing’ yarns in order to investigate uptake of smells by raw textile materials and through the textile processes of making a knitted fabric. Wild moss that grows in the forests of Borås was used for this exploration.

Method

100% PES crimp yarn was selected for dyeing. Moss from a forest near to Borås is used to create a dye bath within the lab environment. Although most of the soil that clung to the roots of the moss was removed, some remained and found its way into the dye bath. The dye bath smelled of a forest ground, moss and plants and so walking into the lab where the moss bath was boiling was olfactorily akin to walking into a forest. The moss was boiled in water for two hours. The polyester crimp yarn was un-winded from cones to hanks and secured all through to avoid any tangling when in the moss bath. These are slowly lowered into the bath ensuring even coverage of the yarn hanks. These were left on a low heat in the bath for approximately 2 hours, then remained in the bath until it had cooled. The hanks were then removed and squeezed to remove excess water, placed in a dry heat chamber, and regularly rotated to avoid any accumulations of residual liquid. The yarns smelled strongly of moss, and were left to dry for around 24 hours. They were then re-wound onto the cones and prepared for knitting.

The circular knitting machine used had been cleaned thoroughly prior to the experiment so as to remove any trace of oil on the needle bed in order to prevent the knitted fabric from picking up its smell. The pattern used was a classic double-bed jacquard pattern from the library of the School of Textiles and the
dyed yarn was used as a ‘sandwich’ material, inlaid between the loops of the front and back of the fabric during the knitting cycles. Polyester monofilament yarn was used as a technical front for the double-bed fabric and polyamide elastane was used as the technical back. Once the fabric had been knitted down, it was left for some time in a relaxed state to achieve residual shrinkage and get into the desired shape of the pattern.

Outcome

The fabric smelled of moss and soil to give a feeling of a distant forest smells. The dyed yarn was almost colourless aside from a few blotches caused by the concentrated moss bath. Visually, the fabric is a basic knitted fabric created using an inlay technique and a quilted look. Upon closer inspection, the fabric has a dimension of smells which opens up even more when one handles it. Over time, the intensity of the smells has changed, but as soon as it is taken out of its box and laid on a table, its smells are very noticeable.
Plant-dyed textiles

The yarn was provided by Linda Worbin (Worbin 2013) and the tufted fabric was developed at the weaving lab at the Swedish School of Textiles.

Aim

To exploring a yarn that was pre-dyed using methods developed by Worbin (Worbin 2013) in order to explore textile expressions of smell. Although the yarn was dyed using a natural colouring method, the focus in this exploration was the dimension of smells, rather than colours.

Method

Tufting as a method to create a textile expression using 100% wool was used here. The yarns were dyed in different batches, resulting in variation in colour and smell intensities. Time was a major factor in this diversity, as the yarns were kept in storage for a long period before they were used. This visual and olfactory diversity is embraced in this tufted fabric sample, where various yarn ends were randomly combined.

Outcome

By tufting the yarns at variable distances, the yarns transcend from a more compact to a looser construction, creating interesting haptic textures, felt best when combing through the fabric with hands. Through physical interaction, the tufted yarns move and give way for the entrapped smell molecules to be present around.
Temporal textile forms

This exploration was performed at the knitting lab at the Swedish School of Textiles.

Aim

The aim was to translate the action of releasing smells through haptic interaction by designing and developing knitted textiles with integrated fold lines. When the fabric is laid flat, it automatically takes on a three-dimensional, folded form, suggesting an interaction based around unfolding that releases smells.

Method

This investigation followed on from an experimental workshop that explored various hand gestures and actions performed on natural materials to actuate smells. The action of unfolding and folding a textile was initially explored on paper in the form of sketches of three-dimensional textiles, with various origami methods being explored. Some of these were translated on the knitting software, wherein the lines of folds were crucial to investigating the automatic folding action. The fabrics were knitted using industrial knitting machines, with various stitch patterns and yarn materials explored in relation to enhancing the folding action. Through various iterations, it was then possible to define the folding pattern and combination of yarns that induced the optimal folding of the fabric.
In the final iteration, a pre-dyed moss yarn (Worbin 2013) was used in the spacer construction.

