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A Visual analysis of the smart home

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Abstract

To date, studies related to the smart home have often focused on the technical aspects of the home. Few have given attention to how ‘smartness’ is reconfiguring a sense of home and how these changes may be identified in the smart home’s visual signatures. This research closes this gap in the current literature by mobilizing a visual methodologies approach comprised of content, compositional, and semiotic analysis to identify whether and how visual representations of the ‘smart home’ in architectural trade publications reconfigure understandings of the meaning of the "home.”

The outcomes of this research are a typology of smart home aesthetics, and a theorization of how these aesthetics as inform how the smart home is reconfiguring meanings of the home. Based on this typology, this research theorizes what image-based representations of the smart home represent ‘home’ to be, and how ‘smart’ aesthetics reconfigure the home as a site for social relations, intimacy, and leisure. This case study sheds light on the various meanings behind smart home images in architectural trade publications, as well as how they represent the concept of ‘home’. This research shows that there are two modalities of smart home images: i) smart home images with visible technology, ii) smart home images in which technology is hidden. My semiotic interpretations of these images find that images in both of these categories are doing two works simultaneously. On one hand, images of smart homes where technology is visible function to build readers’ trust in the ‘smart home’ concept by visually confirming that they are still homes in the traditional sense of a ‘home’. On the other hand, in images where smart home technologies themselves are invisible, sparse furnishings and minimalistic design aesthetics

depict ‘smart homes’ as domestic spaces where smart technologies have already taken care of all the messiness, chaos, and housework that is often associated with ‘home’.

Keywords:

Content analysis, compositional analysis, design aesthetics, home, semiotics, signs, smart home, visual methodologies

Summary for Lay Audience

‘Home’ is a concept that most individuals are very familiar with; however, a smart home is a more recent development. A smart home is a space designed with minimal and modern design features. Minimalist design aesthetics include using simple materials and smooth surfaces, basic ornaments, lack of extra furniture, and usage of new technologies in space. Smart homes are also characterized by everyday digital gadgets that operate many aspects of the home, from coordinating and automating systems such as lighting and heating. Homemakers and architectural designers attempt to introduce the smart home concept as a new living space to the public through mass media publications, such as magazines and websites.

Today’s research regarding smart homes often focuses on technological aspects of the home, but few studies elaborate on the changes that these smart home illustrations may cause to the understanding of ‘home’. This study aims to analyse smart home images in architectural trade publications to develop a typology of smart homes based on their design aesthetics. Furthermore, my research clarifies how the meaning of home is expressed through smart home images and the shift in the home's meanings. I collected smart home images from different architectural magazines and websites to be analysed through visual methods, including semiology, content, and compositional analysis. I used semiology to study signs and what they signify in images. The content analysis focuses on the content of images and compositional analysis concentrates on the composition of images and on how elements of an image are framed. This research reveals that there are two modalities of smart home images, smart home images in which technology is visible and where technology is hidden. My interpretations of smart home images showed that these categories are doing two jobs. Images of smart homes with visible technology operate to

build viewers' trust in the 'smart home' concept by visually reaffirming that they are still conventional homes in which to relax, feel comfortable, and socialise. Simultaneously, in images where technology is hidden, minimalistic design aesthetics portray 'smart homes' as households in which smart technologies manage the chaos and housework at home.

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Co-Authorship Statement

My monograph-style thesis results from collaborative efforts, including contributions to project design, methodology, and writing by my Supervisor, Dr. Leszczynski, and committee member, Professor Streeter. Dr. Leszczynski and I developed the project idea jointly. Dr. Leszczynski suggested the visual methodologies framework, and Professor Streeter suggested the semiotic analytic approach, and I obtained significant feedback from him on its implementation. I am solely responsible for data collection and the execution of the analysis methods. My analytic findings are my own, but Dr. Leszczynski contributed to their interpretations. She also contributed to the writing of the thesis through substantive edits, the provision of some key language, and suggestions for rewording across passages of the text.

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Chapter 1: Introduction

1.1 Background

This research examines whether and how smart homes, as portrayed in architectural trade publications, may be changing the definition of home. At the end of the 20th century, many households in developed countries were connected to information outside the home via personal computers (Harper, 2006). This set the stage for the development of what we today refer to as the 'smart home'. A 'smart home' is characterized as a residential space infused with computer and information technologies, including connected devices or 'smart' objects associated with the Internet of Things (IoT) (Maalsen, 2020), that predict and respond to the requirements of their residents, striving to enhance their comfort, convenience, and entertainment through the control of technology inside the home via links to the outside world (Aldrich, 2006; Harper, 2006). The rhetoric of the 'smart home' suggests a contemporary meaning of the home as a fully technological environment: a residential sphere that is defined by the technologies that facilitate it (Chambers, 2016; Morley, 2002).

Although we may think of the 'smart home' as a recent development, the first 'smart house' was envisioned by the American Association of Home Builders in 1984, when they established a specialty group to lobby for the incorporation of various innovations in new home construction (Harper, 2006).Buildings, electronics, architecture, energy conservation, and telecommunications were the main areas of interest. In this regard, the Council of Industrial Design (COID), was created in 1944 by design reformers under the Britain Board of Trade to promote improved standards of design and enhance interior design in homes (Woodham, 2004). In order to reach the public, COID participated in a variety of open shows, including the Post-War Homes

Exhibition from the Daily Herald newspapers in 1945 and the Modern Homes Exhibition in 1946 (Chambers, 2016). The goal of COID's campaign was to raise the standard of design in both industrial and residential settings. Designers curated these exhibitions to influence and shape public taste in regard to upgrade interior design in homes (Pink et al., 2017; Woodham, 2004). These public displays aided the "normalization" of media technologies at home (Ellis, 1982, p162).

The largest international exhibition of this kind was held at the US New York World's Fair from 1964–1965. This event was designed to showcase mid-twentieth-century American culture and technology (Chambers, 2016, 2019; Pink et al., 2017). These Ideal Home Exhibitions validated the imaginaries of the 'ideal home' as a technologically advanced, spacious, and glamorous space packed with domestic appliances such as televisions (Chambers, 2016; Pink et al., 2017). Public events of this variety had a fundamental influence on the 'standardization' of media technology in the home (Ellis, 1992, p. 162). They advanced the idea of 'domesticating' technology in the 1980s and 1990s to demonstrate the association between the meaning of the home and the political economy of the household (Silverstone 2006, p. 242).

The first smart homes to be designed and actually constructed initially appeared in the United States, Japan, and Europe between the 1980s and 1990s (Chambers, 2016). At the same time, what we now refer to as the 'smart home' began to establish itself as a concept in popular culture in the 1990s when lifestyle publications, including *Vanity Fair* and *House Beautiful*, published stories on smart homes (Chambers, 2019; Pink et al., 2017). Like the earlier exhibitions which staged the smart home for in-person audiences, these publications played a crucial role in normalizing the smart home. They portrayed intimacy and belonging as being part of a nuclear family living in a detached, technologically advanced home to promote the smart home through

media, public policy, and commercial graphics (Pink et al., 2017). By the end of the 1990s, a wide range of media – including other lifestyle magazines, architectural magazines, newspapers, and computer periodicals – were showing images of how computers and smart devices could be coordinated into domestic family agendas (Chambers, 2020). This mass media, particularly architectural journals, and websites, ushered in the digital mediatization of the home and celebrated architects' and interior designers' addition of information and communications technologies (ICTs) into prominent spaces within the home (Pink et al., 2017).

McQuire (2008) argues that the spatial experience of contemporary social life results from a nuanced process of co-construction of architectural elements and urban environments, social behaviours, and media cultural representations. People build opinions based on what cultural representations are offered to them, which is similar to how the public perceives things (Oliver et al., 2019). The media includes every broadcasting and narrowcasting medium, such as television, radio, newspapers, billboards, magazines, and websites (the main means of mass communication) (Mehraj et al., 2014). To date, magazines are increasingly more than just print publications; they are brands backed by a plethora of media outlets (Bolduc-Gosselin, 2018). Architectural design aesthetics and their visualization play an important role in introducing and normalizing the smart home for readers. They not only signify the meanings of "smartness" to audiences, but also express how a sense of home can be experienced in a smart home. This thesis aims to contribute to and address the research gaps in the study of how smart homes are visualized in architectural trade publications and how these visualizations enact changes in the meaning of the home.

Yet to date, how smart home concept is visually represented in architectural trade publications has not been examined. Studies related to smart homes have instead

overwhelmingly focused on the technical aspects of the home, as well as gender roles, energy consumption, and users' privacy. A comparatively limited amount of research attention has been given to how 'smartness' is reconfiguring a sense of home, and how these changes may be identified in the smart home's visual signatures based on architectural and design representations in mass media. This thesis moves to address this gap by examining the linkages between the aesthetics of smart homes as represented in architectural trade publications and shifting social and cultural definitions of 'home' advanced through these representations.

1.2 Research Questions and Objectives

This thesis poses and answers three main research questions:

- How are smart homes portrayed in architectural trade publications?
- Are the aesthetics of the smart home, as constituted by visualizations in architectural trade publications, representative of a changing meaning of the nature of the home ushered in by smart home technologies?
- If so, how are these visualizations reconfiguring the meaning of the home?

I answer these research questions by analyzing a selection of 360 smart home images published in architectural magazines and websites over a three year period. These images were identified as being representations of smart homes on the basis of image metadata, figure captions, tags, and the titles of features and photo essays published in these architectural media outlets. Additionally, the published texts of magazines and the website referred to these images as "smart homes."

To identify the aesthetics and meanings of home expressed by these images, I mobilized a visual methodologies approach to my analysis. A qualitative research approach called Visual

methodology uses artistic media to generate and convey information (Banks & Zeitlyn, 2015; Rose, 2016). A vast source of knowledge that can accurately depict reality is offered through media (Emmison et al., 2012; Rose, 2016). Visual methodologies offer on orientation analytically approaching, thinking about, and interpreting visual culture, which understands culture to be produced by and through visual objects ranging from archival photography and film to websites and social media (Rose, 2016).

Specifically, in this research, I conducted visual content, compositional, and semiotic analysis of my selected sample of 'smart home' images through the iterative qualitative coding of my image data. Visual content analysis is an observational method used to identify how a given visual media represents people, events, and situations (Clifford et al., 2016; Flowerdew & Martin, 2005). Finding frequencies, relationships, and variations in what is being shown is the goal of applying content analysis to examine images from smart homes (included in images). In compositional analysis, analytical attention is put on the formal qualities of images – such as their arrangement, and design aesthetics - rather than their contents, social construction, or cultural effects (Hook & Glaveanu, 2013). Through compositional analysis, meaning is inferred when visual components are analyzed and described. The content and compositional analyzes revealed two dominant modalities of smart home imagery: i) those in which smart technologies are visible, and ii) those in which technologies are hidden.

Within both of these categories, I submitted a selection of the images in my sample of images to further semiotic analysis to identify how image elements and aesthetics function as signs and signifiers of 'home' in smart home images, and the meanings of home that they express. Visual semiotic analysis is the study of signs and how signs make meaning in relation to other signs within an image. In the compositional and semiotic phases of analysis, I also analyzed a

representative image of a ‘typical’ *non-smart* home and used this as a basis for identifying how smart home images may be informing shifting understandings of the meaning of ‘home’.

1.3 Summary of findings and contributions of this thesis

The results of my analysis make three unique contributions. First, the results of my content and compositional analysis inform a typology of smart design aesthetics. Second, my semiotic analysis of a subset of the images in my sample identifies how new and altered meanings of home are expressed and conveyed by visual representations of the ‘smart home’ in architectural trade publications. And third, the findings inform my building of connections between the new understandings of home and cultural assumptions related to smart homes and non-smart homes. Furthermore, visual analysis of smart homes as a research project contributes to and intervenes in key debates in literature towards addressing the gaps regarding how smart homes are visually represented in mass media publications specifically architectural trade publications. It also addresses how ‘home’ is represented in two modalities of smart home images. Last, this study elaborates on the role of smart home images as active agents which contribute to acceptance and alienation of the smart home concept. Findings of this research show that smart home images in which technology is visible mobilize the aesthetic signatures of a non-smart home in terms of design. Smart home spaces in this category of images are densely furnished with various personal and decorative items. Inhabitants have control over smart home functions through numerous smart devices located in different spots at home.

The visual representations of these smart living spaces bring trust and confirmation to the viewers that it is still home in a conventional sense, where inhabitants can relax, socialize, be entertained, and work. On the other hand, smart home images where technology is hidden are

portrayed by minimalist architectural design aesthetics. These smart spaces are pristine, sparsely furnished with a few numbers of minimal furniture, and there are no signs of smart appliances in the home environment. In this category of images, the hidden smart technologies are not only employed to solve and fix the chaos and messiness at home but also take care of all the housework and dismiss occupants' menial tasks.

Moreover, it is important to assess the diverse roles of the home introduced through visual significations of 'smartness' and sense of 'home'. This research elaborates on how smartness and senses of home are signified in smart home images through aesthetics, contents, compositions, and signs in both identified categories of images (smart homes in which technology is hidden and the ones where technology is visible). Furthermore, analyzing smart home images through coding the contents, compositions, and interpreting signs in images reveals that smart home images published in architectural magazines are continuously changing the meaning of the home over time.

1.4 Thesis structure and organization

This thesis is comprised of seven chapters. Following this chapter, the Introduction, **Chapter 2** is a literature review chapter. **Chapter 3**, the methodology chapter, identifies the sampling methods and rationale, elaborates on visual methodologies – including visual content, compositional, and semiotic analysis - and explains how these methods were used to analyze my image dataset. **Chapter 4** presents the results of the content and compositional analysis of all images, and **Chapter 5** presents a detailed semiotic analysis of a selected subset of 12 images drawn from the larger sample of smart home images. **Chapter 6** discusses the significance of the analytic findings as they relate to how the meaning of the nature of the home is reconfigured

through smart home visualizations in architectural trade publications. The conclusion chapter, **Chapter 7**, identifies the limitations and contributions of this research, and directions for future studies related to smart home visual analysis.

Chapter 2: Literature review

2.1 The nature of the "home"

The meaning of the term 'home' is expansive, for instance, in geography, the home is seen as a material and an imaginative site of lived experiences described at different scales of the community, household, nation, and state (Chambers, 2020). More than merely a location, home confers meanings of a comfortable, safe environment in which to relax, be entertained, and communicate (Intille, 2002). In human geography, the home has been conceptualized as a place of shelter and privacy and for socializing with others (Lindahl & Kirk, 2019). It is the physical "setting through which basic forms of social relations are constituted and reproduced" (Rykwert, 1991, p.58). In this sense, home is a "socio-spatial system" that represents the union of physical and social units (Rykwert, 1991, p.58). Furthermore, human geographers have clarified that the home is fundamentally a site of harmony between inhabitants and the environment (Chambers, 2016). Consequently, residents spend remarkable amounts of money, emotional energy, and time to shape homes into living spaces that meet their needs for communication, health, entertainment, work, and leisure. (Intille, 2002).

A home is a space where the concepts of individual and family interconnect with one another. At home, individuals assume they can rest without being disturbed and stay comfortable even when doing nothing (Kraybill, 2005). Moreover, a home has an important meaning in terms of an individual's relationships with other family members (Mallett, 2004). In this way, individuals need to receive physical and emotional unwinding and comfort at home, along with social support (Pink et al., 2017). Blunt and Varley have proposed that the "ideas of home" can "invoke a sense of place, belonging or alienation that is intimately tied to a sense of self" (2004,

p. 3). Lefebvre (2014) notes that the production of space, such as the 'home', can be viewed as three interconnected criteria: "perceived", "conceived", and "lived" spaces. First, the idea of "perceived space" within the creation of space emphasizes the notion of space as an intrinsically "social" product (Lefebvre, 1991, pp. 68-85). Perceptions of space are intertwined between imagined and lived spaces. Second, "Conceived space" can be captured through the portrayals utilized by experts such as architects, engineers, and urban designers to describe a space (Lefebvre, 1991, pp. 68-85). Finally, "Lived space" is an experienced space encompassing the spatial depictions that individuals develop to create meaning in their everyday lives. In a mediatized world, these three types of spaces are interconnected (Chambers, 2016, pp. 11-12; Lefebvre, 1991, pp. 68-85). Blunt (2006, p. 3) argued that the "material and imaginative geographies of the home" are produced not only as lived experiences but also as imagined physical spaces and cultural meanings imbued with feelings.

In addition, the social sciences and humanities bring up differences in domestic life, for example, the ways that material cultures are related to the making of everyday life in the home. Pink et al. argue that the home environment is processual (Pink et al., 2017). This viewpoint is instructive because it permits us to consider how the home is ongoingly reconstituted, and what processes, actions, and things it can involve. Moreover, it is concluded that knowing the trends of everyday life is important to understand how the home is constituted, and ongoingly made, renewed, and transformed (Pink et al., 2017, ch. 3). It is also inferred that the inserted different roles of today's media and communication technologies assure media has become an aspect of private life and entertainment; the home is being transformed by technological changes (Morley, 2002).

It is also critical to consider a home as a site for design since homes are made – or "unmade"– not just by designers and homemakers, but in addition to the relationship with their residents (Pink et al., 2017). Aesthetics provides the connection between the architectural design of the home structure and the living space of its residents (Goldblatt & Paden, 2011). The aesthetics of the home have been associated with the inhabitant's satisfaction with the housing environment (Darke, 1982; Francescato et al., 1979). The primary aspects related to aesthetics of the home were discovered to be based on the personalization of façades and open spaces, quality of materials, furniture, harmony, and organization of private spaces (da Luz Reis & Dias Lay, 2010). This idea is evident in a comparison between the works of modernist architects such as Eileen Gray and Le Corbusier, each an important modernist architect and designer. Both architects understood a house as a space for living, but Gray's conception was inspired by human ecology and fulfilling residents' expectations and needs of the home through a symbiosis between the landscape, space, furniture, body, and soul. In contrast, Le Corbusier's conception depended on a machine and an engineering-centric model focused on exposing the structure and façade rather than the interior. Gray's home designs, while lacking the visual power of Le Corbusier's, show a more nuanced understanding of the habitual dimensions of life (Goldblatt & Paden, 2011). Le Corbusier portrayed houses as machines for living in. He designed them not for decorativeness and beauty but as unadorned structures that supported technological advancements, new materials, and functional design (Chambers, 2016, 2020). Thus, the new role of the home is represented by shifting the home from a place of beauty and decorativeness to one of productive and functional space (Forty & Cameron, 1986; Sparke, 2008).

2.1.2 When technology enters the home

Digital technologies, media, and communication are entangled with everyday life in the home. They have assumed a significant part in creating a sense of home in terms of atmosphere and familiarity with the technological environment (Chambers, 2020). Familiarity assumes a significant part in diminishing complexity in navigating the digital environment, and in creating a feeling of comfort (Kaplan, 1983; Zhang et al., 2019). The feeling of familiarity with technology assists individuals to remember their experiences and past feelings related to technology usage (Zhang et al., 2019). Besides, the atmosphere is something spatial (Valerio, n.d.). It can be depicted as a mood-defining space (Böhme, 2021). A study based on the experience of atmosphere in the home identified four dimensions that contribute to feelings of pleasantness experienced by members of a family in the spaces of the home: socializing with each other, relaxing after work, being allowed to do what one wants, and being occupied/absence of boredom, and home aesthetics (Pennartz, 1986). Therefore, design characteristics and technological advancements play important roles in creating a home's atmosphere and in how these spaces are experienced.

The contemporary home has long been transformed by and for technological change (Morley, 2002). In the mid-20th Century, a series of Ideal Home Exhibitions were held in UK and US (1939–1950) and played a critical role in introducing television into the home, generating tension between primary conceptions of the home as a functional versus ideal space, and between comfort versus efficiency (Chambers, 2020; Madigan & Munro, 1999). The versions of the home at these exhibitions represented a new, modern and advanced media home that informed imaginaries of the 'ideal home' as a spacious and stylish space packed with new technologies that satisfy inhabitants and provide a convenient form of life for them (Chambers,

2016, p. 13, 2020; Saizmaa & Kim, 2008). Architects also played a major role in the placement of TV as a new technology that enters the home. In this case, stylized living rooms were designed with a room layout ideal for television viewing positions and to conceal the set when turned off (Orr, 2016). Television observers were regularly envisioned in the advertising as the 'family circle' gathered around the living room console in sentimental poses (Spigel, 2001). The idealized home is advertised through media, public policy, and commercial illustrations by portraying intimacy and belonging as a nuclear family in a detached house (Pink et al., 2017). These imaginaries of the home provide us with visions of what the home should be. In this regard, the meaning of home is made not only by the home itself but also by its imaginary occupants. This renders an image that the home is an ideal domestic space with characteristics that depict a perfect life (Chambers, 2016). The combined endeavors of designers changed the TV from a machine into a domestic cultural item fit for an "ideal home" (Chambers, 2019, p. 93).

A re-assessment of the home as a modern but private domestic space was commissioned by the ascent of suburban homes designed for the small, nuclear family, and supported by a range of appliances that expressed technological advancement (Pink et al., 2017). This modern home represented a new discourse of domestic modernity in the early and mid-20th Century. Simultaneously, the rhetoric of domestic modernity included powerful ideas regarding the home as an isolated space of self-improvement and stability within nineteenth-Century domestic cultural values (Chambers, 2020). It extended the meaning of the home from a position of protection to an image of scientific advancement that introduced a technologically efficient space for numerous recreation and work-related activities (Chambers, 2016, 2020). As such, television's placement in the home was pre-planned and conveyed in illustrations by a new type

of home; this was a modern and advanced media home, regardless of its depiction of traditional family values. Television offered householders opportunities to attach their home to the world outside and transform domestic cultures (Pink et al., 2017, ch. 4).

On the other hand, media is utilized by families to divide activities according to the fitness of the space or timing in which they are used (Chambers, 2016). Moral decisions are involved in the type of media and technologies chosen to support the intimate connection between inhabitants and home (Miller & Madianou, 2012). These moral decisions are related to several points, including how media are utilized to boost family and household connectivity, control children's media usage, and how media are utilized to help individual media-related followings in the home (Chambers, 2016). Importantly, the fusion of interactional technologies into the everyday lives of the households shifts the temporal rhythms of home life (Hamill, 2011). Mobile media technologies are generating new ideas, experiences of home, and personal life and alter the temporal routines of home life (Chambers, 2020). For instance, Ward (2006) found that family members allotted a position to the computer within a structure of domestic meaning by organizing home life around zones of "work" and "leisure." It is claimed that assuring that families would welcome strange objects into the intimate environment of the home relied not only on the current domestic circumstances but also on the lifestyles of the families. It also depended on material design, commercial marketing, architectural trade publications, and television advertisements before the technology's entrance into the home (Chambers, 2016).

Since the turn of the 21st Century, households have seen a transformation in the variety and number of digital technologies in the home, as well as in the ways that people interact with and use them (Dorai et al., 2018). Information and communication technologies (ICTs) have been repositioned from an external to an internal feature of the domestic environment, extending

the range of the home further than the “brick and mortar” (Dewsbury et al., 200, p. 132). The term that supports the notion of home beyond the brick and mortar is the Internet of Things, which describes the proliferation of internet-connected objects, or “things”, that may communicate with humans and other objects over networks (Carretero & Garcia, 2014). It has been predicted that IoT devices will be used in almost every home in the developed world by 2022 (Akinbi & Berry, 2020). Within the Internet of Things, users can use electronic tags to connect home appliances to the Internet and remote monitor and manage them outside of the physical spaces of the home itself (Dorai et al., 2018). Consequently, IoT systems play an important role in the emerging smart home environment. The suffusion of technology in the home has resulted in domestic spaces taking on various functions, such that the home is now serving as a place not only for comfort but also as a control center (Kennedy et al., 2020; Tirado Herrero et al., 2018), a space of new forms of labour (Strengers & Nicholls, 2018), and a place of technological consumption and production whereby the home accumulates, produces and transmits information in vast quantities (Kennedy et al., 2020). The idealization of this private area is formed via picturing the home on different scales, including categories of material and discursive procedures desired and constructed by commercial homemakers (Chambers, 2020).

Moreover, the incursion of the IoT into the home is informed by and contributes to visions of domestic futurity – defined as “a cultural condition in which the home space is increasingly mediated by platforms, technological products, and informational logics” (Woods, 2021, p. 2). Cowan (2018) argues that domestic technologies have the potential to make remarkable alterations in social relations and the physical settings beyond and within the home. These changes occur within the form of an adaptable and modern domesticity, which integrates

cultural changes that lead to envisioning the home through technological innovations such as the concepts of the “smart home” (Chambers, 2020; Woods, 2021).

2.2 The smart home

Smart homes and their definitions are numerous in the academic literature, and one cannot yet identify a single accepted definition. To represent an overview, a smart living space may be considered a ubiquitous processing application (Alam et al., 2012), which coordinates advanced communication, sensory, control technologies, and automation (Vimarlund & Wass, 2014) to form a smart and context-aware domestic environment (Alam et al., 2012). An additional commonly used definition of smart homes, based on its technological frame, is a home that entails the use of technology to support devices and systems to be controlled automatically including smart speakers and voice recognition devices, smart thermostats, smart lights, smart kitchen appliances, smart security devices, etc. (Kidd et al., 1999). Smart items and smart home systems are fully connected and systematically incorporated to provide suggestions to the user or automatically control the home’s functions (Schiefer, 2015). With these smart home advancements, people are expected to have additional opportunities to unwind and do fewer routine tasks (Maalsen, 2019). The stated aim of smart home innovations is to improve the quality of life by making routine activities at home more intuitive, convenient, efficient, and faster through automation and design solutions (Saizmaa & Kim, 2008). The smart home extends the meaning of the home from a space of refuge to a site of scientific advancement that introduces technological efficiency into the domestic sphere to support numerous recreation and work-related activities (Chambers, 2016, 2020). The social science literature on smart homes calls into question the very notion, as well as the location, of ‘smartness’, rather than developing

smart technologies which automate decision-making for essentially passive users. They strive to position smart home inhabitants as active agents in the lived construction of the home, and to place them in control of smart home technologies (Hargreaves & Wilson, 2013).

The concept of ‘smart’ describes the beginning of an innovative shift spurred by technological promises of a safer, healthier, more convenient, and more effective way of life (Figueiredo et al., 2019). Even if the concept of ‘smart’ has been associated with the digital domain and expressed in the most abstract terms, the underlying presumptions continue to find their most tangible representation in the way it applies to alter how people, cities, and habits are structured (Lara et al., 2016). It unites a wide scope of various challenges, timeframes, spatial scales, and technologies (Figueiredo et al., 2019). The built environment, as we know it, is currently undergoing a drastic upheaval and transitioning to become ‘smart.’ While the world is growing ‘smart’ – from smart surfaces to smart grids, from smartphones to smart citizens – the built environment has been where the pull of the ‘smart’ paradigm has been felt the most (Figueiredo et al., 2019). This is done by integrating various digital devices and networks into the buildings.

The architecture of a smart home is based on various factors, such as engineering, sensor technology, communication, and information technology (Alam et al., 2012). Accordingly, the approach to the conception and development of smart homes exceeds the principles of a simple home design process (Popescu et al., 2018). Supported by the cultural confluence of magazines, advertising, fairs, exhibitions, and demonstration houses (Aldrich, 2006), early smart homes were architectural imaginings of what home life may look like in the future. These were initially affected by the modernism of the 1920s and 1930s, featuring exposed structures, technological advancements, and effective designs such as terraced views of the outdoor environment and

expansive windows, which blurred the lines between interior and exterior (Chambers, 2016). The current smart house concept also expresses advanced modern futuristic aesthetics and architecture centered on minimalism and design elements that support the notion of lifestyles connected to high technology (Aldrich, 2003). Minimalist architecture has various design aesthetics and features including harmonious colours, basic geometric shapes, natural textures, angular and straight components, large windows, flat roofs, and simplicity (Nia & Rahbarianyazd, 2020). Minimalist architects are not exclusively concerned with the physical aesthetic qualities of the building but with the interior aesthetics. They do so by paying attention to the interior, nature, details, materials, people, and technology that is going to be used in space (Bertoni, 2002).

The first smart homes were designed and constructed in the United States, Japan, and Europe between the 1980s and 1990s. For instance, A Day Made of Glass (2011) created by Corning's Investor Day company in New York City, is a visualization of a smart home set in the year 2020 (Chambers, 2020). A Day Made of Glass illustrates a family living in their 2020 dream home, and family members are portrayed interacting with various glass-based technologies such as portable gadgets, wall-mounted televisions, computers, and mirror screens. This vision of a technologized future home creates a narrative of family control and empowerment (Chambers, 2020).

Moreover, Spigel (2005) claimed that smart homes become more uncertain as domestic spaces. Where and when activities such as communication, entertainment, or work are undertaken, the functions served by various devices have implications for them according to the meaning of the 'contemporary smart home.' This research examines how the rise of the smart home is reconfiguring the meanings of home through a semiotic analysis of visual

representations of the smart home sourced from a selection of architectural trade magazines. The meanings behind the concept of the smart home are inspected through three themes: i) aesthetic ideas and economic intentions, ii) technological possibilities through cultural representations, and iii) homes of tomorrow (Chambers, 2016). To begin with, the aesthetic ideas and economic intentions are related to comprehending the social processes engaged in the imaginary home of the early 20th Century. The second theme centres on the technological possibilities being offered through cultural representations and material forms of the connected homes of the 1980s and 1990s. The third theme examines the meanings related to later, digitally automated 'homes of tomorrow' or 'smart home.' This section explores how the digitized home is visualized and advanced through marketing, advertising, and well-known imagery (Chambers, 2016). Smart homes depicted in architectural trade publications comprised not only a smart living room, kitchen, and bedroom but also areas for work and entertainment such as a smart workplace, gym, smart theatre, and game rooms (Allameh et al., 2011). These areas are private and embody visible and hidden smart technologies. The envisioning of the smart home over the decades has blurred the boundaries between domestic interiority and public space by permitting thoughts regarding public space to move into the domestic arena and the other way around. This is underwritten by aesthetic and technological advancements in décor, media equipment, and information and communication that reshaped the meaning of domesticity as an efficient mediated space of not only leisure and family but also work (Chambers, 2016).

2.3 Home architectural design aesthetics

According to Pink's notion, the home as a site for exploration, design, and intervention is known as a passage into the future-making processes that guide us to a more equitable,

sustainable, and healthier life (Pink et al., 2017). The intangible layer of the home aesthetics shapes a key component of the way that the environment of the home is experienced and made, and it is something that cannot be disregarded in design (Pink et al., 2017, ch. 3). Aesthetics are not just what a designer embodies in a design; the focus is on both the property and quality of the aesthetic object and its sensory experience of interpretation and appreciation by the spectator (Cupchik & Heinrichs, 1981). The aesthetics of architecture depend on structures that can be viewed as works of architecture comparable to works of art that are aesthetically pleasing (Mahdavinejad et al., 2014). Following the work of Scruton (2013) and Grutter (2010), architectural design aesthetics are architecturally imparted through:

- Form: A combination of lines and colours in a specified way. Fixed forms and relations, as well as the proportions of these forms, wake aesthetic feelings in us.
- Material: It is the constructional components that determine the façade and shape.
- Harmony: Harmony in architecture means to order and accordance among all apparent parts. It is one foundation of architectural aesthetics. Materials, colour, and surface structure should concord with each other and be counted in perfect order.
- Signs: Each message and the visual message are sent by signs.

Based on (Ingold, 2010) atmospheric and environmental work, we see how the atmosphere is derived through an emanant process. This change comes from the experiences between individuals, materials, and different components of the environments in which they are part of (e.g. light, air, warmth, scents). Focusing on the atmospheres of the digital home offers a critical structure in order to consider what future homes are being designed for (Pink et al., 2017). The digital homes that individuals live in are not dictated by technological possibilities, yet rather by how people interact with and how they feel about the home’s environment and

technological and sensory configurations (Pink et al., 2017, ch. 4). In this regard, several studies have explored the aesthetics of the home and the idea of the inhabitant's tastes. In one such study conducted by Woodward (2003), interviewees reported enjoying consuming images in home decor magazines and dreaming about how their home could look. While people had a desire for their homes to look stylish in terms of the colour, design, and texture of furnishings, it came second to their desire for their homes to be comfortable and functional.

From the view of smart home designers, their aesthetics are comprised of "a plethora of styles, colors, and finishes" (Staff, 2014a, n.p.) meant to add "sophistication and elegance to a home's appearance" (Staff, 2014d, n.p.) through integrating smart technology. As C. Berry et al. (2010) observed, these aesthetics include technologies receding into the background, blending seamlessly with walls and ceilings, decorative features, outdoor spaces, and furniture, all the while other features are foregrounded to revitalize the ambiance of the home. Furthermore, two conditions characterize aesthetic reactions towards home architecture: architecturally shaped space (inside view), and architecturally shaped mass (outside view) (Publishing, 2010). This raises questions not only about how technologies are accommodated in domestic spaces but also how the materiality of domestic architectures does (or does not) accommodate new technologies and infrastructures (Kennedy et al., 2020). Although modern design aesthetics are likely to be found in housing developments and not only in smart homes, what is significant is to see signs of smartness (smart iPad, smart control panel. etc.) embedded in the home to make it feel like a comfortable living space.

The next chapter (**Chapter 3**) introduces visual imagery as a qualitative data source. It identifies the sampling rationale that informed the collection of imagery and discusses visual methodologies as a framework for examining how smart home design aesthetics, signs of home,

and smartness in images work to signify meanings of ‘home’ and ‘smartness’. I also discuss specific methods of analysis and how they were employed to inform an interpretation of the selected smart home images.

Chapter 3: Methodology

3.1 Introduction

3.1.1 Human geography and visual methods

Human geography has engaged visual imagery as a research object, subject, tool, and output since its establishment as an academic discipline (Hay, 2000). 'Visual image' is a broad term of reference encompassing visual forms ranging from cinematic film and photography to promotional materials, such as art, computer games, maps, and diagrams (Clifford et al., 2016). Further, more recent visual materials include extant images from mass media sources (Rose, 2016). Visual imagery also corresponds to "visual culture," which comprises a plethora of ways in which the visual is part of social life (Rose, 2016). Visual methodologies offer guidance and expert theoretical orientation on how to think about visual culture (Rose, 2016). Because the many forms of visual imagery—ranging from archival photography and film to websites and social media images and videos—cannot be interpreted in the same way, it is important to be aware of codes, conventions, and genres related to the specific visual image (Clifford et al., 2016). Geographers are keen on identifying how key concepts like space, place, and landscape are represented and utilized in visual imagery (Hay, 2000). Social scientists have traditionally used photographs as research tools, including the fields of anthropology and human geography that employ images extensively.

Geography is a visual field—or one with a 'visual culture' (Crang, 2003; Rogoff, 2013; Rose, 2016; Ryan, 2003; Sui, 2000). Additionally, advances in human geography research have highlighted the value of visual imagery across all the geography's subdisciplines, including cultural geography (Tolia-Kelly, 2012) and geographic information science (Elwood, 2010).

Drawing on Rose's (2016, p. 25) definition of visual research methods and digital-visual techniques are those that select visual artifacts as 'part of generating evidence to explore research questions,' and/or those that use digital technologies and computational techniques to collect, explore, and analyze visual media or to visualize data.

This study mobilizes visual methodologies as the methodological approach, informing the analysis of images related to the visual representation of smart homes in trade architectural publications. This framework guides my analysis, which informs a visual typology of how smart homes are represented in architectural trade publications, as well as a theorization of whether and how these visual representations contribute to new meanings of 'home'.

3.1.2 Methodologies for researching the smart home in previous studies

To date, many smart home studies have been conducted via a series of research designs, including in-depth interviews and ethnographic approaches. The methods deployed within these approaches range from traditional interviewing (Al-Husamiyah & Al-Bashayreh, 2022; Garg & Cui, 2022; Maalsen, 2020), to researcher and participant collaborations (Friedrich et al., 2022; He et al., 2021; Karimi et al., 2021), video ethnography (Taiwo et al., 2022; Watson et al., 2021), and autoethnographic methods such as diaries, cultural probes, and holding tours in smart homes (Kennedy et al., 2020; Maalsen, 2020; Pink et al., 2017; Strengers & Kennedy, 2021).

Maalsen (2020) argues the smart home can be conceptualized as an assemblage of social, economic, political, and technological apparatuses. According to her, viewing the smart home as an assemblage enables us to understand the network of relationships that constitute it. Assemblages are specified by material and expressive tasks that either stabilize or disrupt the assemblage and are susceptible to various territorialization and re-territorialization processes

(DeLanda, 2006, pp. 250-266). These processes show us how the components of an assemblage can either support or undermine social and political processes and they educate us concerning the relations among the material, human and non-human that produce approaches to being in the world. For the smart home, it helps us understand how things are conceptualized, how they are used, and for what purposes, from a sociopolitical and sociotechnical standpoint (Maalsen, 2020). In order to accomplish this, Maalsen (2020) suggests approaches that can help us see the smart home not as an object but as a network of interactions, and which can make use of the agentive capabilities of smart technologies and the features and affordances of the smart home itself, including:

- *Interviews and discourse analysis with ethnographic sensibility*, which involves conducting qualitative interviews with the people and objects mentioned in the assemblage (Maalsen, 2020). For example, designers, renters, architects, appliance makers, and housing start-ups that experiment and trial new sorts of housing models would be interviewed to better understand the smart home (Maalsen, 2020). This teaches us how past ideas of the smart home have formed and predicted futures, as well as how this has altered through time. Additionally, it is possible to think of things, such as documents, as having social lives and biographies - i.e., discourse analysis (Appadurai, 1988; Maalsen, 2020). We can learn about assemblages by looking at a thing's social life. It is beneficial to imagine all the different tools and components interacting and conversing. Interviewing “things" that are not represented by human actors has obvious limits (Maalsen, 2020, p. 9). But smart gadgets currently allow us to ask questions of assistants like Amazon Alexa, Siri, and Google, and they provide us with information on a variety of topics, like how much energy we use, what foods we need to buy, what shows

we might be interested in, and more (Maalsen, 2020). For the smart home, this entails paying attention to the homes that make up the normative family as well as the households that have been included in the smart home narrative over time, the way that technology is portrayed according to gender, and any differences between the smart home as it is now and the one that is being envisioned (Maalsen, 2020). To do this, we require approaches that can help us comprehend the smart home not as an object but as a web of connections, and which can make use of the agentive capabilities of smart technologies and the features and affordances of the smart house itself (Maalsen, 2020).

- *Smartphone ethnography and enrolling things as co-ethnographers*, Ethnography can provide light on how the integration of smart technology into the home operates on a case-by-case basis. Smartphone ethnography may be a useful addition to conventional ethnographic techniques and has compelling relevance for conducting research in a society that is becoming more digital (Maalsen, 2020). This might involve the establishment of online housing and roommate profiles as part of the effort to access housing, the technologies that circulate through the home, both individual and shared gadgets, technology use, and the ways in which technologies influence household interactions, such as the division of labour, paying rent, and maintenance (Maalsen, 2020). Another strategy is to track a smart technology's development. Maalsen positioned smart home devices as co-ethnographers by leveraging the data produced by smart devices. They also help unpack and map the individual components of smart home assemblage. Smartphone apps may also be used to make communication between researchers and participants easier and let the researcher send reminders to participants to record data (Maalsen, 2020).

In earlier research, Spigel (1992, 2001, p. 406) looked at changing conceptions of "media households" over the last 50 years. This research considered how these changing models of home incorporate ruling middle-class ideologies regarding everyday family life. To do so, Spigel endeavored to follow shifting articulations between domesticity and electronic media by looking at three cultural metaphors through which domesticity and media have been envisioned across the postwar decades in advertisements and magazines (Spigel, 2001). She suggests that the media home has generally been founded on three related concepts: theatricality, mobility, and sentience. These ideas have been fundamental to the linked histories of domestic architecture and electronic communications, and they have appeared in three particular media housing types: the "home theater," the "mobile home," and, more recently, the "smart home" of the digital future (C. Berry et al., 2010; Spigel, 1992, 2001, p. 386, 2005a). Spigel collects moving and still images from magazines and videos in association with smart home advertisements as evidence. She looks at the linkages between the building and home appliance sectors and the hi-tech industry that underpin the new image of the home, as well as the subjective style that a smart house requires (Spigel, 2005b).

Her analysis uses a visual rhetoric approach to smart home images collected from multiple trade publications. The relationship between visual images and their effects is the subject of visual rhetoric studies. The art of rhetoric involves persuasion via signification. It is a style of speech that uses logic and emotional appeals to inspire the audience (Aiello & Parry, 2019). Rhetoric includes visual rhetoric, such as images and movies, besides speeches and written works (Aiello & Parry, 2019). This methodology often starts by defining the broad form of rhetoric and, within that, the rhetorical devices used (metaphors and symbols), and then it makes suggestions on how these traits elicit particular responses from audiences. Through

certain persuasive signals, such as the way visual elements are coordinated to form connections, pictures can offer argumentative assertions in visual rhetoric (Aiello & Parry, 2019, pp. 119-133).

A distinct technique for studying smart homes is that conducted by Woods (2021). In this study, Woods (2021) concentrates an interpretative effort on the 'smartest' areas of the smart home, those locations in which domestic futurity permanently altered the perception of the house. A collection of cultural practices and meanings linked to a mediated, technologically enhanced house and home life was addressed as they relate to how smart homes produce domestic futurity. She toured three particular smart houses in three diverse areas and townships, focusing specifically on their 'smartest' features. This project approaches smart homes from a critical, interpretive perspective, featuring the platformed capital streams which make possible luxury smart homes (Woods, 2021).