Outcome

Samples were developed through multiple iterations. The first of these were flat knitted fabrics with fold lines that had to be manually folded and reinforced to create a three-dimensional form as they lacked stiffness in the material and in the fabric. In the next iteration, yarns were changed and that provided greater stiffness, but these still lacked the body and were also unable to hold a three-dimensional form. The knitting structure was changed for the third iteration, using the technique of spacer fabric with fold marks to create three-dimensional design that maintained its form, but also can be made flat upon pressing and the geometry created was successful. The final iteration combined smell induced yarns and the spacer knitting technique, creating a temporal form imbued with smells that embodied the concept of playing with and intensifying smells through haptic interaction.
Exploring methods of actuating smells through touch

Can the sense of smell define an architectural space? Olfactive interactions at the intersection of architectural spaces and textiles

These exploratory installations were presented at the ArcInTexETN ‘Speculate, Collaborate, Define’ exhibition at the Textile Museum of Sweden, Borås held between March 23 and May 7, 2017.

The aim of this research was to explore ways of using smell as a design material in the creation of architectural spaces. Using practice-based design research tools and methods, the work was of an interdisciplinary nature within the fields of textiles, architecture and interaction design. This exploration used textiles as material for architectural space design and ways to design with smell. The resulting installations explore olfactive interactions by activating smells through touch or body movement. Surface textile processes such as impregnation, coating and printing, were used to investigate the applications of smell on the textiles. By using these methods, different textile expressions of smell for spatial interactions were proposed; these textiles were designed for interactions such as folding and unfolding, opening and closing, rubbing and pressing in order to activate and release smells.
**Sight of smell**

This illuminated installation focuses on smells that are released through interaction. Visitors are to walk among the strings and try to catch the balloons by holding the strings, causing smells to be released in the space.

Pic. 2: Interacting with smells

Pic. 3: Interacting with smells
Touch of smell

What does touching a smell feel like?

Visitors interacted with this installation by touching, rubbing, sticking together, and unpeeling the loose ends of Velcro tapes, and thereby releasing smells. The intensities of the smell could be experimented and played with, by varying the length of the tape and the speed at which they were peeled apart.
Play with smells

Conducted a workshop at the ‘Cross-over’ ETN 2017 conference in Borås, held between September 13 and 19, 2017. The participants of this workshop were; Christina Leitner, Qin Dali, Berit Hals, Krista Leesi, Fan Fengyuang, Sofia Hagström, Doris Gall-Schuhmann, Li Zhi, Teresa García-Muro, Melanie Greussing, Marisa Calduch, Chen Wenlie, Veronika Persché, Dorothy Wedderburn and Aune Tamaal.

Aim

The aim of this workshop was to create games that involved interacting with both pleasant and unpleasant smells by exploring different textile materials, shapes and forms. The workshop was intended to highlight the importance of the instinctual senses of touch and smell through physical materials.

Background

The idea of creating games was to provide a multi-sensorial experiences and playful interaction with textile objects and materials. It was to challenge and distract the attention onto something analogue in the midst of the fast, digital way of interactions of our current environments. However, sense of smell does not need a conscious attention, as smells around us communicate with us subliminally. These smells are interpreted subjectively based on individual experiences, and learnt associations, such as disgust or pleasure. The reaction or reflex to smells occur at the same time as other senses are stimulated. However, in order to make the experiences of smells more tangible, the interactions in the games were designed with the sense of touch, resulting in a near-synesthestic experience.