3.1.3 Visual methodologies for researcher built environments

Furthermore, additional previous studies were conducted not specifically on smart homes *per se*, but on a visual analysis of urban built environments elaborating on using semiology—which is engaged in more detail in the next section—as a method of analyzing visual imagery. For instance, Aiello (2021, p. 137) developed what she terms a "visual-material" approach to research the urban built environment as a media of communication in its own right. Her visual-material methodology draws from social semiotics and multimodality, to engage in how "formats" of urban regeneration and redevelopment are mobilized to change the urban built environment with the assistance of a globally appealing aesthetic (Aiello, 2021, p.137). Using semiology as the framework of how images construct meanings reveals insight into the different

messages behind visual imagery and how they convey the culture and social norms to audiences (Harrison, 2003). Multimodality involves key concepts, such as composition and framing of visual imagery. Multimodality is a term that has emerged over the most recent 20 years to represent the various assets utilized in communication to express meaning (Kress, 2009). As a phenomenon of communication, multimodality characterizes the combination of various semiotic resources, or modes, in texts and communicative events, such as still and moving images, speech, and writing (Aiello, 2021). Aiello collected data from the text- and field-based empirical observation of three different sites. The approach shows how cities make meaning by deploying both symbolic, technological, and material resources and how individuals in urban settings connect or do not connect, with others and with their environment (Aiello, 2021). She argues that what building materials, public road signs, advertising billboards, street names, place names, commercial shop signs, and public signs on government buildings and urban built environment design aesthetics as symbolic signs signify and how they make meanings (Aiello, 2021). Aiello's visual-material approach draws on and contributes to analytic frameworks that are collectively referred to as 'visual methodologies.'

3.2 Visual methodologies

3.2.1 Overview

Qualitative researchers are taking up a challenge to understand a society increasingly dominated by visual rather than verbal and textual culture (Prosser, 2012). Visual research focuses on what can be seen and uses the term visible ontologically in referring to imagery (Prosser, 2012). Visual is not just about an image itself but is more concerned with the perception and the meanings attributed to it (Prosser, 2012). The term visualization refers to

modes of representation. A lot of the research on visual culture contends that an image's 'audiences' will influence its meaning and impact through their own interpretations (Rose, 2016).

Films, video games, paintings, photographs, selfies, magazines, advertisements, still images, book illustrations, maps, paintings, and cartoons have long been essential study tools in the fields of anthropology, sociology, and human geography, and this is where the idea of a visual methodology originated (Banks, 2007). There are several reasons wherefores in recent years, social researchers disseminate using visual techniques and visual material to convey research results. The first reason is that images carry a variety of information not found in written form (Rose, 2016). This is supported by the argument that visual pictures transmit their meanings far more effectively than academic writing because they can have a stronger impact (Rose, 2016). Second, a lot of researchers are using visual materials to deliver their research findings due to the belief that research given through visuals may reach larger audiences and various types of audiences than the typical academic research output (Puwar & Sharma, 2012). Third, academic research must begin using visuals to communicate. Since platforms and apps contain so many images, according to Jacobs (2013, p. 714) who asserted that "the Internet and digitization are disrupting the hegemony of the printed word," geographers (and other social researchers) should improve both their ability to interpret and create visual materials in order to communicate their research more effectively.

A visual technique offers a foundational set of epistemological presumptions for study; it posits that individuals and groups 'see' the world differently as a result of their unique and shared experiences in extraordinary sociocultural contexts (Wee et al., 2013). Rose (2016, p. 4) utilizes the term "visual culture" to refer to how the world is rendered in visual forms on a

regular premise. Seeing, however, does not just allude to what the eye sees, yet additionally the ways in which implications are developed from seeing (Rose, 2016). According to Rose (2016), for each analysis of visual imagery, specific techniques have been introduced that may be used either standalone or in concert, and which in the aggregate are referred to as "visual methodologies." Visual methodologies are defined as "an indispensable resource for anyone working with visual materials" (Rose, 2016, p. 15). It offers guidance and expert theoretical orientation on how to approach, think about, and interpret visual culture (visual culture refers to a plethora of ways in which the visual is part of social life) (Rose, 2016). "Visual methodologies" comprise a range of specific techniques, or methods, for the study of visual phenomena. These include visual content, compositional, and semiotic approaches, which are described in more detail below.

3.2.2 Visual content analysis

Visual content analysis comprises the identification and quantification of observable elements (content) in individual samples of visual phenomena (e.g., images) classified into certain categories based on researcher-identified variables. A variable in content analysis relates to characteristics of what is represented, e.g., included in an image frame (Clifford et al., 2016; Cope & Hay, 2021). Visual content analysis is an observational approach used to evaluate theories about how the media portrays people, events, and situations (Clifford et al., 2016; Flowerdew & Martin, 2005). The purpose of using content analysis to analyze smart home images is to identify frequencies, correlations, and variations in what is being visualized (included in images). This is consistent with the description of at least one particular area of visual representation, historical period, or type of image (Flowerdew & Martin, 2005).

3.2.3 Visual compositional analysis

Visual compositional analysis looks at images of "what they are" (Rose, 2001, 2016, p. 57). The visual compositional analysis aims to present a detailed vocabulary for describing how a picture appears (Rose, 2016). In compositional analysis, analytical attention is put on the formal qualities of images rather than their social construction or cultural effect (Hook & Glaveanu, 2013). Compositional interpretation provides means to describe the expressive content, colour, montage, spatial organization, and light of diverse still and moving images (Rose, 2016). This is quite helpful as a first step in understanding a new image, and valuable when discussing the visual effect of an image (Rose, 2016). Compositional analysis is helpful as a first phase of having the chance to grasp a picture that is unfamiliar to the viewer (Rose, 2016; Wee et al., 2013).

Both compositional and content analysis result in theme building, which is fundamental to interpretive work since it allows for the organization of information into trends, categories, and common elements that are theoretically important (Cope & Hay, 2021). Understanding the meanings of images, however, requires attention to what elements of an image mean and how their composition works to express specific meanings. Interpreting visual images' meanings is informed by semiotic analysis.

3.2.4 Semiology and visual semiotic analysis

Semiology is the study of signs and meaning (Josephson et al., 2020; Rose, 2016; Tejera, 1988; Van Leeuwen & Jewitt, 2001). It is characterized by building a reliant connection between the aesthetics of the image (for instance, symbolic and compositional content, colour, atmosphere, perspective) and wider social meanings (Clifford et al., 2016). This relationship

concerns sign and signification—the visual form that has been "encoded" with meaning, and its "decoding," or interpretation, by the semiotician (researcher) (Clifford et al., 2016, p. 133). Signs in visual images work together and with other elements of an image (G. Kress, 2009; G. R. Kress, 1988; G. Kress & Van Leeuwen, 2020). In semiology, there is no objective way to quantify the meaning of the image, as all images derive their meaning from being compared to other images (Rose, 2016).

Semiology analyzes signs in images, adverts, and media texts (Bouzida, 2014). It clarifies the functions and mechanisms of visual communicators (signs) and helps us to comprehend the idea of the social processes (Solík, 2014). Semiology as science is identified with the word semiosis, which is a "term utilized in semiotics to designate the production and interpretation of a sign" (Bouzida, 2014, p. 1002; Schasfort et al., 2006). Anything can be a sign provided that someone or a group of people are part of the same culture which society interprets as "signifying" something (Khettab, 2021; Aiello & Parry, 2019). According to (G. R. Kress, 1988, p. 261), "social semiotics is concerned with the social meanings constructed through the full range of semiotic forms, through semiotic texts and semiotic practices, in all kinds of human society at all periods of human history." Formal semiotics is primarily interested in the methodical study of the systems of signs (Harrison, 2003). Social semiotics incorporates formal semiotics and asks how signs are used to construct the life of a community (Chandler, 2007, pp.130-140).

Signs are composed of two parts, which are discernable at the analytical level; they are constantly coordinated with one another (Rose, 2016). First, there is the *signifier*, which is the physical form of a sign, such as an object, a drawing, a word, or a photo that relays signification (Aiello & Parry, 2019). And second, each signifier has a *signified*, the concept or

meaning being expressed by that signifier (Rose, 2001, 2016). The meaning of signs is inferred by people and does not exist independently from their interpretations, which are informed by their life experiences, social and cultural beliefs. Thus, signs have various meanings in various social and cultural settings (Harrison, 2003). There are different signs, including iconic, indexical, and symbolic (Berger, 2018; Bouzida, 2014; Rose, 2016). Icons are signs where meaning is based on the similarity of physical appearance (Rose, 2016); for example, the sign for *drink* visually represents a person drinking from the cup. *Indexical signs* have a cause-and-effect relationship (direct link) between the sign and the meaning of the sign (Rose, 2016); for instance, smoke signifies fire. *Symbols are the opposite of icons*. Symbolic signs have a conventionalized but clearly arbitrary relation between signifier and signified, and the meanings of the sign are learned culturally (Rose, 2016). For example, the word "flower" has no intrinsic relationship with the notion of flowers. In another language, its symbolic sign might be "fleur" (French).

It is critical to note that signs do not communicate meaning, but rather signify meanings. The act of conveying, receiving, and exchanging information is what distinguishes communication from signification (Cobley, 2008). Signification (meaning) is the act or method of signifying through signs, which occurs in the absence of an audience or receiver (a necessary condition for communication). There are various levels of signification that can be identified during the investigation of signs. The denotative level of meaning is the first level of signification in which the sign is self-contained (Seiler, 2000). The second level of signification, known as the connotative order, is where the signification connects with a wide range of cultural meanings that are formed not from the sign itself, but rather from how society employs and interprets it (Seiler, 2000).

The distinction and association between connotative and denotative meanings among different signs are a significant point of analysis in semiotic theory (Josephson et al., 2020; Smith et al., 2004). In visual semiotics, the meaning is made through layering (Bouzida, 2014). The principal layer is the layer of denotation, of "what, or who is being portrayed in the image?" (Van Leeuwen, 2005, pp. 37-43). Denotation describes the literal or obvious meaning of signs. Thus, the denotation of a visual image refers to what all people see without association with their culture, ideology, or society (Berger, 2018; Bouzida, 2014; Rose, 2016). The subsequent layer is the layer of connotation, of "what ideas and values are signified through what is addressed, and through how it is represented?" (Van Leeuwen, 2005, pp. 37-43). Connotation involves the various social overtones, cultural implications, or emotional meanings associated with the sign (Berger, 2018; Rose, 2016).

Denotation is the beginning stage; meaning making then shifts to the second level, where connotation dominates and conveys a more elaborate experience of the meaning by engaging interpretants (Josephson et al., 2020; Moriarty, 2005). In Barthes's work, connotation, which is built on denotation, reflects cultural meanings, mythologies, and ideologies (Bouzida, 2014; Josephson et al., 2020; Smith et al., 2004; Van Leeuwen & Jewitt, 2001). It is derived from repeated associations between a sign and its object. Denotation and connotation are both used in visual signification (Josephson et al., 2020; Moriarty, 2005). They are tools that can be utilized to unload different meanings in more complicated visuals (Moriarty & Sayre, 2005). As such, semiological analysis is a critical component of perceiving the significant visual messages used by the media and creating meanings that refer to the sociocultural relations at the second level of significance through different codes which are connotations (Bouzida, 2014). However, signifiers and signs can have various meanings by nature and are subject to varied interpretations

based on the person interpreting them (McKeown, 2005). Thus, it is challenging to explain the implications of pictures in verbal or written language (Van Leeuwen, 2005). As such, it is critical to note that the interpretations are those of one person (Rhoades & Irani, 2008).

As a method, the semiological analysis of the image deals with reading, analyzing, and explaining the image (Bouzida, 2014). Following Rose (2016), visual semiotic analysis involves the following steps, which inform interpreting the interplay of an assortment of signs (Josephson et al., 2020):

1. Determine what the signs are.
2. Find what signs signify in themselves.
3. Ponder how they relate to other signs in themselves (connections and differences).
4. Investigate signs connections to wider systems of meaning (cultural implications).
5. Finally, look back on the signs to seek the precise articulation of meaning.

In the following sections, I present my research design, describing how I deployed visual methodologies—including specific techniques of visual content, compositional, and semiotic techniques—as the analytic framework of this study.

3.3 Research design

3.3.1 Data collection and processing

As described in the Introduction (**Chapter 1**), this study examines whether and how visual representations of smart homes intended for public consumption inform changing meanings of 'home.' To achieve this aim, this research project has sourced images of smart homes from a selective sample of five architectural trade publications: the magazines ICON[1],

[1] https://www.iconeye.com/

Canadian Architect[2], Control4[3], Home & Design[4], Dwell[5], and the ArchDaily website[6]. The rationale for the selection of these resources is that they are publicly accessible online without a paywall, and they publish visual architectural content, including representations of smart homes. I collected 360 images from the years 2018, 2019, and 2020, representing 3 years' worth of imagery from these six publications.

The selection of the images starts with determining the population that is eligible to be included in the sample. In general, the effectiveness of samples in this qualitative research is assessed in relation to how effectively they fulfill the objectives of my analysis (Given, 2008). The sample's size highly impacted the accuracy of an assessment from a prospect sample (Given, 2008). Smaller samples provide less accurate evaluations, whereas bigger samples yield more accurate assessments (Given, 2008). In this sense, due to the importance of sample size, I collected data from three years. With a sufficient number of images, I could improve the accuracy of the results of content, compositional, and semiotic analysis. Moreover, I aimed to gather more than 200 published images that present the latest built smart homes under novel design aesthetics in recent years. I could also emit images that do not fit into my selective sample and analysis process. I chose images that show the whole space of the smart home, do not zoom on specific smart appliances with blurry backgrounds, without texts, are unanimated, and have proper quality. Further, these images are identified as being representations of smart homes based on image metadata, figure captions, tags, and the titles of features and photo essays published in these architectural media. They are also referred to as 'smart homes' in the published texts of magazines and the website.

[2] https://www.canadianarchitect.com/magazine/
[3] https://www.control4.com/tools/hsh
[4] https://www.homeanddesign.com/
[5] https://www.dwell.com/magazine/issues
[6] https://www.archdaily.com/

Once collected, I brought the digital images into NVivo. NVivo is analytic software highly used for qualitative research and supports qualitative coding of various kinds of textual materials, including images. According to Rallis & Rossman (2012, p.282), coding is an iterative process that aims to find "a word or short phrase that captures and shows what is going on in a piece of data in a way that ties it to the general analytical issue." Coding involves dividing the data and assigning categories (Dey, 2003). According to Seidel & Kelle (1995) coding entails identifying pertinent phenomena, gathering instances of those phenomena, and analyzing those phenomena to discover patterns which form the basis of themes. Codes develop into themes that may subsequently serve as the major topics for the finished output and are tied to the project's theoretical framework (Clifford et al., 2016). The commonalities found in the data work as the basis for themes, or in the opposite case, differences that stand out (Clifford et al., 2016). A theme "captures something important about the data in relation to the research question and represents some level of patterned response or meaning within the data set" (Cussen & Cooney, 2017, p.392).

My iterative coding approach to the smart home images themselves mobilized visual methodologies as a basis for their interpretation. In this study, the mode of interpretation is distinguished by the establishment of the connection between the aesthetics of the smart home images (content, color, signs, etc.) and broader social meanings related to 'home' expressed, conveyed, and put into circulation by these images. This iterative coding approach to interpretation included time spent viewing, creating notes of initial impressions, and taking time away from each image for additional reflection (Clifford et al., 2016; Hay, 2000). I used an analytical structure coding for organizing smart home images, identifying trends emerging from the content and composition of the smart home images, interpreting what elements and their

organization meant for the understanding of ‘smartness’ and ‘home,’ and building themes that connect my empirical findings with broader literature (Clifford et al., 2016; Cope & Hay, 2021). By identifying categories, patterns, and themes, I made more sense of the data. Coding the smart home images leads to the creation of new codes, new interpretations of the data, and thinking about what content or elements within the image needs to be coded and why (Clifford et al., 2016). Finally, this process results in developing a typology of smart home representations in architectural trade publications.

3.3.1.1 Content coding and analysis

My coding of the selected sample of 360 smart home images began with identifying descriptive codes to analyze the content and composition of images (Clifford et al., 2016; Hay, 2000). Content analysis is based on several rules and procedures that should be followed for the analysis of images. These concern the selecting, coding, and qualitative analysis of numerous images. The first step of content analysis is sampling (a selective sample of five media outlets from which I collected all images for a three-year period), and subsequently, coding. After having selected a sample of images to work with, the next step involves devising a set of categories for coding the images. I developed these codes based on various features, characteristics, conditions, actions, and categories seen in smart home images. These descriptive codes are raised from my background literature review of scholarship on smart technology in the home, architectural and design aesthetics of smart homes, and elements and signs used in visual images of a smart home.

On the basis of the descriptive coding of the images, I identified two broad categories of smart home representations published in my selection of trade architectural outlets: those in which the presence of (smart) technology is highly visible (prominent and observable), and those

in which (smart) home technologies are hidden (implied to be seamlessly integrated). I discuss this in greater detail in **Chapter 4**, which presents the findings of my content analysis. Within both of these categories (smart homes in which technology is hidden and smart homes where the technology is visible), the images were submitted to further, more detailed content and compositional analysis in which additional axes of coding were identified in the process of a recursive, iterative close visual reading of the images. Of the 360 images brought into NVivo, 202 images are smart homes in which technology is hidden and 119 images are smart homes where the technology is visible. Further, 39 images did not fall into either category. This category of images often focuses on the technology itself, without showing the smart home interior, has blurred backgrounds, and are generated by graphical software.

NVivo codes are produced by my interactions with the data, as I browse the sources (Clifford et al., 2016). The purpose of coding the images is to develop a typology of smart homes and extract patterns based on the content, aesthetics, and composition of figures. Because these codes respond to who, what, where, when, and how questions, they can be viewed as category labels (Clifford et al., 2016). I created codes on both categories of images in which technology is visible/hidden. In this sense, examples of descriptive codes which I produced include coding for what kinds of smart home space is shown, what type of smart technology is mostly in the space, is it in the background or foreground, are there any characters, humans, family pet or plants in images, what about the presence or absence of personal items. I summarize some examples of coding for smart home images in **Table 3.1** (content coding structure for smart home images where technology is visible), and **Table 3.2** (content coding structure for smart home images where technology is hidden).

Table 3.1. Content coding structure for smart home images where technologies are visible. Codes progress from more general to more specific as one moves across the columns from left to right.

Content codes			
Room/space pictured			
	Living Room		
	Kitchen		
	Game room/ smart theatre		
	Dining room		
	Bedroom		
	Hallway/corridor		
	Other (e.g., garage)		
	Not applicable (N/A)		
Visible technologies by type (categories not mutually exclusive)		Foreground	Background
	Lighting		
	Large-formatdisplay (e.g., Smart TV)		
	Smart home devices/hubs		
	Appliances (fridges, toasters, etc.)		
	Privacy (e.g., smart curtains, blinds, etc.)		
	Tablets		
	Smartphones		
	Smart speakers		
	Smart thermostats		
	Mounted touch panels		
	Surveillance devices (e.g., cameras)		
	Laptops		
	Smartwatches		
	Smart elevator		
	Solar panels		

Presence/absence of people/ pets/ plants				
	Humans present	Humans absent	Pets present	Pets absent
Personal items				
Presence of plants				
Placement of technology				
Technologies in the foreground or background				
Foreground				
Background				
Both				

Table 3.2. Content coding structure for smart home images where technologies are hidden. Codes progress from more general to more specific as one moves across the columns from left to right.

Content codes				
Room/space pictured				
	Living Room			
	Bedroom			
	Hallway/corridor			
	Kitchen			
	Dining Room			
	Game room/smart theatre			
	Other (e.g., garage)			
	Not applicable (N/A)			
Presence/absence of people/ pets				
	Humans present	Humans absent	Pets present	Pets absent
Personal items				
Presence of plants				

In addition to coding the content of smart home images, I categorized images for their architectural design aesthetics. For instance, are images showing the smart home from the interior or exterior, if it is from the interior what types of the geometric form (shapes) are observable in space (angular, round, curved, or straight), construction material in space (glass, exposed concrete, wood, stone), what colour palette is used in the home, and finally do we have flat roofs, large windows, or terrace view. These descriptive codes, summarized in **Table 3.3**, are important since they inform whether a smart home (with hidden/visible tech) contains minimalist or modernist design aesthetics and disclose resemblances or differentiations with a non-smart home's visual aesthetics.

Table 3.3. Content coding structure for design aesthetics of all smart home images. Codes progress from more general to more specific as one moves across the columns from left to right.

		Smart home images with visible technology	**Smart home images with hidden technology**
Aesthetic content codes			
Interior or exterior of the home			
	Exterior (visualization of the outside of the home)		
	Interior (images capture interior of the home)		
Geometric form (shapes)			
	angular		
	round		
	curved		
	straight		
Interiority/exteriority			
	Image captured from inside the home		
	Exterior space highly visible from inside		
Construction materials			
	Glass		
	Exposed concrete		
	Wood		
	Stone		
Colour palette			
	Dark neutral tones		
	Light neutral tones		
	Warm tones		
Flat roof			
Large windows (all smart home images)			
Terrace view (all smart home images)			
Modern designed			
Minimal designed			

3.3.2.2 Compositional coding and analysis

The term “compositional” describes the unique material characteristics of a visual item or picture (Rose, 2016). Images are created using a variety of formal methods, including content, colour, and spatial organization (Rose, 2016). After the content analysis, I analyzed smart home images in which the technology is hidden/visible through coding for the composition of the images. Here, I concentrated on compositional modes about the location of smart technologies in the images, what are the impacts of color use, lighting (are images captured in the daylight or at night), spatial arrangement, and the perspective of the image (how the image frame positions the viewer relative to the elements in the image, e.g., face to face, above or below). I focused exclusively on features related to image composition with an emphasis on technology and colour use. Each compositional component of smart home images independently contributes to the image's main strategic goal while simultaneously showing the power of visual communication to create a different type of interaction between the creator and the spectator (Prosser, 2012). As such, my compositional analysis proceeded via the iterative emic coding of visual compositional elements and attributes identified by Hook and Glaveanu (2013), including:[7]

- Spatial organization: How is the space of the image organized, and how does this orient the spectator (viewer)? This requires paying attention to the geometrical perspective and the position of the spectator (the viewing audience).
- Colour use: How does the colour appear? What are the effects of colour use?

I summarize the compositional coding structure in **Table 3.4**.

[7] "Emic" codes are typically understood to be those employed by informants (the author) themselves. Coding emically refers to evaluating the subject matter, considering the author's perspective. In addition, an emic construct's validity is determined by the native informant, not by an outside social scientist's view (Clifford et al., 2016; Hay, 2000).

Table 3.4. Compositional coding structure for all smart home images. Codes progress from more general to more specific as one moves across the columns from left to right.

	Smart home images with visible technology	**Smart home images with hidden technology**
Spatial organization		N/A (as no technology is visible)
Information value (technology concentration)		
Top		
Bottom		
Left		
Right		
Center		
Perspective		
Frontal angle		
Low angle		
High angle		
Colour use		
Contrast in colour		
Harmony in colour		
warmth		
coolness		

The results of the content and compositional analysis inform a typology of smart home representation in architectural trade media and disclose the similarities and differences between a smart home and a non-smart home representation, which is presented in **Chapter 4**.

3.3.2.3 Semiotic coding and analysis

Finally, I mobilized a semiotic analysis approach to my smart home images to identify signs and meanings of 'home' in the two groups of collected images (smart home images where technology is visible, and smart home images in which technology is hidden) identified in the content analysis stage. Signs identified in images express the meanings; coding is a way of distilling those meanings, they continue to signify in the absence of codes. However, unlike the content and compositional analyzes, for the semiotic analysis, I selected 12 images that represent the larger sample of smart home images. I chose images based on two criteria. First, they were published online, were publicly viewable without a paywall, and met the copyright requirements for reproducibility in this thesis. Second, they were "representative" in that they included the most frequently encountered elements (contents), aesthetic designs, and compositional forms identified in my content and compositional analysis of the larger image sample.

Once the images were chosen, I used the steps outlined by Rose (2001, p. 91), summarized in Section 3.2.4 above, to code images for the presence of different signs (Indexical, Iconic, Symbolic), and which elements in those images functioned as which types of signs. To identify how signs are determined to be a particular kind of sign, it is important to mention that a sign may function as more than just one certain type of sign (Iconic, Indexical, Symbolic). For example, there are signs which may be both iconic and symbolic. I coded/assigned signs to the sign type or category in which the sign signified the meaning of home and smartness most strongly. For instance, in Figure 4.1, a dog on the floor as a sign can be identified as both symbolic and indexical. On one hand, this sign as a symbolic sign signifies a family home (lived-in space), and on the other hand, as an indexical sign, it signifies a personalized living space. In this instance, I designated the dog on the rug as a symbolic sign.

I also coded the image elements identified in the content analysis phase, for whether they were connotative or denotative signs of 'home'. To interpret how these signs were signifying meanings of 'home,' and what the meanings being signified were, I semiotically analyzed the two categories of smart home images in comparison and contrast to the semiotics of a conventional photographic representation of a 'typical,' or 'non-smart' home. This allowed me to identify the differences, connections, and similarities of meanings in images with both visible and hidden smart home technologies to signs in a selected image of a typical (non-smart) home. The results of the semiotic analysis of signs and meanings of home in smart home images with visible/hidden technology—and how they work to signify 'home' both by repeating and resisting semiotic tropes of a "typical" home—are presented in **Chapter 5**.

Chapter 4: Content and Compositional Analysis

4.1 Introduction

This chapter reports on the content and compositional analysis of my selected sample of smart home images published in architectural magazines. As I show, the content and composition of 'smart home' images both reflect and contrast with the contents and compositions of images of 'typical' – or non-smart – homes. As such, this chapter begins with a compositional and content analysis of an image of a 'typical home', which I conduct to compare with the patterns that I have found with the content and compositional signatures of the smart home representations. The analysis of an image of a typical home indicates how the patterns in smart home images in which the technology is visible and hidden are similar or distinguishable from a non-smart home where the technology is absent.

The content and compositional analysis of smart home images starts with the content analysis of images. Visual content analysis is an observational approach used to evaluate theories about how the media portrays contents of an image, including people, events, and situations (Clifford et al., 2016; Flowerdew & Martin, 2005). One way to analyze the content of images is through coding and categorization. I conducted the coding process on 360 images utilizing NVivo software. I created codes as I interacted with images and asked questions about what and how different elements of an image are represented. Further, I generated the NVivo codes related to this analysis according to architectural and design aesthetics, technology concentrations, and the content of smart home images.

Subsequently, I conducted a compositional analysis of images that focuses on the composition of an image. Compositional analysis of smart home images comprises analyzing the

spatial organization of images, the use of colour in images, as well as investigating how different components of an image are framed and organized. Both compositional and content analysis of smart home images results in developing a typology of smart homes based on the content, design aesthetics, and multimodality (which involves composition and framing of visual imagery). My content analysis finds that there are two categories of images: smart homes in which technology is hidden, and those where technology is visible.

I compared the results of the content and compositional analysis of smart home images to that of the image of a typical home, which informs a typology of smart home visual representations in trade architectural publications. The significance of this typology is to extract the visual signature and patterns that architectural trade publications introduce to the readers.

4.2. The content and composition of a 'typical' home

A contemporary 'typical' (non-smart) home is shown in **Figure 4.1.** I selected this image because it appeared on the first page of a Google image search result for the search phrase 'typical home'. This image is broadly representative of the interiors of residential spaces (homes) featured in online and print architectural and interior design media (websites and magazines). **Figure 4.1** is neither described nor tagged as 'smart' homes, nor featured as part of photo essays of smart living spaces. It was instead described as 'a comfortable home to relax in'. The 'typical' home depicted in **Figure 4.1** portrays a conventional living room without the presence of any visible type of smart technology.

Four things are striking about the content of this image. First, the home's interior is characterized by modernist design features, such as a flat roof, large windows, and basic geometric design elements such as rectangles, squares, and circles. A definition of modernist

architecture features three principal perspectives: “[e]mphasis upon volume; symmetry or other types of obvious balance; and, last, dependence on the intrinsic elegance of materials, technical perfection, and fine proportions” (Hitchcock & Johnson, 1997, p. 29). Modernist architects believe that family life and social interaction are at the focal point of the modernist dream of a planned environment, such as residential spaces (Rowe, 2011). Second, the room shows a warm colour palette on furniture choices and walls, which makes the living room look cozy, i.e., a space that may be relaxed in. Third, a family pet (dog) lying on the rug in a densely furnished space, plants needing watering, and an imperfectly placed, rumpled blanket show this space to be lived in. And fourth, the elements of the image express a personalized living space by presenting a written-on blackboard, stylized comfortable furniture, paintings on the walls (which are personal choices), and diverse decorative items, including plants, candles, lampshades, and sculptures, that are selected and located in different spots in the living room according to inhabitants’ taste.

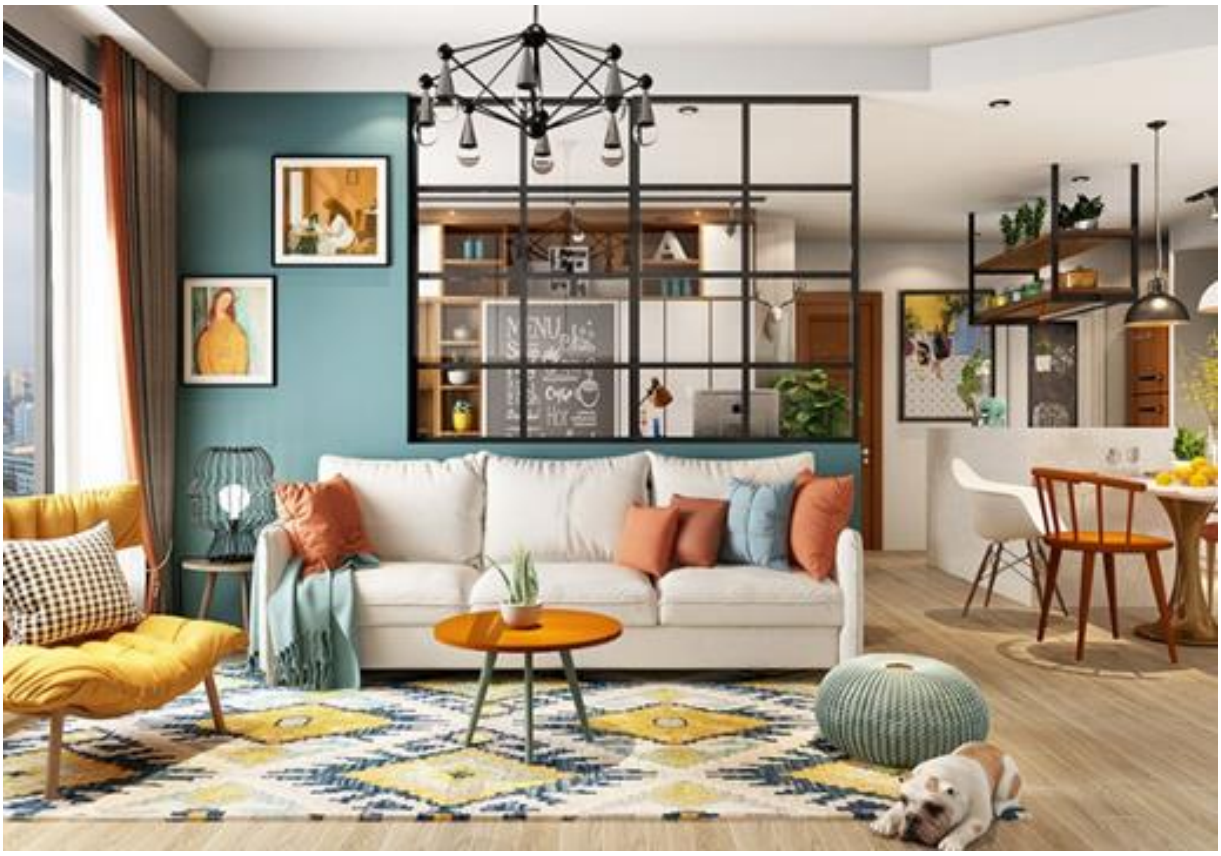

Figure 4.1. A trade architectural image representative of a ‘typical’ (non-smart) contemporary home. Published: 2019. Photographer: Unknown. Title: A comfortable home to relax in. Website: OPPEIN. Date of access: 2021-11-12.
URL: https://www.oppeinhome.com/comfortable-home-to-relax-in/

Additionally, in terms of the image’s composition, **Figure 4.1** is apparently taken in the daytime to show the importance of natural light at home. This image has a frontal angle which engages the viewers' focus on all components of the image equally. Moreover, there is no contrast between the colours in the image (many are similarly saturated), and all the colour tones, besides having harmony, are warm, which evokes a feeling of coziness and comfort. Overall, this image of a typical home shows a personalized, comfortable, and cozy home that is occupied (lived in) by its residents.

I use the result of content and compositional analysis of this typical (non-smart) home image (**Figure 4.1**) as a base against which to compare smart home images. Differences and similarities between the visual representations of a non-smart home and smart home images, as well as identifying key patterns as the chapter continues, are discussed. In this sense, I analyze smart home images for what they represent (their content), compositions, and design aesthetics. Lastly, I identify the visual signatures of smart homes and how they are depicted in architectural trade publications compared to a conventional home trade image.

4.3 Visual content analysis of smart home images

I first started coding smart home images to determine whether the images included visible instances of smart technologies, or whether there were no visible illustrations of technology. I identified two main groups or categories of smart home images that emerged from this coding/analysis of images. Out of 360 smart home images collected, 119 were images where the smart technologies were visible, and 202 were images where smart technologies were fully hidden from view. Further, 39 images did not fall into either category. This category of images often focuses on the technology itself without showing the smart home interior space, has blurred backgrounds, and is generated by graphical software.

Examples of codes that I produced for each category of images (technology is visible/hidden) include coding to answer several questions, such as what kinds of smart home spaces are shown; what type of smart technology is visible in the space, and whether it is in the background or foreground; are humans and family pets in the images; and the presence/ absence of personal items. Because these codes respond to who, what, where, and how questions, I viewed them as category labels.

4.3.1 Smart home images where technology is visible:

The first category of visual images is that of smart homes where smart technologies are highly visible and feature numerous smart devices, including touch panels, displays, and smart blinds. I coded this category of images (119 smart home images with visible smart technologies) according to the rooms or domestic spaces pictured in which the technology is used, the smart technologies that were visible in these spaces, and whether the visible technologies were present in the foreground or background, presence/absence of persons (and demographics); presence/absence of pets and animals. I also coded smart home images based on the visibility of plants or personal properties in the home spaces. I present this coding structure in **Table 4.1**.

My analysis identifies that smart technologies appear in only 33% of the images. Of these images, 48% include technologies that appear in the foreground of the image, while in the remaining 52% of images within this category, smart technologies appear in the background. Additionally, in the 48% of images with foregrounded visible smart technology, as per **Table 4.1**, the technologies that feature most prominently are smart lighting, smart monitors including smart TVs, and smart home hubs. In contrast, the technologies that feature least prominently are small-scale personal tech (smartphones, smartwatches), and laptops.

Table 4.1 Content coding structure for smart home images where technologies are visible.

Content codes					
Room/space pictured		**n of images**		**% of images**	
	Living Room	42		35	
	Kitchen	33		28	
	Game room/smart theatre	12		10	
	Dining room	10		8	
	Bedroom	8		7	
	Hallway/corridor	5		4	
	Other (e.g., garage)	2		2	
	Not applicable (N/A)	7		6	
Visible technologies by type (categories not mutually exclusive)		Foreground		Background	
		n	**%**	**n**	**%**
	Lighting	8	7	7	6
	Large-format display (e.g., Smart TV)	7	6	15	14
	Smart home devices/hubs	8	7	7	6
	Appliances (fridges, toasters, etc.)	6	5	9	7
	Privacy (e.g., smart curtains, blinds, etc.)	4	5	13	12
	Tablets	7	6	3	2
	Smartphones	3	2	0	0
	Smart speakers	3	2	0	0
	Smart thermostats	1	0.5	3	2
	Mounted touch panels	2	1	3	2
	Surveillance devices (e.g., cameras)	2	1	0	0
	Laptops	1	0.5	0	0
	Smartwatches	1	0.5	0	0

	Smart elevator				1	0.5	2	1
	Solar panels				3	2	0	0
Presence/absence of people/ pets								
	Humans present		Humans absent		Pets present		Pets absent	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
	17	15	102	85	5	4	114	96
Personal items	***n***				***%***			
	19				9			
Presence of plants	31				26			
Placement of technology								
Technologies in the foreground or background	***n***				***%***			
Foreground	57				48			
Background	62				52			
Both	38				32			

Images where smart technologies appear in the background (62% of smart home images in which the technology is visible) express a comprehensive visualization of smart homes and show how the home interior would look in the presence of multiple smart technologies. These smart devices in the background are dominantly smart curtains/blinds, smart TVs, smart kitchen appliances, and wall-mounted control panels. Further, in the smart home images with visible technology, the living room in the first place, the kitchen in the second place, and then the game room/smart theatre are pictured the most. Humans and pets are highly visible in smart home images, where technology is visible compared to other set of images where technology is hidden. Among this latter group of images, where they show smart home interiors, humans and family pets are present only in 15% and 4% of images, respectively. Personal properties are also in the home space in only 9% of images and planets are seen in 26% of all smart home images in which

technology is visible. This means that smart home interior spaces in this category of images are highly occupied with visible smart technology in various locations rather than green plants.

4.3.2 Smart home images in which technology is hidden

The majority of the smart home images – 77% of images in the sample – are ones in which smart technologies are not visible. The content codes created for smart home images with visible technology are also applied for smart home images in which technology is hidden, with the exception that there are no smart devices in the foreground or background of home space. **Table 4.2** presents the content coding of smart home images with **hidden** technology.

Table 4.2 Content coding structure for smart home images where technologies are hidden.

Content codes								
Room/space pictured					**n of images**		**% of images**	
	Living Room				62		30	
	Bedroom				24		12	
	Hallway/corridor				24		12	
	Kitchen				22		11	
	Dining Room				20		10	
	Game room/smart theatre				9		5	
	Other (e.g., garage)				19		9	
	Not applicable (N/A)				22		11	
Presence/absence of people/ pets								
	Humans present		Humans absent		Pets present		Pets absent	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
	22	11	180	89	6	3	196	97
Personal items								
	n		**%**					
	13		11					
Presence of plants	47		23					

Content codes show that the most prominent kinds of spaces that are depicted in the smart home images where technology is hidden are the living room, bedroom, and hallways. In these home spaces decorated artificial plants are much more visible (23% of images) rather than in smart home images with visible technology. Furthermore, among images that show smart home interiors, I only observed personal items in 13 of those images. These items are mainly blankets, children's toys, sunglasses, and hats. Humans and pets were present in 11% and 6% of smart home images in which technology is hidden, respectively. It should be noted that humans and pets are lightly visible in this category of images.

Although in most of the smart home images there are no instances of technology such as smart home devices, it is important to investigate how architectural trade publications visually signify 'smartness' and the 'smart home' in the absence of overt presence of technology. I take this matter up in the next chapter, reporting the results of my semiotic analysis (**Chapter 5**). Accordingly, one purpose of content analysis of smart home images with hidden/visible technology is to develop a typology of smart homes based on architectural design aesthetics in the absence and presence of smart technology in this chapter. Features of architectural design aesthetics include minimalist and modernist forms of visual representation and possibilities provided by new materials and technology in space. In addition to coding for the content of smart home images in each category, I subjected both categories of images to be coded based on the design aesthetics of the spaces of the smart home.

4.3.3 Design aesthetics of smart home images

Aesthetics are not what designers embody in a design, but they also focus on both the property of the object and appreciation by the spectators (Cupchik & Heinrichs, 1981). Home

aesthetics shape a key component of the way that the environment of the home is experienced and made (Pink et al., 2017). From the view of smart home designers, their aesthetics are comprised of “a plethora of styles, colours, and finishes” (Staff, 2014a, n. p.) meant to add “sophistication and elegance to a home's appearance” (Staff, 2014d, n. p.) through integrating smart technology. As M. Berry et al. (2016) observed, this aesthetics includes technologies receding into the background, blending seamlessly with walls and ceilings, decorative features, outdoor spaces, and furniture, while all the other features are foregrounded to revitalize the ambience of the home.

Under the broad theme of architectural design aesthetics, I coded all images in my selective sample for their modernist and minimalist design features, construction and object materials, colour palettes, architectural forms (their geometries), whether they depict smart home interiors or exteriors, and visibility of exteriors from within interiors (e.g., outdoor space is visible from the inside). For smart home images to be classified under the minimalist aesthetic category, the home interior not only needs to be pictured sparsely furnished, depersonalized, and has bare walls with a dark and light neutral colour palette, but it also requires embodying minimalist design features. Minimalist architecture has various design features, including harmonious colours, basic geometric shapes, natural textures, minimal furniture, angular and straight components, no ornaments, and simplicity in design (Nia & Rahbarianyazd, 2020).

For the modernist aesthetic category, smart homes entail certain characteristic features, including flat ceilings, large windows, and light neutral tones in furniture choices and walls. These design aesthetics are the language of modern architecture that expresses a modern living space inspired by early advanced home exhibitions (Kudryashova et al., 2020). I coded smart home images to identify whether they are showing the smart home interiors or exteriors, with

further attention to what types of geometric forms (shapes) are observable in space (angular, round, curved, or straight) in images of interiors. Further, I coded for construction materials (glass, exposed concrete, wood, stone) as well as colour palettes are used in the home space. Finally, smart home interiors are represented by flat roofs, large windows, and terrace views. Coding smart home images based on design aesthetics is important since they inform whether a smart home (with hidden/visible technology) contains minimalist or modernist design aesthetics. The differentiation of minimalist or modernist aesthetics is important to show what categories of smart home images (visible/hidden technology) mobilize the design aesthetics of a typical home. Identifying smart homes aesthetics is associated with patterns of smart home representations in architectural trade publications. Moreover, it discloses resemblances and differentiation with non-smart home visual aesthetics. Classifying smart home interiors as minimal or modern spaces expresses how a particular design aesthetic is applied in smart homes in which technology is hidden or visible. I summarize the coding structure for this section in **Table 4.3**.

Table 4.3. Content coding structure for design aesthetics of all smart home images.