Instructions

The participants were grouped into five teams of three members and the two-hour workshop was designed such that interaction between team members was quintessential to make an object. In the introduction round, the participants had to ask one another questions about their likes and dislikes as regards memories and places visited in relation to smells, with the intention of focussing the groups with regard to the sense of smell and encouraging them to articulate their experiences as of unwittingly
perceiving the world around them through smells. After the introduction, each team was provided with textiles, which either possessed an inherent smell or had had a smell added to it, and was instructed to make an object using the textile and a selection of tools. Each team had a set time to understand and discuss the material they received within the group and create a narrative relating to the object created. Once the objects were finished, they were swapped between teams, without any accompanying information and each team had to guess the narrative and value of the smell of the created object, then give a short presentation.

One of the teams - consisting of Sofia Hagström, Doris Gall-Schuhmann and Melanie Greussing - created a roll-up mat for sitting on, yoga or wall decoration. Their narrative was allowing smells to interact with anyone, irrespective of impairment relating to sight. To this end, they used black and white strips of Velcro that were pre-treated and coated with micro-encapsulated smells, which had been used in a previous installation and so had dried glue on them (which was incorporated as an element of the pattern) to weave a mat that had both haptic and olfactive qualities.
Exploring methods of actuating smells through movement

*Smell, space and body movement*

This exploration was performed in collaboration with a dancer, Giedre Kirkilyte-Jankauskiene, at Vilnius Academy of Arts and presented at an exhibition at the VAA Gallery, Vilnius, held between November 28 and December 2, 2016.

**Aim**

This exploration investigated methods of actuating smells through body movement in a space. The dancer performed with the textile objects as a medium for smells.

**Method**

Two textile objects were designed and knitted on an industrial flatbed machine for this exploration, and several two metre by two centimetre sponge strips were prepared in a bath of tatami (rice straw) smell, dried at room temperature, and inserted into tubular structures. The first textile piece (a) is a knitted tube and four meters long by twenty centimetres wide. The second textile piece (b) was a four-meter long fabric consisting of three-centimetres wide vertical tubular structure alternating with a three-centimetres wide rib structure, running through the whole length. Polyamide monofilament yarn was used to knit the textile structures and the textile objects were made to be interactive. The first textile object - the tubular knitted panel - was filled with two bunches of sponge strips, each of which was tied together at one end. The tied ends of the two bunches were then attached together head-on, and drawn through the tubular structure, such that the sponge strips protruded from both ends. The second textile object was created by filling the tubes across the width of the knitted panel with sponge strips.
The Performance

The dancer picks up these free objects in the space and starts interacting with them. These interactions are done at two scales. And the following scene is taken as an inspiration for this exploration.

The same things at two different scales

Smells at different scales in a space in relation to the body

A scale that is near to the body

is reachable with hands and feet

allows interaction

A scale that is far from the body

envelops the body

in its dynamism

in its stillness

Fig.23: The performance using textile object (a)
Outcome

The two textile objects functioned as free objects in a space, and were not fixed at any point. The dancer interacted with these objects, creating an artistic performance by exploring the objects with regard to volume, shape, surface, size, and smell. She played with them, slipping, sliding, cuddling, curling, twisting, wrapping, fanning, pinching, pressing, releasing, rotating, and twirling, improvising her movements.

The scale of the first textile object allowed an interaction on the near-to-body scale, with the dancer improvising movements with the textile object as guided by smells. Her own movements in relation to the object and her breath moved the air and the smell in and out of her body and thereby guided her body. With the smells being pleasant the movements were flowed easily and had their own aesthetic.

This opens the question, of whether and how the movement of a dancer might be affected if the smells are not pleasant.

The scale of the second textile object opened up for interactions on the far-from-body scale in that the movements of the dancer were spatial. Through her movement in relation to the textile object the air in the space was moved and so the smells were too. The frequency – as to how often and with what intervals and the intensity- these smells were spread in the space with the movements of a dancer seemed like a smell orchestra in a space. Further explorations are planned to explore the movements and smells in space by designing the rhythm and pattern of smells as they get released in the space.
Fig. 25: The performance using textile object (b)
**Touch of a smell**

This exploration was presented during ‘everything and everybody as material: beyond fashion design methods’ conference at the Swedish School of Textiles, Borås, held between June 7 and 9, 2017.

**Aim**

To investigate how ‘sub-spaces’ are formed within architecture if smells are our only source of spatial perception. This was undertaken using everyday materials and actions, which were performed through different scenes.

**Method**

The performance consisted of a series of design experiments that were based on the improvisation and performance notes of Tufnell and Crickmay (Tufnell 1993). The text below presents re-written forms of the scenes, which focused on touch and smell. These scenes were translated into real physical experiments using objects that were designed for olfactory interactions. These were presented in a form of a performance together with the audience as an interactive workshop. The audience could decide what scene/s they wanted to experience.

**Scene # 1**

**Context**

In this scene, similar smells are present on different scales in relation to the body. On the near-to-body scale, a designed textile with olfactory attributes (material) was presented to the audience. This material was able to be moved and carried in a hand or other parts of the body.

On the far-from-body scale, the material was a smell that was presented to the audience in the space. This material was intangible and invisible, although its ambient presence was felt.

**Research question**

This scene investigated the formation of spaces through spatial interaction and the engagement of an audience with a material through olfactory attributes.
Method

The scale and quality of a material in relation to the body

The same thing on two different scales

Smells on different scales in a space in relation to the body

A scale that is near to the body

is reachable with hands and feet

allows interaction

by holding in a hand

by teasing with feet

by rubbing your back

A scale that is far from the body

envelops the body

in its dynamism

in its stillness
Scene # 2

Context
In this scene, the actions of carrying, placing, walking on and activating the smells all occurred simultaneously. These actions can be interpreted in multiple ways; for example, an object could be carried with one or two hands, on the head, or on the shoulders, and could even be dragged using the provided tools. The placement of an object varied based on the materials and their weight and volume. Visual estimations could fail the reality and this creates interesting patterns of smell activation.

Research question
How smells may change the patterns of movement? How various intensities of smell change a space?

Method
Let objects change you, how you move

Let smells change you, how you move

Let smells transform the interactions of you within a space

Let smells change the space

CARRY The jar

PLACE The jar near to you

WALK ON With the jar on the platform

ACTIVATE The jar by opening the lid
Scene # 3

Context In this scene, there were multiple actions and materials, many of which were bound to one another. The participants were not able to change one action for a material or vice versa. All of the actions happened simultaneously with all of the materials in the space. Within the given time, several ‘action materials’ were interacted with by one or more participants.

Research question This scene investigated multiplicity of smells in a space and thereby scales, patterns and intensity within a particular duration of time. This scene also explored whether these smells, when presented together, could create invisible boundaries within a space. How does a space change when these boundaries are blurred and begin to overlap?

Method Performance on material processes from day-to-day life routines are taken for activating smells.

filter out coffee

polish leather

squash lemon

stack lavender

spread garlic

dissolve essential-oils

tie flowers

roll up textile
Research programme and theoretical framework

This thesis has focused on using smell as a design material and began by exploring relationships between textiles, architectural spaces and interaction through smells. Through the methods and expression, olfactive dimension in textiles has been proposed as a new attribute in relation to designing textiles in the context of interacting in architectural spaces. As a result of the material explorations, this thesis proposes a theoretical framework for ways of designing textiles by adding an olfactive dimension. The connections between smells, textiles and spaces are demonstrated by relating the methods of designing with smells by textile design processes to the spatial qualities of smells when released through interaction. In conclusion, this licentiate thesis identifies two-way approach to designing textile architecture with smells; by adding smells as a design element to textiles and activating them in order to design and define spaces.

The design explorations investigated methods of adding a new attribute – smell - to textiles, in addition to known design elements such as colour, pattern, form and texture. In approaching smells in relation to parameters such as intensity, duration, drag and flow, the starting point of this research was investigating conventional textile design processes in order to add smell as a design element. The additive methods of printing, coating and dyeing textiles were experimented with using natural materials including moss and synthetic smell molecules.