Aesthetic content codes					
		Smart home images with visible technology		**Smart home images with hidden technology**	
		n of images	**% of images**	**n of images**	**% of images**
Interior or exterior of the home					
	Exterior (visualization of the outside of the home)	13	11	48	24
	Interior (images capture interior of the home)	106	89	154	76
Geometric form (shapes)					
	angular	22	18	41	20
	round	10	8	18	9
	curved	10	8	24	12
	straight	77	66	119	59
Interiority/ exteriority					
	Image captured from inside the home	97	81	154	76
	Exterior space highly visible from inside	22	19	48	24
Construction materials					
	Glass	27	21	41	20
	Exposed concrete	14	12	37	19
	Wood	53	43	80	40
	Stone	31	24	44	21
Colour palette					
	Dark neutral tones	43	36	107	53
	Light neutral tones	76	64	95	47
Flat roof		84	71	97	48
Large windows	223	69			

(all smart home images)					
Terrace view (all smart home images)	56	18			
Modern designed		91	77	51	25
Minimal designed		28	23	151	75

Coding for the content analysis of the design aesthetics of the smart home images shows that images are mostly captured from the interior of smart homes. Furthermore, smart homes with visible technology are characterized by modernist design features (77%) more so than minimalist ones (75%). In smart home images where technology is visible, 64% of the smart homes' interior spaces are portrayed with light neutral tones applied on furniture and surfaces, adorned construction materials (stone - 24%, wood - 43%), flat roofs (71%), and large windows. In contrast, following (Gudkova, 2014), signatures of minimalist architecture include:

1. a single, reduced-space building with an outward form that is monolithic, rigid, and unified.
2. dark and neutral colour palettes.
3. emptiness and simplicity.
4. homogeneity of surfaces and the lack of details and altering the scale of interior and exterior.
5. "authenticity" of materials" (glass, concrete, wood without coloring).

These minimalist design features are predominantly characteristic of images of smart homes where technology is hidden, for instance, angular and straight forms (ceiling) (79%), exposed glass (20%) and stone (21%) in interior design, and a combination of light and dark tones (53%) are highlighted in this category. This matters that the aesthetics are minimal rather

than modern since smart home interiors in which technology is visible resemble non-smart home design aesthetics. While content analysis of the design aesthetics of smart home images, where technology is hidden, notify an opposition with the representation of a typical home (**Figure 4.1**).

Overall, by comparing the findings of a content analysis of both categories of images with a non-smart home (a typical home), in an image of a typical home, no types of smart technology are visible in the home. Personal items, plants, and pets are observable in smart home images in which technology is visible and the image of a typical home. In terms of architectural design aesthetics, smart home images where technology is hidden are significantly visualized based on minimal aesthetics, while smart home images with visible technology are represented by modern design features. To make more sense of the findings of this analysis, the compositional analysis of images supports content analysis.

4.4 Visual compositional analysis of smart home images

The art of creating and appreciating beauty in an image is the subject of image aesthetics (Hook & Glaveanu, 2013). A variety of psychological and perceptual aspects influence our understanding of an image's aesthetic value, including presences of people, the placement of image elements (composition), the concentration of components of an image (spatial organization), and contrast and harmony in colours (Freeman, 1990; Savakis et al., 2000). The spatial composition of the smart home images is important to compositional analysis: which elements are put next to what, placing technology within the image frame, and how certain components are outlined. In many cases, specific compositional factors may be effectively analyzed based on the question being asked, as not all elements are involved in the

'constructions' of an image at once (Hook & Glaveanu, 2013). As such, it is frequently sufficient if we are selective about the compositional aspects we choose to address (Hook & Glaveanu, 2013). As such, in a compositional analysis of smart home images, I focus solely on features related to image composition with a focus on technology and colour use. Each compositional component of smart home images individually contributes to the image's overarching strategic goal while simultaneously showing the power of visual signification to create and sustain a different type of interaction between the creator and the viewer of the image in architectural trade publications (Prosser, 2012). I used compositional analysis as an analytic approach to identify important elements of images and the aesthetics that influence on generating smart home typology and patterns of smart home visualizations in trade publications.

The strategy for conducting a compositional analysis of images places a strong emphasis on interactive orientation besides attention on compositional features in the interpretations I seek to generate. Following Hook & Glaveanu (2013), compositional image analysis involves coding for image elements, including:

- *Spatial organization*: How is the space of the image organized, and how does this orient the spectator (viewer)? This requires paying attention to the geometrical perspective and the position of the spectator (the viewing audience).
- *Colour use*: How does the colour appear? What are the effects of colour use?

To code for these compositional elements, I coded smart home images for the colour use and spatial organization since the colour and placing smart devices in the home space play an important role in engaging the viewers and taking part effectively in the image aesthetics. Introducing the smart home concept by depicting a home space in which smart appliances are located in different spots of view is more sensible. This means that particular information

(new/already known) associated with the spatial organization of components of the smart home images may be communicated, which I discuss in detail further below. However, smart home images where technology is hidden demonstrate a pristine living space in which no smart technology is observable. This brings up the importance of analysing smart home images according to architectural design aesthetics implemented in the previous section. Compositional analysis of smart home images with both hidden and visible technology communicates the differentiation and similarities in images' aesthetic patterns compared to a typical home image (**Figure 4.1**).

I first started analysing the composition of smart home images by coding for the spatial organization of images in both categories discussed below. Substantially, images are coded based on the colour used in images and whether there is a contrast or harmony between them.

4.4.1 Spatial organization

Compositional analysis not only pays attention to the mood of the image but also focuses on how different elements in an image are framed and organized. In this case, I examine the spatial organization of smart home images to investigate how it orients the spectator with an emphasis on the placement of technology. It should be noticed that two considerable aspects feature in this examination: (1) information value; and (2) perspective (Hook & Glaveanu, 2013; Marks & Polan, 2000; Rose, 2016).

4.4.1.1 Information value

Harrison (2003) compares image composition to sentence structure (or syntax) in language —a set of rules that enable signs or words to be arranged grammatically so that they

make sense to the reader. If the image components are not assembled in a rule-oriented way, viewers will see a mess of images rather than a coherent whole. Therefore, placing image elements is important and allows them to take on different information roles, which are called information values (Najafian & Ketabi, 2011). In this sense, the conventional relations between portrayed components of an image are analyzed in terms of position in the frame, which implies the information value of the respective constituents (Hook & Glaveanu, 2013). Kress & Van Leeuwen (2020) show that the value of an element in the top half of a portrait-shaped frame differs from its value than if situated in the base. To simplify, components depicted towards the top suggest the ‘goal’ of an ad, while the pictorial elements in the bottom area are the ‘real’, the specialized means of the ideal end (Van Leeuwen, 2005). On the other hand, in layouts organized horizontally, the left is the side of the accepted or currently 'Given' information (what has [just] been seen, discovered, now known) while the right is related to 'New' or contestable information (the element which is about to be said or shown, not yet known) (Harrison, 2003).

As per **Table 4.4,** the information values in smart home images with visible technology are mostly in the centre (30%) and on the right (27%) side of the images. This means that smart appliances in this position communicate new knowledge regarding what smart home technologies are specifically and how they function. The list positions where the main components of images are situated is in the top (12%) and bottom (8%). The goal of these images is to introduce the latest smart technologies.

4.4.1.2 Perspective

The angle and position of the image elements or participants from which they are ‘seen’ structures the interaction between the viewer and the image (G. Kress & Van Leeuwen, 2020).

The angle is considered both on the horizontal (frontal) and vertical planes. The horizontal and vertical angles in smart home images affect the sense of involvement in a way that, when looking at the images, requires viewers to move their eyes around from left to right or top to bottom.

The vertical angle is determined by the height of the point of view relative to the element in the image. Participants shot from above were coded as high angle and those shot from below were coded as low angle (Hook & Glaveanu, 2013). "Low angles give an impression of superiority, exaltation, and triumph; high angles diminish the individual and signify power" (G. Kress, 2009, p. 53). Moreover, if the picture is at eye level (frontal), there is no power differential, and the viewpoint is one of equality. In this case, image components will become an object of contemplation for the interpreters (Harrison, 2003). As summarized in **Table 4.4**, I frequently identified perspective with high angles in the images (11%) captured from the exterior of smart homes with hidden technology. Over 70% of smart home images with either hidden or visible technology picture the home at a frontal angle, which creates stronger involvement by the viewer, as the viewer needs to pay attention to all the represented participants in the image.

On the other hand, a low-angle perspective is very common in introducing and presenting technological devices in images where smart technologies are visible, which is only 3.5%. This presentation shows that characters in images who engage with smart devices have power over to control their functions. In this sense, the viewpoint of the image guarantees the viewers look down on the scene itself (Harrison, 2003).

4.4.2 Colour use

The visual appeal of a picture is greatly influenced by colour. Colours can highlight certain elements of a picture, prioritize content, or establish relationships (harmonious or

differentiable) between them (Hook & Glaveanu, 2013). Accordingly, it is important to note how colour is utilized to link and associate various items, as well as how discord and/or harmony are established when we see a coloured image. An image's colour, for instance, might create resonances throughout the picture plane (playing off, emphasising one region against another), or it can be used primarily to contrast the perception of warmth and coolness (Hook & Glaveanu, 2013). According to Joy and Sherry (2003), colour is one element of an image that can be categorized into several objective characteristics. For example, a sense of coolness, is expressed via glossy, unruffled surfaces or blue colours. In contrast, an impression of warmth is given off by a mix of components such as reddish colours, wooden materials, and matte finishes (Biehl-Missal, 2013).

As detailed in **Table 4.4**, the contrast in colour use is most evident in 47% of smart home images in which technology is hidden due to certain interior design aesthetics. On the other hand, in 86% of images where technology is visible, the colour palettes have harmony and contrast is not noticeable. In addition, the impression of coolness is mostly given in smart home images with hidden technology, while images in which technology is visible express that of warmth.

The compositional codes for spatial organization and colour use in smart home images are indicated in **Table 4.4**. I coded smart home images based on the concentration of technological devices in the home space, whether they are in the center, top, bottom, on the right or left side of the image. In terms of smart home image perspectives, I classified them under three different angles: frontal, low, and high angle. It is important to code for the spatial organization of images since it discloses if new information is given to the viewer by placing and focusing on image components at various angles and perspectives of smart home images. Additionally, coding for colour use (harmony/contrast in colour palettes, warmth, and coolness)

and spatial organization establishes the relationships regarding both the contents within the image and between viewers.

Table 4.4. Compositional codes.

Compositional codes				
	Smart home images with visible technology		**Smart home images with hidden technology**	
Spatial organization	**n of images**	**% of images**	**n of images**	**% of images**
Information value (technology concentration)			N/A (as no technology is visible)	
Top	15	12		
Bottom	10	8		
Left	27	23		
Right	32	27		
Center	35	30		
Perspective				
Frontal angle	112	94	176	87
Low angle	4	3.5	4	2
High angle	3	2.5	22	11
Colour use				
Contrast in colour	17	14	96	47
Harmony in colour	102	86	106	53
warmth	82	69	47	24
coolness	18	31	155	76

4.5 Summary

Within both of these two categories, I submitted the images to further, more detailed content and compositional analysis in which I identified additional axes of coding in the process of a recursive and iterative close visual reading of images. Overall, to compare the compositional

analysis of smart home images to the image of a typical home, it is important to mention that the information value of smart home images is on the right side and center in order to give new information regarding smart home devices. Further, images are mostly taken at a frontal angle to attract viewers' attention to all parts of the image equally. Generally, smart homes with both visible and hidden technology are represented with a maximal interaction with the outside due to using expansive windows and wide entrances and the exterior is much visible from the inside. Natural light and a green environment play an important role in showing a fresh and lively space, which makes the home feel naturally warmer and welcoming as well as improving overall wellbeing. Natural lighting boosts productivity, happiness, and calmness, according to research (Bille, 2015). Natural light is also beneficial for enhancing the physical aesthetics of the space since it makes rooms deeper, substantially brightens the interior, and accentuates the overall attractiveness (Patioenclosures.com, 2012)[8].

Identifying these patterns is important towards clarifying the differences and similarities between an image of a 'typical' (non-smart) home and image-based representations of 'smart' home spaces, and how patterns in each category of images differ and/or are similar to each other. The results of my content and compositional analysis in this chapter identify the dominant contrasts between three image types - 1) smart home where technologies are visible; 2) smart home spaces where technologies are hidden; and 3) a representative image of a 'typical', non-smart home - involve differences in colour palette, architectural design aesthetics, presence of a variety of technological devices, and the arrangement of decorative and personal objects in the home environment. These differences inform my development of a typology of smart home images published in trade architectural publications, presented in **Table 4.5**.

[8] https://www.patioenclosures.com/

Table 4.5. A visual typology of smart home images published in a selection of architectural trade magazines.

Content and compositional analysis		
Axis of differentiation	Smart homes with **visible** technology:	Smart homes with **hidden** technology:
Architectural design	Modern architecture design features (having flat roofs, large windows, and diverse ornamentation in the living room, bedroom, and kitchen)	Minimal architecture design features (simplicity, angular and straight shapes, ample use of space, minimal furniture, and exposed construction materials)
Furnishings and personalization	Densely furnished spaces with multiple decorative and personal items	Sparsely furnished spaces with scant decorative objects and adornments
Colour palette	Light and neutral colour palette on walls and furniture; low colour contrast	Comparatively, more usage of darker tones and greater contrast in the colour palette between furniture and surfaces as compared to images of smart home spaces where technologies are visible
Other distinguishing characteristics	Location of smart devices are in the center and background of images	Absence of smart devices, humans, and pets

As reflected in the **Table 4.5**, smart home images in both categories (hidden and visible technology) inform certain aesthetic features under architectural design section. The analysis of the first category of images reports that smart homes with visible technology involve modern design aesthetics (having flat roofs, large windows, and diverse ornamentation in the living room, bedroom, and kitchen). On the other hand, smart home images where technology is hidden are represented by minimalistic design features (simplicity, angular and straight shapes, ample use of space, minimal furniture, and exposed construction materials). Moreover, in the furnishing and personalization section, smart homes with modern design aesthetics are shown densely furnished and the ones with minimal aesthetics are visualized with a few numbers of furniture in home environment. Colour palettes have contrast in two categories (smart homes with hidden

versus visible technology). Finally, other distinguishing characteristics show that smart home images with visible technology present smart devices in the center and background of images. However, no instances of smart technology are visible in images where technology is hidden. In terms of demographics, humans and pets are dominantly visible in the second category (hidden technology).

By conducting content and compositional analysis of smart home images, I identified patterns of differentiation between images of smart homes - with visible and hidden technology, respectively - as compared to a non-smart, 'typical' home. These patterns, summarized below, are informed by content and composition codes created in each section (**Tables 4.1, 4.2, 4.3,** and **4.4**). Particularly, these patterns are different in smart home images in which technology is visible and those in which technology is hidden.

4.5.1 Smart home images where technology is visible

In this category of images, first, the interior design of the smart home embodies modernist design features rather than minimalistic and is similar to the visualization of a typical home that has flat roofs, large windows, and diverse ornamentations. The smart home interior space is densely furnished, decorated, and personalized with personal and multiple decorative items. Further, the colour palette that is used in these images is mostly light and neutral tones, while within the image of a typical home, warm colour tones are applied on furniture and walls. From a compositional and technology concentration perspective, smart appliances are evenly distributed in the background and foreground of the smart home space. These devices are in the center and on the right side of the images. However, in the image of a 'typical' (non-smart) home, there is no sign of technology. The visualizations of smart homes with visible technology

in architectural trade publications encourage the viewers to ponder and imagine what it looks like living in smart living spaces surrounded by the latest technologies since they are framed by frontal angles to attract attention.

4.5.2 Smart home images where technology is hidden

In my sample of images, smart homes in which technology is hidden are portrayed with the bare minimum of various types of embellishments. They are designed based on minimalist design features, which include simplicity in the aesthetics of interior space, angular and straight shapes, ample use of space, minimal furniture, and exposed construction materials (concrete, wood, stone). In contrast to the smart homes with visible technology and the typical home, the home interior is extremely depersonalized and sparsely furnished with minimal decorative objects. There is no clutter in the space, which makes it sparse and spacious. Furthermore, in this group, compared to the number of collected images (202 out of 360), humans and family pets appear less than in the other category in which technology is visible.

Employing visual analytic approaches, including content and compositional analysis, provides an entry point for interrogating whether visual representations of the 'home' as expressed in architectural magazines images map onto conventional representations of 'home', or whether they point to a transformation of this concept. A content and compositional analysis break apart the smart home images in both categories into their individual elements and compositional forms and relations, which then allows me to identify and analyze those elements as particular signs in my subsequent semiotic analysis (**Chapter 5**). In other words, content and compositional analysis support my identification of image elements and components to then

consider as functioning as a certain sign (e.g., symbolic, indexical, iconic) and investigating what types of meaning (connotative, denotative) are signified.

The next chapter (**Chapter 5**) deploys semiotic analysis of a selected subset of my image sample to investigate the meanings of home that are transferred through image elements that function as signs of both ‘smartness’ and ‘home’.

Chapter 5: Semiotic analysis

5.1. Introduction

This chapter presents a semiotic analysis of smart home images collected from multiple architectural trade publications, as described in the methodology chapter (**Chapter 3**). The purpose of this analysis is to identify signs of home and of smartness, and what they semiotically signify in the selected images. The semiotic analysis offered in this chapter is conducted on two categories of images that were identified as a result of content and compositional analysis (**Chapter 4**): smart home images in which technology is visible, and smart home images with hidden technology. Substantially, this chapter discusses semiotic themes related to each category of images on the basis of the semiotic analysis. The semiotic analysis starts with analyzing a visual representation of a 'typical', non-smart home. This image defines the type of signs of home (Iconic, Symbolic, Indexical), as well as their denotative and connotative meanings. The purpose of semiotic analysis of a non-smart home is to demonstrate how the paradigm of a typical home is visually represented in selected smart home images in this chapter. With this aim, I carefully chose a selective sample of smart home images to underline the discrepancies and the similarities between the visual imageries of a typical home and a smart home.

This chapter uses smart home images for the detailed semiotic analysis reported, based on the results obtained in the content and compositional analysis of the images in the previous chapter (**Chapter 4**). Specifically, I have selected a total of 12 smart home images and included for semiotic analysis. These are images that I have deemed to be illustrative of both i) images of smart homes in which technology is visible (6), and ii) images of smart homes where technology is hidden (6). These selected images are 'representative' in that they include the most frequently encountered elements (contents), aesthetic designs, and compositional forms identified in my

content and compositional analyses (**Chapter 4**) of the larger image sample and met the copyright requirements for reproducibility in this thesis.

To recognize how images of smart homes function semiotically to signify both 'home' and 'smartness', it is important to understand how representations of 'typical', non-smart homes function semiotically as well. I use a contemporary visualization of a domestic space that semiotically expresses a normative representation of 'home' to show how meanings of 'smartness' and 'home' are expressed and how the 'smart home' itself is signified through visualizations in architectural magazines. Smartness commonly describes a new product, referring to the environment, condition, or motion of technology that adapts to certain functions or is tailored to specific circumstances (Cross et al., 2013). Images of smart homes (containing visible and hidden technology) function semiotically in two ways relative to the figure of a 'typical' home: by invoking semiotic tropes of the typical 'home', and also in opposition to them, particularly when technologies are visibly absent. As such, I begin with a semiotic analysis of a 'typical' (non-smart) home to establish a basis of analytic comparison to show how 'smart' home figures signify both 'home' and 'smartness'. To achieve these objectives, iconic, indexical, and symbolic signs that signify smartness and meanings of the home through their relations and opposition to this 'typical' representation are identified and analyzed. Based on the methodology described in **Chapter 3**, key semiotic themes for a representative image of a 'typical' home, as well as for smart home images in which technologies are present and those where they are hidden, are described.

5.2. Semiotic analysis of a typical home:

A trade architectural image of a 'typical' (non-smart) contemporary home is provided in **Figure 4.1 (Chapter 4).** A 'typical' home in opposition to a smart home is not one devoid of technology, but rather one in which it is assumed that individuals may need to manually turn on the TV, close the blinds, and turn on/off the lights and other gadgets, whereas, in a 'smart' home, the imaginary is of a domestic space in which such tasks have become automated and can be remotely controlled. A typical home is often imagined as a relaxing and cozy space in which the living room, dining area, and kitchen are densely furnished with comfortable furniture, diverse decorative objects, family photos, and personal items – all present in **Figure 4.1**. The colour palette for the furniture, accents (pillows, throws), and walls in **Figure 4.1** includes warm tones, which makes the home atmosphere warm. These warm colours - such as yellow and orange used on surfaces and in furniture – are the first symbolic signs (have a conventionalized but arbitrary relation between signifier and signified) that attract attention as the dominant warm colours. They evoke feelings of warmth and comfort, which signify the home environment as being cozy and comfortable, and a place in which to relax. This sense of comfort is likewise expressed by the furniture, specifically, the overstuffed sofa and fluffed cushions on the couch, which open onto an imagination of coming home from work, laying down on the couch, and unwinding.