Through the new knowledge gained as a result of experimenting with adding smells to textiles and investigating spatial qualities of smells, the question arose; how can we negotiate already existing smells in our living environment through design? This led to the thinking of designing methods of subtracting smells that would add to the spatial quality. This method of designing textile expressions of smell will be further explored in future research.
Knitting and tufting were used to create tactile expressions of smell. The ‘performative’ aspect of smells in these textile materials was expressed through the actuation of smells on different scales; that of the body and that of architecture. Furthermore, methods of activating smells as, as is discussed in reference to spatial installations above, were used to explore the spatiality of smells.

Actuating the smells in a space through touch and movement creates a potential for using smells as an interactive design materials: Can these interactions, however, be further explored to design adaptive spaces?

It is interestingly leading to think of chemo-signals, through which animals and also humans communicate (Semin 2014). If the spaces are designed using chemo-sensory actuators, these spaces could be made adaptive to the inhabitants and the smells.

How can time be used as a factor in designing textiles and architectural spaces using smells?

Through the design explorations, this question is explored. The expressions of a smell exemplify the dynamic nature of smells. In the design experiments, the textile
materials either possessed inherent smells or had smells added to express the spatial
qualities of smell in relation to the body and space. The attributes of intensity and
strength change as the time passes.

Design examples such as ‘smells defining spaces’ focusses on the interactive nature
of the expression of smells. This relates to smells in space, in that making a space
adaptive with respect to the body, it creates boundaries, opens or closes the space.
Adaptive spaces constantly change with time as smells move within a space.

Changing textile surfaces with the dimension of time is still a fairly new area of
research. However, designing textiles with smells is akin to being in a ‘time-lapse’,
wherein the attributes of smells leave its substrate (textiles) and make their presence
felt in the space around, leaving its traces for the coming times. The textile substrate
wears out on its visual and haptic quality but transcends in the dimension of smell,
however the drag or the residue of the smells still remain in the textiles, to make it
archaic and eventually memories and associations start to build up.

The value of smells in the design and design processes in some fields is more evident
than others. Design decisions are often based on the material in its totality. Varying
any aspect or dimension of a material has an effect on the design and related proces-
ses of a material. A leather designer or practitioner, for example, has a relationship
with the material and this is felt strongly in its smell, but what if real leather is
replaced with a skin prepared in laboratories that simply miss this materiality of
smell. It would not be out of the place to speculate, that the relation of a designer to
the material would be affected. The question however is, how will this be negotiated
in the field of design?

Moreover, what about the working spaces in which smells are quintessential? How
are these spaces designed? Which attributes are taken into consideration? Who gets
to design these spaces?

Conceptualising interior spaces through textiles by going beyond visual and graphical
representation and adding depth to non-visual dimensions - sound, touch and smell -
would enrich working spaces by opening up the aspects of looking beyond to what we
already see. Be ready to explore the existing materials by the way they can feel, hear
and smell.
We touch screens on our devices all day, but these are as flat as these can be. By being visually or auditorily stimulated at all times, we realize that we have over-worked these senses of vision and sound. Although, from the perspective of those with a visual or hearing impairment, the world looks, feels and sounds different. The language of communication strongly divides the able and differently able. Somehow, in most of the design fields, we have cared more for the sense of vision and sound and have left the other senses unexplored.

Textures, can constitute artistic expression or non-verbal language and function as a tool for communication. They can be equally enjoyed by those with and without impairment of the visual and/or auditory senses and are used in the form of Braille as a language for the visually impaired. If an equivalent language for smells could be developed through a textural representation, perhaps by by-passing the social codes and taboos, some tactile vocabularies could perhaps be developed and be used to describe a perfume, for example.

The conclusions drawn through the thesis encourages and suggests the potentials of sensory-sensitive thinking in terms of designing with non-visual materials. This licentiate thesis opens up a dialogue that spans the volatile and dynamic nature of smells and their representation and communication through tangible methods of designing responsive spaces for interaction.
DISCUSSIONS
Design explorations and further research

The design experiments described in this thesis focussed on understanding smells as a material attribute, their value in the (design) objects and materials around us in everyday situations within the context of spatial design. The research explored materials with both inherent and added smells in order to focus on this dimension of the materials. For this reason, the design experiments are consciously conducted keeping the visual attributes of materials, such as colour and pattern as neutral as possible. Experimenting through the materials and making, the initial phase of research was based on exploring smells for their intensity, duration, drag, portability and flow. Through the process of making, how smells as a material attribute react and changes in terms of its presence or absence during the final stages of the development of a product – as well as beyond this process- was investigated. Designing with smells and textiles was the focus of this research. Textiles become the holding thread and expression for the spatial qualities with a dimension of smells. Designing with smells in this research was planned in two-fold direction; using additive methods (which is covered within this licentiate thesis) and subtractive methods (which will be undertaken in the future). Parallel to exploring the methods of adding or removing smells, the research is also investigated methods of actuating smells through interaction either by touch or body movement.

In these investigations, the scales of a space, smells and interactions were reflected on. When a material required physical interaction, it was defined as being on the near-to-body scale. If the stimuli were environmental conditions - changes in moisture, temperature or light- or spatial movements, the diffusion and dissemination of smells was ambient and so it was defined to be on far-from-body scale.
Smells and textiles

The experiments that involved using additive methods explored ways of incorporating smells in textiles and were conducted using smells in natural materials and synthetic smell molecules. The conventional methods of dyeing, printing and coating textiles were used to add smells to fibres, filaments and yarns, which were used to create woven, knitted, and tufted textiles. Natural smells, added using plant dyeing methods, have the advantage of smelling authentic. However, this lacks discretion. Smells being present all of the time poses a challenge for designing. Further experiments conducted investigated ways to design expressions of smell that are not obtrusive and that the diffusion and dissemination of smells could be designed responsive to stimuli. These additive methods were explored as described in this thesis using micro-encapsulated smell molecules, when applied to the textiles through coating or printing can be activated by rubbing the textile material and thereby opening up the encapsulations locally. This application method of smells is discreet and it requires a physical interaction with the textile object, however, on the scale near-to-body.

In investigating tactile stimulations and textures as a method of diffusing and disseminating smells, tufted textiles were created by adding the dimension of smell to yarns. By adding tactile textures to the otherwise smooth interior surfaces of a soft membrane exteriors, Petra Blaisse in collaboration with Rem Koolhaas, created an unusual experience for visitors to perceive the entire building in its tactile form (Quinn 2010). Experiencing an architectural space through textures is interesting, however, adding smells to such a space would provide another dimension of materiality. Utilising sensory sensitive information (Lally 2013) of near environments such as living and working spaces and perceived through our bodies and skins is the next step in designing spaces that extend beyond the physical boundaries of architecture as we know it today.

Further research in the area of additive methods would explore the possibilities of the local diffusion of smells. This could be achieved by designing interactive mask onto the textiles, by three-dimensional printed additive techniques on textiles. Substrate materials and printing filaments, based on their adhesive properties (Pei et al. 2015), could be explored to create texture-based masks for textiles as actuators of smells, and these masking patterns could be individually activated by temperature, moisture, or light to diffuse smells. Masking using intarsia knitting and three-dimensional flat-bed knitting techniques technology is also planned to be explored.
Smell and body

Examining designed interactions on the near-to-body scale involved haptic explorations, leading to thinking about how textures and forms might represent and express smells. Experiencing sense of smell through the sense of touch almost leads to a synesthetic experience. As Jones suggests that ‘synaesthetes experiences a sensory stimulus through another powerful perception. Could be visual but often it’s a smell or tactile sensation that is easy to remember but difficult to describe’ (Jones 2006).