The image of a 'typical' home furthermore showcases an exhaustive use of space occupied with various pieces of furniture. The space is filled with personal items strewn across the living room, including a messily strewn blanket (indexical signs), a blackboard with writing, and a family pet (a dog) stretched out on the rug (symbolic signs). These are symbolic (signs where the signifier and signified have arbitrary relation) and indexical (signs where the signifier is caused by the signified) signs of home signal it to be an inhabited (lived-in) space. It is

significant to think about paradigmatic contrasts here, for instance, why a dog is used as a symbolic sign of home to show a family place. This representation refers to the fact that owning a family pet, especially a dog, is very common in Western culture, where dogs are treated as members of the family and are seen as protectors of the home.

Another indexical sign that signifies this 'typical' contemporary home to be a highly personalized space is a home interior arranged with a wide range of decorative items, including plants, paintings, desk lamps, and sculptures. These items indicate occupants stylized the living room in the foreground of the image (**Figure 4.1**) according to their personal tastes, which are open to change. Inhabitants have the authority to move and locate any type of furniture whenever and wherever they wish, according to their preferences at home. Furthermore, from an architectural and design aesthetic perspective, the ceiling height of this home is low. In addition to making the home look cozy, it also causes the living space to look more cramped and creates a sense of smallness and limited opportunities for bodily movement. A lower as compared to higher ceiling works indexically to stimulate the effects of confinement versus freedom, respectively (University of Minnesota, 2007[9]).

Lastly, the home environment visualized in **Figure 4.1** is filled with natural light and plants. The existence of sunlight and plants as indexical and symbolic signs respectively in the house implies freshness and happiness, which are opposed to senses of darkness and depression. Likewise, the presence of these plants, which require frequent attention and care, also signifies lived-in-ness (the presence of inhabitants who, for instance, water the plants). **Figure 4.1** is also a 'busy' visualization of a typical home - one dense with multiple pieces of colourful furniture and paintings on the wall. Overall, one does not immediately observe a typical home signaled as a highly personalized space with sparseness, separation, and signs of smartness. Therefore, signs

[9] https://www.sciencedaily.com/releases/2007/04/070424155539.htm

of coziness, personalization, 'lived-in-ness,' and a family place in which inhabitants are assumed to feel comfortable and relaxed correspond with the paradigms of a traditional sense of 'home'. Signs, including furniture that is dedicated to more than two individuals, fruits on the table, and a pet (dog) in this figure, signify the expression of a family place.

The introductory section of this chapter mentions that in this research, smart home images in my sample have been categorized based on the visibility of technology in the home environment: those where technologies are visible, and those where technologies are hidden. As I show with reference to select images drawn from this larger sample, images of smart homes where technology is visible mobilize semiotic tropes of a 'typical' home, such as that represented in **Figure 4.1** to preserve the meanings of 'home' that are attached to domestic spaces. However, in images of smart homes in which technology is not visible, semiotic tropes of a non-smart home are not similarly mobilized. Instead, my analysis identifies these images function to express 'smartness' through semiotic opposition to visualizations of a 'typical', non-smart home. I analyze signs of home and smartness, their contrasts, and connections with signs of home in a 'typical', 'non-smart' home for both categories of images in the sections that follow.

5.3. The semiotics of 'smart home' images where technology is visible

To conduct the semiotic analysis of images with visible smart technology, I have selected 6 smart home images where technology is visible (**Figures 5.1 - 5.6**) from the ArchDaily website[10], Control4[11], and Home and Design[12] architectural magazines. These images are a selective sample, which is a comprehensive example of the most common and important features (contents, aesthetic designs, and compositional forms) of images in this category. Figures are

[10] https://www.archdaily.com/
[11] https://www.control4.com/tools/hsh
[12] https://www.homeanddesign.com/

demonstrative of the semiotic themes that I identify by analyzing the signs of home and smartness within smart home figures where technology is visible. Furthermore, the main difference between smart home visual representations in this category with the 'typical home' is the presence of diverse smart devices in the home environment. In these figures, the focus is on smart technologies occupying the home space and how they are embedded within the home design aesthetics and family living environments. In this section, I introduce six selected images and present the key findings of their semiotic analysis.

My semiotic analysis of smart home images with visible technology (**Figures 5.1 - 5.6**) informs my identification of four keyways – or 'themes' – through which these images semiotically express the meanings of 'home' via the mobilization of four key themes. Specifically, depictions of smart homes in which the technology is visible assemble tropes of 'home' by:

1. Signifying the ability to control the space(s) of the home.
2. Signalling smart home spaces as 'lived in' by visualising housework activities.
3. Mirroring non-smart ('typical') home interior design aesthetics and mobilizing additional 'typical' indexical and symbolic signs of 'home' such as densely furnished home space (s) with personal properties.

5.3.1 Signifying the ability to control the space(s) of the home:

Figures 5.1 – 5.6 are representative of images where smart home technologies are visible in that they characterized by the presence of iconic signs of smartness, which involve the foregrounding of smart home interface and appliances. The reason smart home devices (interfaces/panels, appliances) are considered iconic signs of smartness is that the signify the

literal meaning of smartness, which is associated with technological advancement. The presence of several smart devices in the home environment is seen in, for instance, **Figure 5.1**, where smart appliances such as smart lighting, smart switches, mounted touch panels, smart curtains, and smart thermostats are visible and located in multiple spaces in the living room. In contrast, in **Figure 4.1** (image of a 'typical' non-smart home), there are no direct signs of technology to signal smartness. These iconic signs (smart appliances and interfaces) function to signify that the entire home may be managed and monitored from residents' fingertips at any time. As such, situating smart devices in different spots in the home according to individuals' demands as typified in **Figures 5.1** and **5.2** signifies smartness in these images. As the superimposed, red-encircled icons in **Figure 5.1** directly signify, controlling various functions of smart home devices from different locations within the home space is possible as long as residents have access to a network connection, which is implied. Smart home devices are constantly interconnected and need to be configured to implement various tasks to meet householders' needs for communication, health, entertainment, and work at home. These visible signs of smartness include mounted touch panels (**Figure 5.1**), smart blinds (**Figure 5.1**), tablets (**Figure 5.1**), smart switches (**Figure 5.1**), smart TV's (**Figure 5.2**), smart lighting (**Figure 5.2**), smart voice recognition gadgets (**Figure 5.2**), large-format display (**Figure 5.3** and **5.6**), laptop (**Figure 5.4**), smart security systems (**Figure 5.5**), and smart elevators (**Figure 5.5**).

Figure 5.1. A smart home interior focussed on a living room area. Published: 2019. Photographer: AVE Chile. Website: ARCHDAILY. Date of access: 2021-09-16. URL: https://www.archdaily.com/908468/how-to-design-smart-homes-8-tips-for-incorporating-domotics-into-architecture/5c1166ee08a5e54bad000904-how-to-design-smart-homes-8-tips-for-incorporating-domotics-into-architecture-photo

5.3.2 Signaling smart home spaces as 'lived in' by visualising housework activities:

Another recurring sign of these spaces as 'home' is the presence of inhabitants within images engaged in quotidian activities that regularly take place in the home. As in **Figure 5.2**, characters (two women) gathering while working with a smart monitor function not only as a symbolic sign of smartness but also connotes the smart home to be a space of socialization. Home is the physical "setting through which basic forms of social relations are constituted and reproduced" (Rykwert, 1991, p.58). **Figure 5.2** also displays individuals' tendency to be familiar with and use of smart technologies. Familiarity plays a significant part in diminishing complexity in navigating the digital environment in the smart home (Guo et al., 2019; Zhang et al., 2019). In this figure, being in contact with the smart monitor functions as an indexical sign of smartness, which causes interaction and interfacing with smart appliances in a digital environment to be an

inseparable part of household routine activities. This figure allows one to feel that the home has always been a recipient and user of new smart technologies (Argandoña et al., 2021).

Furthermore, in **Figure 5.3**, a man lies down on the couch with a comfortable posture, aiming to control and personalize the smart home lighting through a laptop. Switching on and off the lights at home is a regular activity which is carried out by the inhabitants. This figure plays into the ‘signaling a lived-in space by picturing housework activities’ theme semiotically. Presenting an individual working with a personal device to control a smart technology connotes that a smart home offers to learn about and maintain smart technologies throughout life comfortably. In this sense, residents are able to perform ordinary tasks from different locations effortlessly. Additionally, they will be capable of working with smart devices by experiencing and experimenting with everyday life.

Figure 5.2. A smart home kitchen. Published: Fall 2018. Photographer: Unknown. Magazine: CONTROL4. Date of access: 2021-09-09.
URL: https://www.control4.com/files/preview/825fa04ff93a120

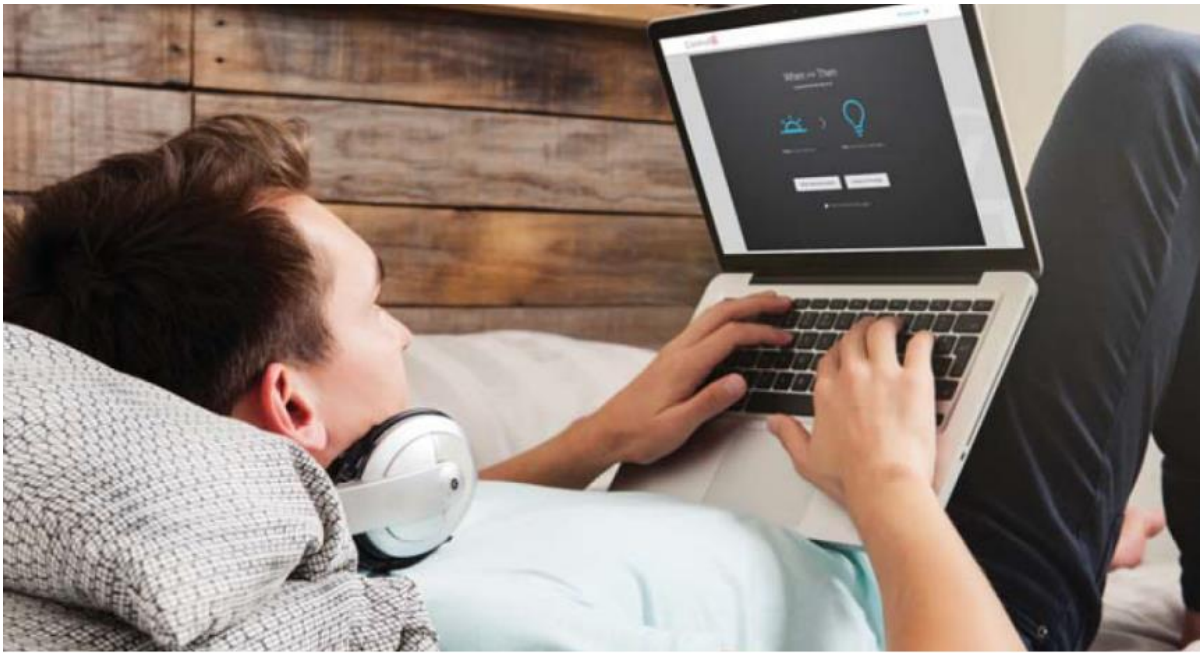

Figure 5.3. Smart people customise their smart homes. Published: Spring 2018. Photographer: Unknown. Magazine: CONTROL4. Date of access: 2021-09-09. URL: https://www.control4.com/files/preview/cdcf823f8d0d3c6

5.3.3 Mirroring non-smart ('typical') home interior design aesthetics and mobilizing additional 'typical' indexical and symbolic signs of 'home' such as densely furnished home space (s) with personal properties.

My semiotic analysis of smart home images where technologies are visible shows that there are specific signs within images that create similarities with a non 'smart' homes. Smart home visualizations with visible foregrounded technology mobilize semiotic tropes of the typical home, a representative example of which is provided in **Figure 4.1**. As exemplified in **Figures 5.1** and **5.4**, despite the visibility of technology, the home environment comprises comfortable furniture, neutral colour tones, crowded with several decorative objects and plants. Smart homes are depicted as spaces that we still would be familiar with as (or would recognize as) a 'home' in the traditional sense of the word. The images continue to semiotically convey the meaning of

‘home’ inspired by ‘typical home’ representations. In further detail, **Figures 5.1** and **5.4** depict a smart home in which the comfortable furniture and decorative objects are arranged and centered around the TV and coffee table despite the presence of smart devices in the space. This arrangement of the living room comes into play in the image as a symbolic sign of home in contemporary homes.

Particularly, from an architectural and design aesthetic point of view, smart homes where technology is visible mobilize the aesthetic features of a typical home as well. For instance, **Figure 5.4** pictures a smart home interior space that features a typical (non-smart) home design aesthetic such as having large windows, a harmonious colour palette on furniture and walls (light neutral tones), being densely furnished with comfortable furniture, a few personal items, as well as resemblance in decorations (patterns). The architectural design aesthetics are dominantly modern rather than minimal, which is utilized in smart homes with hidden technology. Modernist design entails certain iconic signs, including large windows, flat roofs, exposed construction materials, and a light neutral colour palette on furniture choices and surfaces. These modernist design aesthetics are the language of modern architecture that expresses a modern living space inspired by early advanced home exhibitions (Kudryashova et al., 2020).

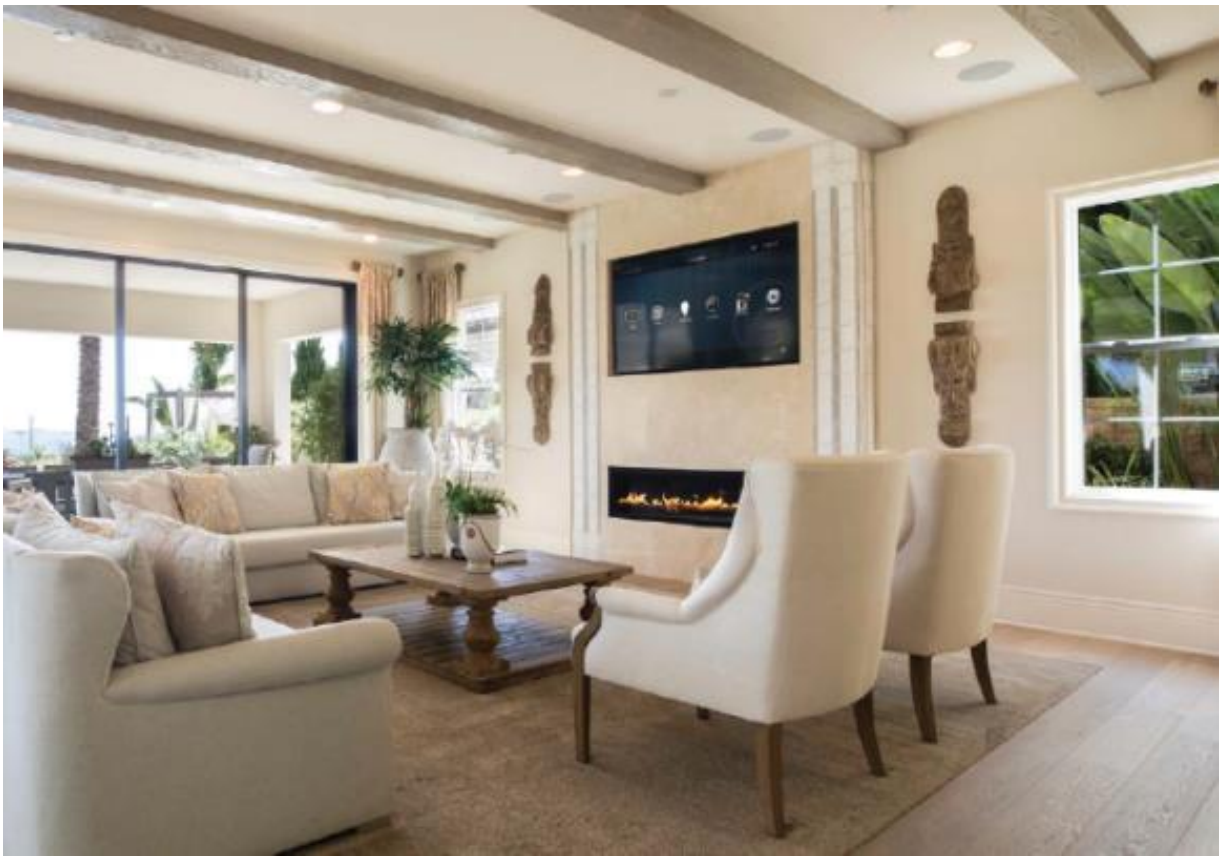

Figure 5.4. A smart home interior with large windows. Published: Spring 2018. Publisher: John Sciacca. Magazine: CONTROL4. Date of access: 2021-09-09. URL: https://www.control4.com/files/preview/cdcf823f8d0d3c6

As I mentioned in a semiotic analysis of an image of a typical home (**Figure 4.1**), symbolic signs of home including, a dog on the carpet, and multiple personal and decorative objects signify a personalized space. These symbolic signs of home are also evident in smart home images where technology is visible. In this respect, the home environments in **Figures 5.5** and **5.6** are represented densely furnished with various items from personal to decorative ones which function as signs and signify that the home is lived-in by inhabitants. These figures also show that characters are in a process of daily activities (indexical sign) that cause the home

spaces to look like habitable family homes. Therefore, the mobilization of symbolic and indexical signs of home in smart home images with visible technology suggests that these home spaces are still ‘homes’ in the conventional sense.

Figure 5.5 shows a child’s toys, an untidy carpet, personal items, and a man who is carrying a baby –these are indexical signs that signify that the smart home is a family-friendly and private space that considers the comfort of families with young siblings. Furthermore, the man’s gesture signifies a sense of cherishing and care, as does his movement towards the smart elevator as he carries the child. It is important to mention that the living room is illustrated as fairly chaotic and occupied with multiple personal properties, which plays into the idea that employing smart technology functions as a solution to the messiness in the home. Another semiotic paradigm of the home is also evident in **Figure 5.6**, which shows two individuals holding hands while watching a movie in a smart theatre. The theatre signals the design aesthetics of a living room in a ‘typical’ home with comfortable furniture and a warm colour palette. By looking at this figure, one can feel the social intimacy and a friendly atmosphere. All these feelings can be evoked through characters' posture and design aesthetics, despite the visibility of smart technology. Further, clutter in space reminds us of an image of a typical home in which sparseness is hardly observable and the living room is adorned with diverse comfortable and decorative furniture.

Figure 5.5. A smart home interior showcasing an elevator. Published: 2020. Photographer: Erik Undéhn. Website: ARCHDAILY. Date of access: 2021-09-16. URL: https://www.archdaily.com/961996/reinventing-the-platform-lift-as-a-design-statement-for-accessibility-at-home-aritco?ad_source=search&ad_medium=search_result_articles

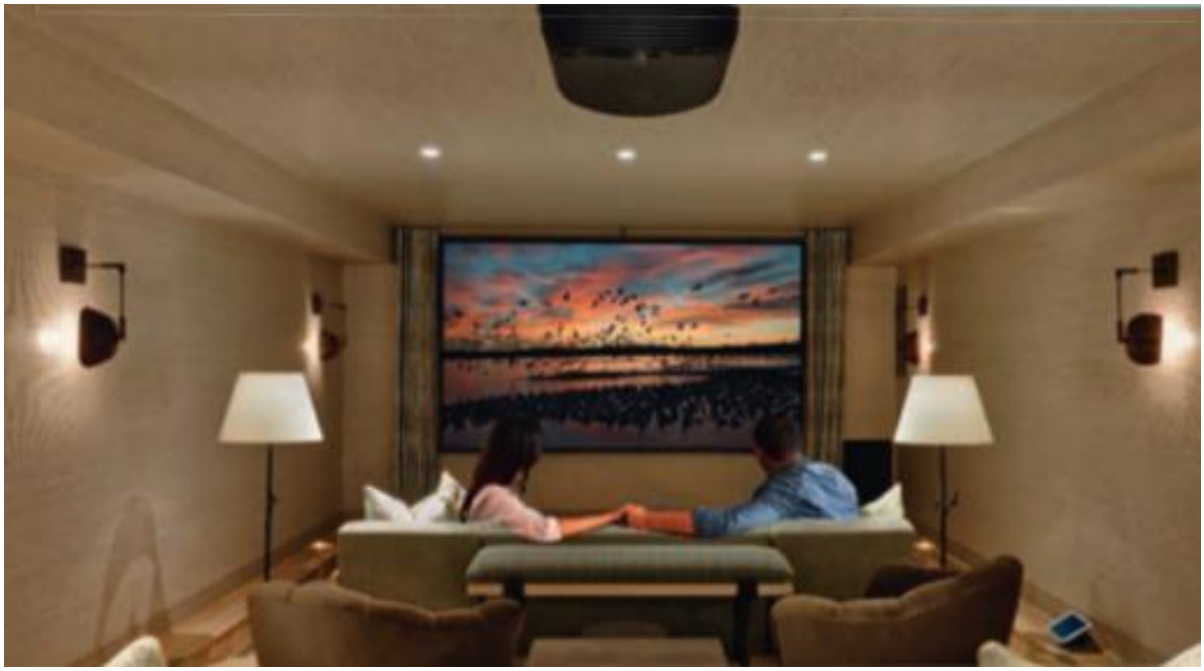

Figure 5.6. A smart theatre. Published: September/October 2020. Photographer: Unknown. Magazine: HOME AND DESIGN. Date of access: 2021-09-10.
URL: https://www.homeanddesign.com/flipbooks/homedesign-september-october-2020/

To summarize, based on the semiotic themes that I identify in my semiotic analysis of smart home images where technology is visible, the major contrast between this category of images and a 'typical' (non-smart) home, such as the one depicted in **Figure 4.1**, is the visibility of iconic signs of smartness (smart appliances) in the home environment. Yet smart home images containing visible technological devices signal common design aesthetic features *of* these 'typical' representations. The overall smart home representations in these figures have a resemblance to a conventional (typical) home. In other words, smart home images in this category are visualized in a way to express a familiar and traditional home by mobilizing the semiotic signatures of a 'non-smart home' through indexical, iconic, and symbolic signs of home. The significance of these semiotic findings is discussed in **Chapter 6**.

5.4. The semiotics of 'smart home' images where technology is hidden

My semiotic analysis of selected images continues with analysing smart homes in which the technologies are hidden, or not visible. In this category, I selected six images (**Figures 5.7-5.12**) representative of a bigger sample of smart home images from the ArchDaily website[13] and Canadian Architect[14] magazine. They involve aesthetic appeal and highlight perceptions of a smart home through conventionalized depictions and compositional forms, as well as being publicly viewable without a paywall. Selected smart home images with hidden technology empirically illustrate the themes that I concluded through semiotic analysis.

In images of smart homes where smart technology is hidden, various signs nevertheless function to signify 'smartness' through relationships and contrast with images both of typical (e.g., **Figure 4.1**) and of smart homes with visible technology (e.g., **Figures 5.1 – 5.6**). In this class of images (where technologies are absent/hidden), there are no denotative signs of smartness as visible smart devices. Instead, 'smartness' is expressed through connotative signs. Connotation represents the various social overtones, cultural implications, or emotional meanings associated with the sign (Berger, 2018; Rose, 2016). On the other hand, denotative signs signify the literal or obvious meaning of the sign. Thus, the denotation of the visual image refers to what all people see without association with their culture (Berger, 2018; Bouzida, 2014; Rose, 2016).

My semiotic analysis of smart home images with hidden technology (**Figures 5.7-5.12**) reveals five semiotic themes which are identified and discussed below. These themes were identified by exploring signs of home and smartness within images and looking for distinctions and resemblances related to the image of the 'typical home'. The following semiotic themes

[13] https://www.archdaily.com/

[14] https://www.canadianarchitect.com/magazine/

capture a meaning of ‘home’ that is being changed through images in this category (absence of visible signs of smart technology):

1. Minimalist design aesthetics; (dark and cool colour palettes, simplicity of furniture and forms, pure materials).
2. Sparseness in home interiors.
3. Contrast in the colour palettes of furniture and walls.
4. Depersonalization of the home environment.
5. Depopulation of the home and absence of ‘signs of life’ (people and pets).

5.4.1 Minimalist design aesthetics

A symbolic sign that appears to dominate in most of these figures of smart homes, such as **Figures 5.7, 5.8, 5.9,** and **5.10,** is the neutral, dark, and cool colour palettes of the figures, including gray, white, brown, and black on built surfaces and as found in furniture choices. These colour palettes (dark tones/hues) work as a sign to signal that these spaces are *non*-typical homes – which is achieved in contrast to the warm colour palettes of a paradigmatic ‘typical’ home, as shown in **Figure 4.1**. As such, this representation of the smart homes’ interiors in which smart technologies are themselves hidden from view connotes smartness through aesthetic differentiation from a ‘typical’ home. Further, the home is composed of the prominence of exposed building materials (mostly poured concrete and natural stone; **Figures 5.7** and **5.8**), simple finishes, bare walls, angular lines (e.g., **Figure 5.10**), and terraced views of the outdoor environment (e.g., **Figure 5.9**). These features work together as iconic signs that express the minimalist design aesthetic of smart homes (Nia & Rahbarianyazd, 2020). Minimalist architects are not exclusively concerned with the physical aesthetic qualities of the building but with the

aesthetics. They do so by paying attention to the interior, nature, details, materials, people, and technology that is going to be used in space (Bertoni, 2002). Therefore, presenting smart homes with minimalistic design aesthetics as well as creating remarkable colour palettes signifies a simple and unadorned smart living space without the visibility of smart technology.

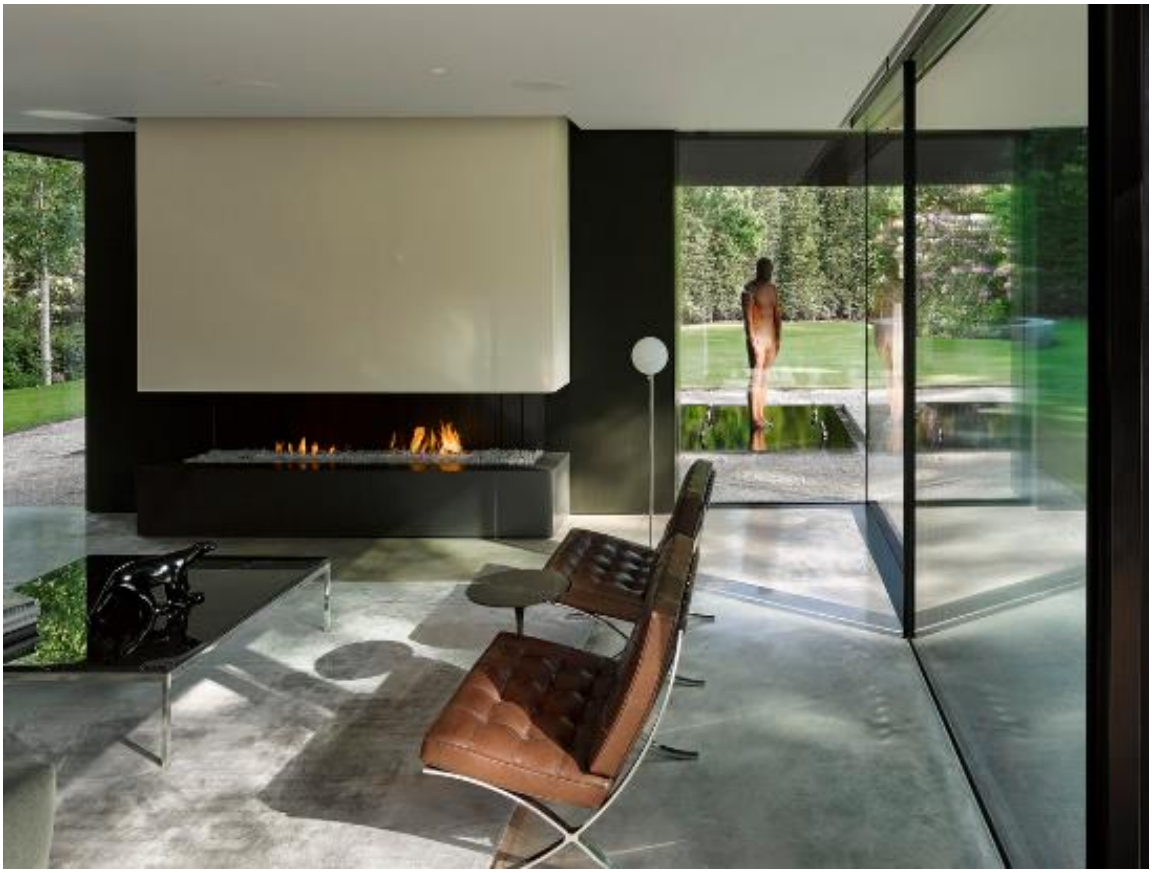

Figure 5.7. A smart home living room with ‘hidden’ technologies. Published: 2020. Photographer: Daniel Hopkinson. Website: ARCHDAILY. Date of access: 2021-09-16.
URL: https://www.archdaily.com/963734/winter-house-scott-donald-architecture/60d0dcc52d3a130164f57d92-winter-house-scott-donald-architecture-photo?next_project=no

5.4.2 Sparseness of interiors:

Additionally, a number of the home interiors where technologies are absent are sparsely furnished. Here, the minimal presence of furniture in these figures (e.g., **Figures 5.7, 5.8,** and **5.9**) function as a connotative sign signifying the ample usage of space in a smart home and shows that the use of space is not exhausted, which opposes a densely furnished space as seen in a representative image of a 'typical' home (**Figure 4.1**). The article of Stevanovic (2013) speaks of concepts of simplicity, and emptiness which are unique to minimalism since the start of its development. In a smart, minimal, and controlled home where technology is hidden, clutter is unnecessary because the space itself is the ultimate expression of the efficiency ushered in by the 'smart' home technologies.

5.4.3 Contrast in the colour palettes of furniture and walls:

The contrast between the colours of the living room furniture and walls in **Figures 5.8** and **5.9** is also a symbolic sign that is mostly seen in smart home images with hidden technology, while in a non-smart, 'typical' home (e.g., **Figure 4.1**), there is greater 'harmony' amongst the colours used. The 'digital' environment is often expressed using a strong colour palette, namely blue, green, and black (Houser, 2014). Colour conveys no meaning on its own but connotes feelings and emotions that alter depending on culture, time, individual experience, or gender (Science Daily, 2018)[15]. Consequently, in a smart home environment where technology is hidden, such as that depicted in **Figures 5.8** and **5.9**, light and neutral colours, such as white and brown, have been combined with dark backgrounds (black, blue, and green).

[15] https://www.sciencedaily.com/search/?keyword=usage+of+color+in+technology

This colour palette semiotically evokes the response of being in a smart environment by inhabitants. In visual representations, ‘digital’ is often expressed using a bold colour palette, namely colours of fluorescent blue, neon green, and black (Cerrato, 2012; Sharpe, 1974). Technology companies are looking for a way to establish credibility, trust, security, and authority, so they often choose one of four colours: Blue, White, Black, and Red. These colours are fundamentally mystical, unnatural, and inhuman that fit the technology of the future world. (99 percent invisible podcast, episode 95)[16]. As such, the contrasting background colour palettes – which are blue, black, and green – also play into the idea of technological space and signify smartness.

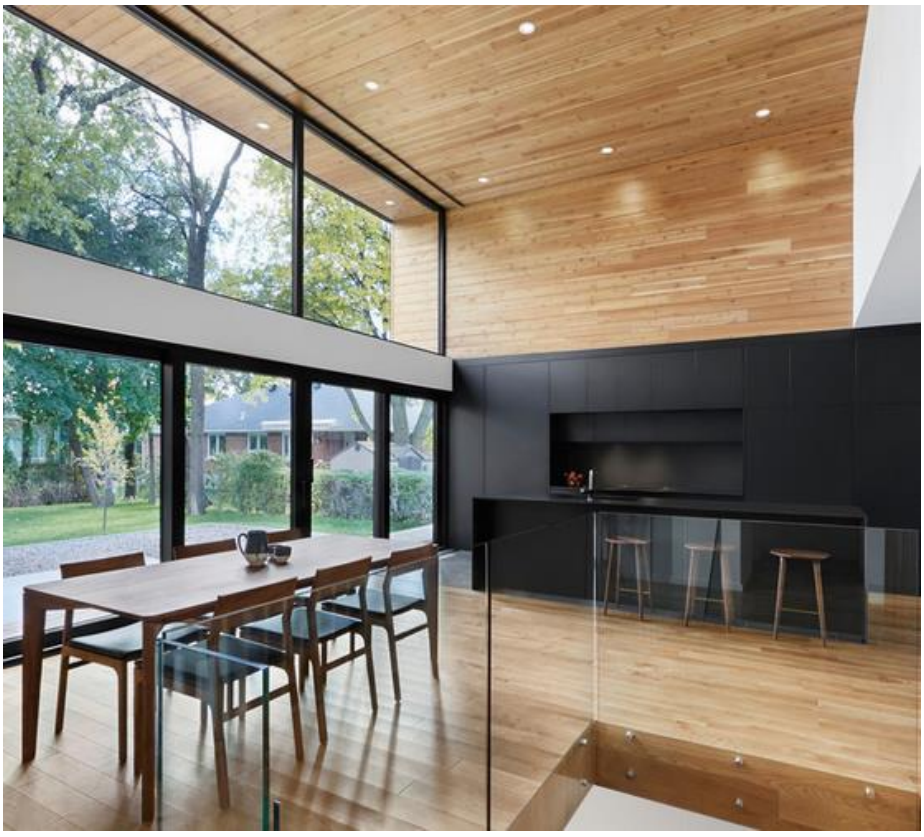

Figure 5.8. A smart home dining area. Published: 2018. Photographer: Annie Faffard. Website: ARCHDAILY. Date of access: 2021-09-17.
URL: https://www.archdaily.com/959683/pearl-house-mxma-architecture-and-design/606cd6c4f91c8155b90002d7-pearl-house-mxma-architecture-and-design-

[16] https://99percentinvisible.org/episode/episode-49-queue-theory-and-design/

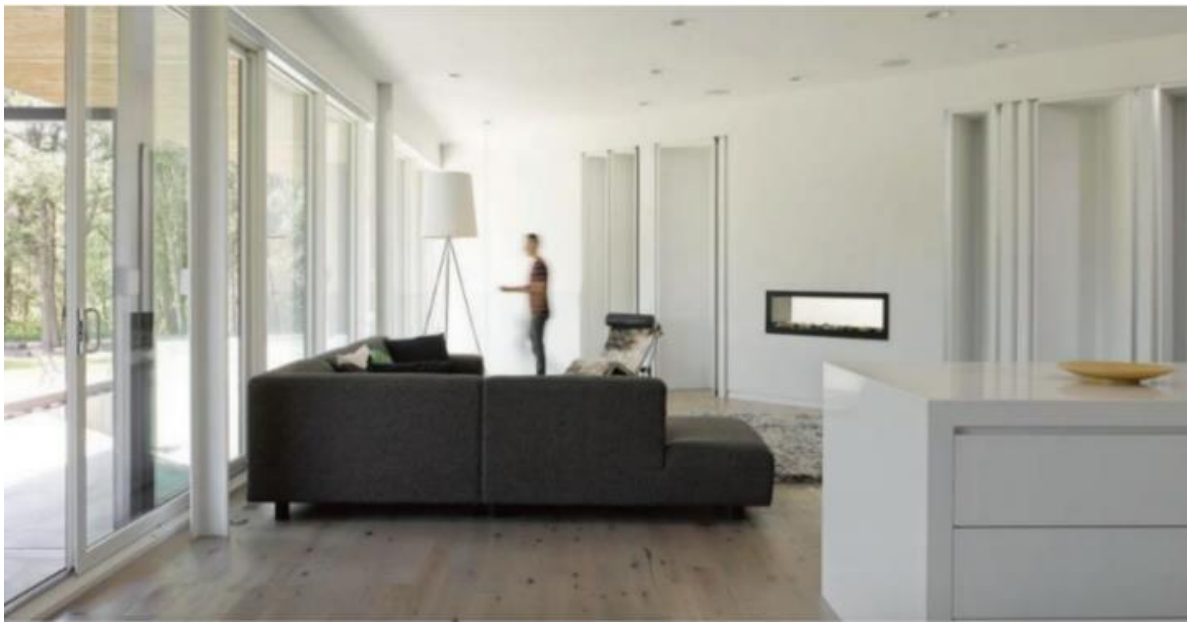

Figure 5.9. A smart living room with ‘hidden’ technology. Published: May 2018. Photographer: James Brittain. Magazine: CANADIAN ARCHITECT. Date of access: 2021-09-10.
URL: https://www.canadianarchitect.com/canadian-architect-may-2018-issue/

5.4.4. Depersonalization of the home environment:

Whereas a typical home is commonly portrayed as a private and personalized space containing family photos, books on bookshelves, and diverse decorative furniture in the living room, in figures of smart homes where technology is hidden, the spaces of the home are unadorned, with the least number of personal items visible (e.g., **Figure 5.10**). A semiotic theme apparent in such images is of the depersonalization of the home environment. In other words, smart homes are not represented as spaces that serve as storage for placement of personal ‘stuff,’ (e.g., **Figure 4.1**), but rather as unadorned structures that support technological advancements, new materials, and functional design (Chambers, 2016, 2020). This depersonalization functions as a sign that signifies the shifting place of personalized decorativeness to one productive smart

space. This suggests that in smart homes equipped with invisible technology, there is no need for extra personal items or furniture, since technology as a solution takes care of the messiness and disorder at home. As a result, these home environments mostly look clean and pristine.

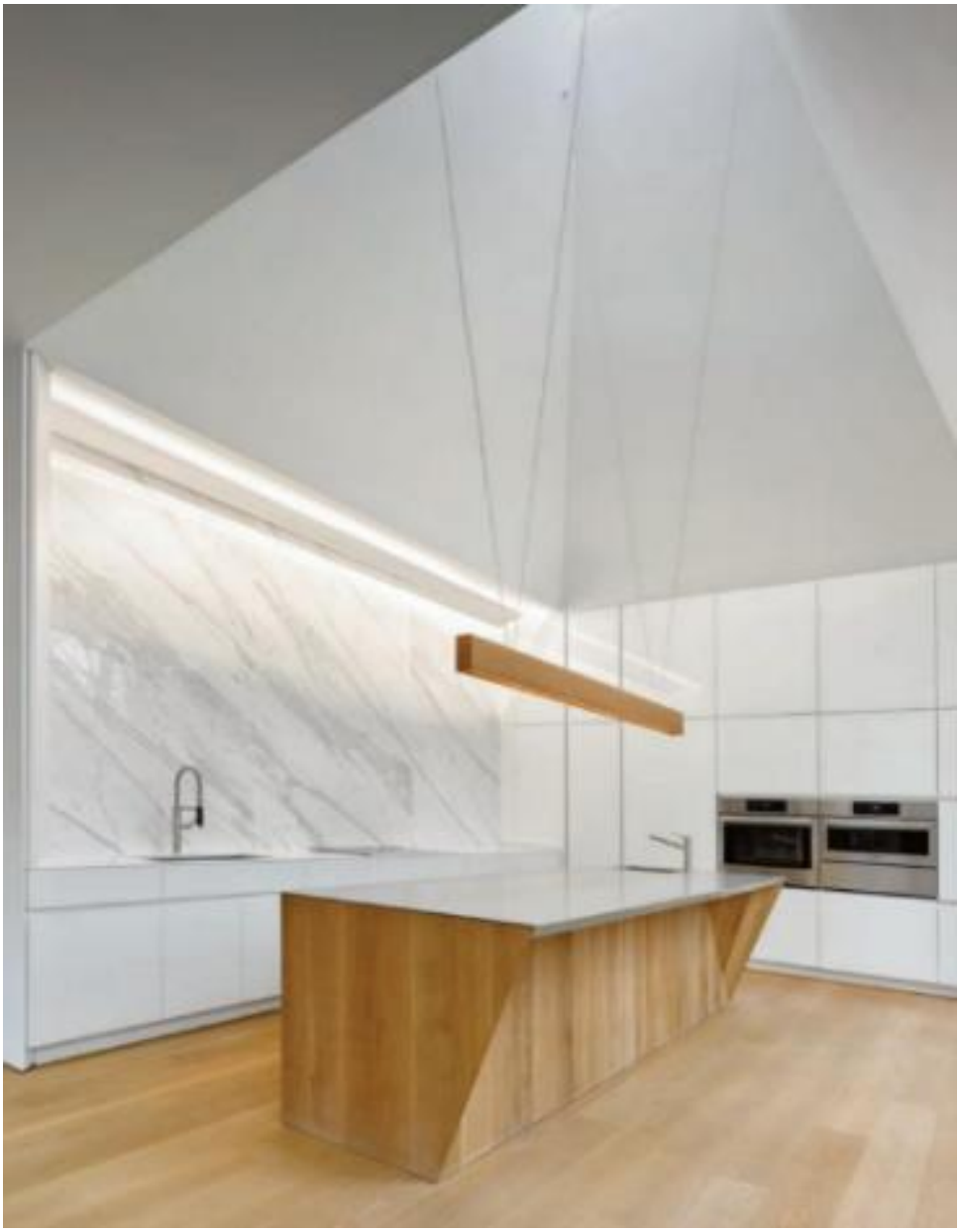

Figure 5.10. A smart kitchen. Published: April 2018. Photographer: Ben Rahn. Magazine: CANADIAN ARCHITEC. Date of access: 2021-09-10.
URL: https://www.canadianarchitect.com/canadian-architect-april-2018-issue/

5.4.5 Depopulation of the home and absence of 'signs of life' (people and pets):

Under this semiotic theme, **Figures 5.11** and **5.12** are the only two examples in my selected images of cellular life in smart home images where technology is hidden. The majority of smart home images with hidden technology do not include the presence of people or animals. In other words, images of smart homes with hidden technology are largely depopulated and the demonstrations of quotidian activities by individuals are hardly seen. In contrast, in smart home images in which technology is visible, characters who engage in working with smart appliances are much more noticeable. **Figure 5.11** shows a man who is reading a book peacefully while pet dogs are relaxing and lying down close to him on the floor. As I point out in the analysis of a typical home image (**Figure 4.1**), I consider the dog a symbolic sign of home that signals the lived-in place by inhabitants (a domesticated pet that is both loved by its owners and needs taking care of by humans). Moreover, the portrayal of the man reading a book in front of a wide window in a bright living room filled with natural light works as a connotative sign of home, which signifies the peace and comfort of living in a smart home, whereas technology embedded seamlessly in the home space is in work and menial household tasks are already taken care of.