Design experiments related to touch, techniques of origami were investigated in order to design textiles with a ‘built-in’ interaction method of unfolding/folding. Replicating origami folds through knitting have been far from being simple, but this research has been successful in creating several folding methods. The temporal textile forms require further investigations for scaling up the idea by adding smells to the materials using either natural or synthetic smell molecules. Further research in this area is planned through an interdisciplinary collaborative project, using hollow fibres (Leal et al. 2016) filled with smells, responsiveness of the fibres through touch, body temperature and ambient room temperature for diffusing the smells will be investigated.

The installation Sight of smell, which used ribbons as ‘space opener’, had a soft layer of interaction as, through touch, the smells printed on the ribbons were diffused in the space. Tricking the sense of vision through the strong lights within the hanging balloons, kept the curiosity of the visitors in that space. Once within that contained space, the unexpected dimension of smell became apparent. ‘Hitoshi Abe has also experimented with the concept of flow in the form of layered, perforated surfaces—as well as interlinked, topological spaces or “ribbons” that facilitate smooth physical transitions’ (Brownell 2011). Although, this expression of smell intrigues the senses and opens up the space for not only the soft transitions of movements through it but also for the interactions in the space through the tangible expression of smells.

On touching the soft side of the Velcro tape, the reflex of an action is attaching the loop side of Velcro to it, in the context of clothing as an element defining closures. However, in the installation Touch of smell, velcro tapes were used to open rather than close a space. The Velcro tapes were coated with micro-encapsulated smell molecules and were attached to one side of the corner on the wall but its other half was attached onto the other side of the corner. To symbolize, that, it is not a closure
but a space defining element, corner walls were selected. The peeling interaction of the Velcro tapes was only possible across the walls where in between opposite side (loop/soft) was hanging half un-glued. This led to a visual chaos through criss-crossing of the tapes. Visitors constantly interacted with the Velcro by peeling it apart, diffusing the smells and creating a space within the gallery. By changing the scale, the purpose and the context of a two-dimensional material created an unexpected three-dimensionality; a space through the smells. This related to the aims of Sophie Mallebranche: ‘[M]y challenge is to create three-dimensionally with a material that is often regarded as two-dimensional […] I believe in extending the boundaries of textiles far beyond functionality’ (Quinn 2010).

Smell and space

Performance is temporal; it happens in a moment. The flow of time continues but the movements cannot be traced back; the performance becomes a memory. Once encountered, a smell remains as a memory of a moment in time, a place, an event, or a person. This was the core concept for the performance Smell, space and body movement. Through the traces of smell, movements can be generated or used as non-visual cues for navigating through our daily living spaces. If we step outside the realm of artistic performance and apply this concept to the future ways of living, we can posit smells as a means of navigating through urbanscapes for both visually able and impaired, including those whose sensory perception is strong or who wish to train their abilities of smelling places. As a future research, this could be explored by developing ‘smell maps’ layered on digital street maps. Adding the dimension of smells to the maps for browsing the cities would make it more interactive and attractive especially for pedestrians and cyclists, and add quality to ways of living within urbanscapes.

The performance Touch of a smell opened a dialogue regarding perceiving spaces through smell. Here, performance is used as a method of defining spaces without any fixed visual boundaries. This is a provocative approach to highlighting changing and unfamiliar smellscapes in our neighbourhoods, workplaces and public spaces in reference to mobility; either forced or wishful. The idea behind the performance was to create invisible boundaries in close proximities and create a dialogue regarding negotiating these boundaries.
Following on from this exploration, further research will focus on designing textiles for spatial applications that are responsive to smells in the environment. The idea is not to ‘re-make’ smell neutral spaces, but to apply the architectural concepts of absorbers, dividers and reflectors to smells. This research is based on the possible applications of chemical sensors and nanotechnology in textiles and membranes. The possible application of these textiles could be in health care institutions, clinics, hospitals, public spaces and so on.
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