In **Figure 5.12**, two individuals appreciate the view from a smart home while having a drink in the bedroom. Coziness, relaxation, and feelings of intimacy that could be experienced in a smart home are signified due to room's warm atmosphere using yellow light, a fireplace, comfortable furniture, wooden materials, and the posture of the couple. However, in **Figures 5.7-5.10**, no signs of human or animal life are included. Absence of individuals, personal objects, and pets are indexical signs which imply depopulation in the smart home images in which technology is hidden.

In general, invisibility of these signs causes the smart home environments to appear depopulated, empty, pristine and more spacious. This representation of smart homes is distinct from smart home images with visible technology and the non-smart home images (typical home). In this regard, depopulating the home environments where smart technology is hidden indicates that home is so perfected that smart technology is able to take care of any types of housework and there is no need for additional supports by residents. Moreover, the minimalist design aesthetic features of home spaces and the role of hidden smart technology in ministering the living spaces are noticeably underlined by depopulating the home environment.

Figure 5.11. Interior photography. Published: 2019. Photographer: Emma Cross. Website: ARCHDAILY. Date of access: 2021-09-17.
URL: https://www.archdaily.com/959812/the-snug-house-green-sheep-collective/606f61aff91c817281000067-the-snug-house-green-sheep-collective-

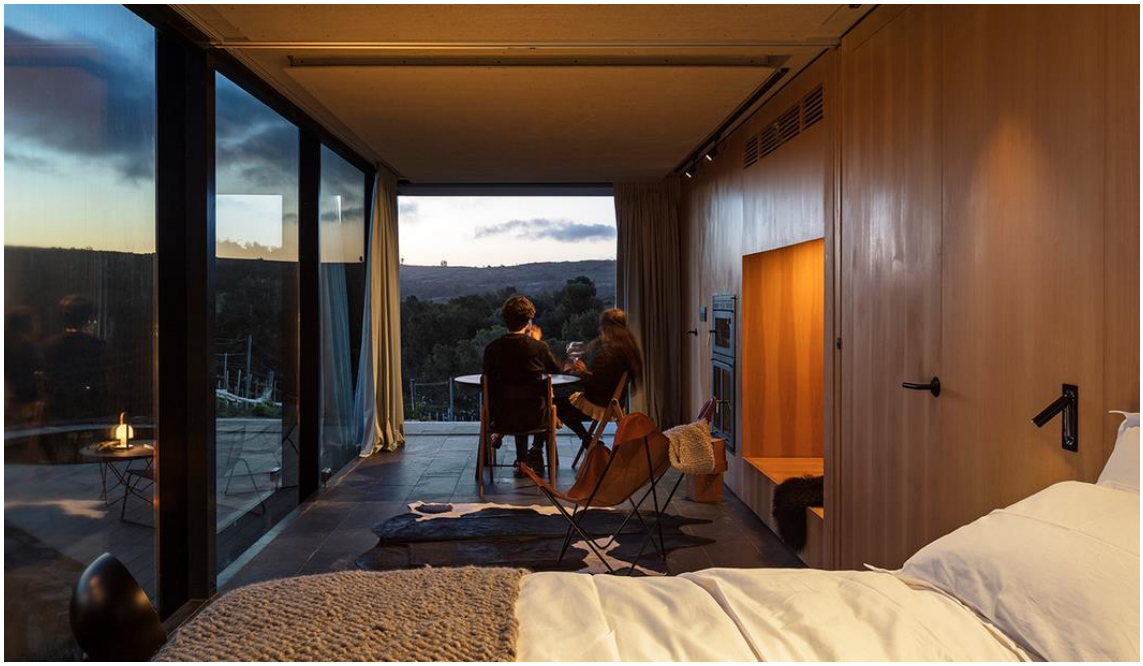

Figure 5.12. A smart bedroom. Published: 2020-06-25. Photograph: Leonardo Finotti. Website: ARCHDAILY. Date of access: 2021-09-16.
URL: https://www.archdaily.com/941241/how-to-design-a-smart-and-contactless-home/5eddbdb1b357652a61000446-how-to-design-a-smart-and-contactless-home-photo

Overall, according to relations and contrasts with signs of home and smartness in smart homes with invisible technologies and a typical home, the home in this category is represented as quite spacious, sparsely furnished, and features minimalistic design aesthetics. The semiotic tropes seen in a non-smart home (e.g., **Figure 4.1**) are barely visible in these figures compared with smart home images where technology is visible. In this regard, the smart home environment is pictured without warm colour palettes, lack of personalization, and is depopulated. Emphasis in this category of images is on the signification of efficiency by creating an open space with no clutter and minimalist aesthetics.

5.5 Summary

In this chapter, I have reported on the findings of a semiotic analysis of images of smart homes with a selective sample of images. In these images, types of signs of home and smartness are identified, and the meanings related to signs are signified. The key semiotic themes I have identified through this analysis are summarized in **Table 5.1** below. In addition, I claim the resemblances and differences between a non-smart home representation and smart homes based on the identified signs. As per **Table 5.1,** which indicates the summary of semiotic analysis of smart home imagery published in a selection of trade architectural outlets, I identified the types of signs (iconic, indexical, and symbolic) in each category of images (smart home images with hidden and visible technology) and what they mean. In this respect, Iconic signs in smart home images in which technology is visible are decorative items, comfortable furniture, and harmonious colour palettes that signify mobilization of a non-smart home (modern typical home) interior design aesthetics. In contrast, the simplicity of furniture and forms, pure and exposed materials, and contrast in colour palettes as iconic signs in another category indicate minimalist design aesthetics. Moreover, densely furnished living space with multiple smart appliances as indexical signs in smart home images with visible technology signal clutter in space and having control over smart home applications, while sparseness in home space in smart home images where technology is hidden is signified by signs including scattered furnished with a few decorative and minimal furniture pieces. Finally, existence of personal properties in the home, and showing ordinary activities as symbolic signs in smart home images with visible technology imply lived-in space by picturing housework activities, however smart home images in which technology is hidden are shown depersonalized and depopulated through signs such as the absence of individuals, personal objects, and pets.

Table 5.1. Summary of semiotic analysis of smart home imagery published in a selection of trade architectural outlets.

Type or category of signs:	Smart homes with **visible** technology:	Smart homes with **hidden** technology:
Iconic signs	Decorative items, comfortable furniture, harmonious colour palettes ↓ Signify Mobilization of a non-smart home (modern typical home) interior design aesthetics	Simplicity in furniture and forms, pure and exposed materials, contrast in colour palettes ↓ Signify Minimalist design aesthetics
Indexical signs	Densely furnished living space with multiple smart appliances ↓ Signify Clutter in space and having control over smart home applications	Scattered furnished with a few decorative and minimal furniture pieces ↓ Signify Sparseness in home space
Symbolic signs	Existence of personal properties in the home, and showing ordinary activities ↓ Signify Lived-in space by picturing housework activities	Absence of individuals, personal objects, and pets ↓ Signify Depersonalization and depopulation of the home environment

This chapter functions as a base to express the shift in the meaning of the home and how smart homes in which technology is hidden and visible are visually represented in trade publications. I dedicate the next chapter to the discussion and conclusion related to this research and explain how representations in architectural trade publications change the meaning of the home by the smart home. It also elaborates on the limitations and contributions of this study for future research.

Chapter 6: Discussion

6.1 Introduction

This chapter identifies the importance of analytical outcomes presented in **Chapters 4** and **5**. The findings of this study inform a typology of smart home aesthetics and a theorization of how this aesthetics are reconfiguring meanings of 'the home.' Summarized in **Table 4.5**, this typology, informed by the content and compositional analysis of the selected imagery described in **Chapter 4**, identifies patterns of how the smart home is portrayed in architectural trade publications. From the findings of the semiotic analysis presented in **Chapter 5** and summarized here in **Table 5.1**, this chapter subsequently discusses what trade architectural images of the smart home represent 'home' to be, and how 'smart' aesthetics are reconfiguring understandings of the home as a site for social relations, intimacy, leisure, and work.

It is important to acknowledge that in the digitally mediated present and future, the smart home will not necessarily be an accepted and widespread phenomenon, nor a universally experienced one (Kennedy et al., 2020). Indeed, some people will decide to reside in a non-smart home in the future. Nevertheless, the home has always been a site for introducing and using new technologies. In addition to many other advantages, technology in the home offers comfort, convenience, companionship, security, and relaxation (Argandoña et al., 2021). However, it does not always achieve this effectively and without causing inconvenience because what experts try to accomplish with their devices and programs does not always align with what individuals and families expect or accept in their personal, private residences. It is not straightforward to learn to live in a smart home and make the most of its technological features (Argandoña et al., 2021), requiring the acquisition of new kinds of skillsets associated with new modes of housework

focussed on the installation, maintenance, repair, and configuration of smart technologies (Strengers & Kennedy, 2020; Strengers & Nicholls, 2018). Familiarity with technological environments has significantly created a sense of home (Chambers, 2020; Kaplan, 1983; Zhang et al., 2019). Yet at the same time, the ‘smart home’ is not simply a matter of bringing innovations into the home; it is not even enough to “embed” them in domestic spaces, because “these artefacts... are restructuring interactions, social order and relationships in the home” (Urquhart et al., 2019, p. 247).

The introduction of smart, digital, and virtual technologies alters people's lifestyles while enabling adaptation to a new lifestyle in a digitalized environment. Physical space has become less important, and emotive involvement has grown more volatile due to the usage and management of domestic space to meet modern and technological lifestyles (Argandoña et al., 2021). Additionally, the home's furnishings, decorations, and appliances work together to make up the home’s human world (Highmore, 2009; Miller, 2021). Architecture can provide the multidimensional experiences of space and time; the home correlates such sensations to the human actors in a structured and synchronized organization (Abdelmonem, 2016). In this sense, the design goal of residential spaces has always been to make the home space more ‘habitable’ in all aspects, including the physical/material, spiritual, psychological, emotional, cognitive, cultural, and symbolic ones (Findeli, 2010). Designers create material forms and envision future technologies, offering ways of living and human experiences, as well as thinking about demonstrating the intricate ramifications of technology in our daily lives (Dunn & Cureton, 2019).

According to scholars like Midal (2009) and Vial et al. (2010), the home environment, which includes the presence of technology, expresses a double bind dilemma quality. On the one

hand, technology design aims to produce something appealing and helpful to adopters (e.g., consumers of smart home technologies). On the other hand, there is a need being expressed by individuals who demand home makers taking more significant actions in terms of design and function as they become more and more conscious of the effects of bringing innovations into the home. As such, in terms of smart homes, architects should act in a way that encourages the smart home inhabitants' desires for user-centered projects rather than technologies that simply reflect that goals of designers' visions (Argandoña et al., 2021). In this sense, the future of the 'smart home' is neither a predetermined path nor an unavoidable destination (Argandoña et al., 2021).

This double bind is evidenced in the analytic results of this research, which find that images of smart homes published in trade architectural outlets conform to two visual modalities summarized in **Table 5.1**: images where smart technologies are highly *visible*, and those where these technologies are *hidden*. These two visual 'tropes' of smart home representation (where smart home technologies are highly visible, characterized by a particular type of aesthetics; and where they are invisible, characterized by a different dominant type of aesthetics; see **Table 4.5**) matter because they perform two kinds of linked 'work' simultaneously by deploying a range of semiotic signs summarized in **Table 5.1**. Specifically, these two modalities of images work semiotically to achieve two contradictory goals simultaneously: to *confirm* smart homes as conventional 'homes', and at the same time to signify smart homes as spaces for *new* and superior kinds of living.

6.2 Images where technologies are visible: building trust in the smart home

Smart home images in which technology is visible confirm for people – by which I mean viewers and readers of these architectural trade publications – that smart homes are still 'homes'

in the traditional sense, functioning as spaces of personalization, feeling secure, intimacy, and comfortable lived-in-ness, socialization, and relaxation. Indeed, 'home,' as defined in the key literatures, is more than merely a location but rather confers meanings of a comfortable, safe environment to relax and be entertained in (Intille, 2002). Specifically, smart home images in which technologies are visible semiotically deploy signs that visually *reassure* people that smart homes – the residential, domestic spaces into which smart technologies have been introduced- still **confirm** the (traditional, conventional, expected) meaning of the 'home' in this above-mentioned sense. For instance, **Figure 5.2** shows two women performing the domestic cooking task according to a recipe displayed on a large-format smart monitor. In this image, kitchen supplies are also visible in the background, which signifies a personalized smart kitchen where residents can perform routine daily activities such as cooking and communicating with one another in the heart of the home (the kitchen). 'Kitchen' in Western culture is the most common place in the home where residents usually gather and socialize (Johnson, 2006).

Elsewhere, **Figure 5.5** portrays a man who is carrying a child and walking towards a smart elevator as well as presence of a child's toy on the floor and a strewn rug in the background. These symbolic signs signify one of the conceptions of home as a place of lived-in-ness populated with personal belongings (toys) as well as a space for – and occupied by – families. Visual representations of the smart home as a conventional space for family and social intimacy as well as spaces for the introduction of new technologies is also evident in **Figure 5.6**. This image shows a couple holding hands – a sign of intimacy that may not necessarily be displayed in public – while watching a movie in a smart home theatre. The smart theatre symbolically refers back to a living room in a 'typical' home with comfortable furniture and a warm color palette on walls and furniture choices.

In semiotically deploying signs of the 'traditional' home, images in which smart home technologies are highly visible do the work of building **trust** in/amongst the public in the idea of the 'smart home' as an acceptable concept for domestic living (and as architectural spaces for living in). 'Trust' in this sense involves cultivating a feeling of a sense of control in an environment rendered unpredictable through the introduction of new kinds of technology, and the confidence to move forward into the future – e.g., moving into a smart home – despite the uncertainty of what life in a smart home may look like (Pink et al., 2018). Knowing how individuals use data and technologies to manage their lives helps us think through how the potential offered by the 'smart home,' 'smart city,' and other technology aspirations such as self-driving cars (autonomous navigation) may be socially accepted or rejected (Dourish & Bell, 2011). According to this theory, individuals only trust when they are sufficiently certain that any improvised activity is adequately restrained by a known procedure or environment, which involves subjective experiences of emotion toward something rather than merely cognitive choices (Pink et al., 2018).

The cultivation of emotional feelings of familiarity is crucial to securing social 'buy in' to the smart home concept. Routine is related to familiarity, people therefore feel at ease in routines and proud of themselves when they fulfill them (Pink et al., 2017b). Figures **5.2, 5.3** and **5.5** are a few examples of selected images in which smart home technologies are visible, showing inhabitants performing regular activities such as cooking and controlling the home lightning and heating through smart appliances. These images visually reinforce smart home environments as mapping onto 'familiar' spatial imaginaries and expectations of homes in the traditional sense, *and* also signify that (fictitious) residents of smart homes are at ease in these environments,

appearing to be familiar with working and managing smart devices and feel secure about utilizing them in their everyday life.

6.3 Images where technologies are hidden: smart homes as spaces for new kinds of living

At the same time, smart home images in which technologies are hidden are creating a visual discourse of the 'smart' home as a new kind of space that gives rise to new kinds of living: those where the introduction of 'smart' technologies addresses, and 'fixes' inconveniences associated with the conventional, non-smart home. Visual discourses are modes of visually representing the world in ways that reflect the interests of the powerful in Society (Rose, 2016) – in this case, the interests of digital technology companies and technoscientific capitalism in building and expanding consumer bases for their domestic technology products.

In this context, the visual discourse of smart homes in which technology is hidden as new kinds of homes – or reconfiguration of the spaces of the home in the traditional sense – 'matter'. For images of smart homes where technologies are visible, they are important because they build trust in the smart home concept. For smart home images with hidden technology, it could be that it is positioning the smart home as a desirable product – i.e., something to be chosen by consumers. This functions in a way to promote a particular lifestyle in smart living spaces designed by the recent minimalist features in which there is no need for additional support of habitats or equipment. As a result, the home environments in these images are predominantly depicted as pristine and sparse. Therefore, the promotion of this category of images builds aspirations for smart minimalist designed domestic spaces in which technology resolves all the messiness at home as well as managing the home functions. In other words, minimalism,

sparseness, and pristineness of interiors signal ’new ways of living’ where all menial household tasks are presented as being always already taken care of by smart technologies.

This visual discourse of the ‘inconveniences’ of the home as being resolved by the smart home includes alluded-to messiness and clutter in ‘traditional’ home spaces. Messiness and clutter are not only visually displeasing but are also signs of the need for domestic work – such as cleaning up and other menial tasks. Instead, the ‘smart home’ is represented as having already driven – or ‘taken care of’ – these trivial inconveniences. These include smart curtains or lightbulbs, which may be turned on/off with specific applications installed on a personal phone or laptop that negate the need to physically get up and turn on/off a light switch. Also, smart panels allow multiple house functions to be controlled at the touch of a resident’s fingertips from a single centralized console rather than running between different house rooms to do different tasks. While images such as **Figures 5.7, 5.8,** and **5.10** do not show obvious traces of such devices within the image frames, they show pristinely clean, sparsely furnished residential interiors that visually allude to the invisible, seamlessly incorporated technologies having already resolved the need for menial domestic work. They do so by visually contrasting against typical depictions of ‘conventional’ home spaces, such as that represented in **Figure 4.1**. **Figures 5.7** and **5.8** portray a minimalist designed living room in which minimal furniture is sparsely furnished and has no personal property. The living room is depicted as clean, adorned with basic and simple forms, materials are exposed, and a dark and neutral color palette is used on the walls and furniture, contrasting with an image of a non-smart home.

In other words, the first group of images semiotically expresses the ‘smart home’ as the solution to the messiness and chaos of home life. The infusion of technology in the home has resulted in domestic spaces taking on various additional functions, such that the home is now

serving as a place not only for comfort but also as a control center (Kennedy et al., 2020; Tirado Herrero et al., 2018). It is a space of new forms of labour (Strengers & Nicholls, 2018), and a place of technological consumption and production whereby the home accumulates, produces, and transmits information in vast quantities (Kennedy et al., 2020). As Strengers & Kennedy (2021) argue, introducing smart technologies introduces new kinds of housework centred around digital work (maintaining, configuring, installing, troubleshooting, and updating smart devices.). These new forms of digital housekeeping concentrate on the invisible forms of articulation work (the work to keep things working) required to retain digital media in practical working order and proper purpose in the domestic media ecology (Kennedy et al., 2020, ch. 2 & 4). For instance, **Figure 5.3** shows people doing digital 'housework,' setting up and managing the smart devices for specific functions.

Specifically, the second set of smart home images where technology is hidden is **reconfiguring** the meaning of the home by leading to a new meaning of what the purpose of a home is, what it means to live in a smart home, and how these purposes are achieved. In other words, these images give rise to a new semiotic 'myth' – or narrative – of the meaning of home. The smart home is still a space of relaxation, but one where relaxation means something new or different: enjoying technology-driven efficiencies. Smart home images in which hidden technologies extend the meaning of the home from a space of refuge to a site of scientific advancement that introduces technological efficiency into the domestic sphere in support of numerous recreation and work-related activities (Chambers, 2016, 2020). For instance, **Figure 5.11** demonstrates a man sitting by an expansive window and reading a book in a comfortable posture. Additionally, the presence of dogs sitting on the floor close to him in a well-organized home space filled with natural light signifies a peaceful living space in which to relax, feel

comfortable, and unwind without any visible sign of smart technology while alluding to the ‘smartness’ of the space as creating the conditions of possibility for this relaxation to occur. These conditions are semiotically expressed in this group of images in two ways. First, images where technologies are hidden are characterized by minimalist design aesthetics – such as that shown in **Figures 5.7** and **5.10** – visually-discursive constructs of the home as a space to be perfected by hidden smart technology, which is never messy and negates the need for extra appliances, ornaments, and furniture. (Bertoni, 2002), working with a small group of minimalist designers, reflects their conception of a minimalist architectural space as the idea of vital activity of a modern human, a sentiment echoed by Nussaume (p.2, 2009) who contends that " minimalist architectural spaces totalize simplicity as a way of life." The minimalist design aesthetic of these images of smart home environments in which technologies are hidden positions seamlessly incorporated (invisible) smart technologies as ‘tools’ for attaining this perfected standard of living (Gudkova, 2014).

Second, in this group of images where technologies are hidden, the smart home's emptiness and absence of clutter express another purpose of living in a minimalist-designed smart home: resistance to the consumerist society (Gudkova, 2014). The ‘natural’ forms and emptiness of interiors, such as those depicted in **Figures 5.7, 5.8,** and **5.10,** express the rejection of the capitalist imperative to acquire ‘stuff’ – lots of furniture, decorative ‘kitsch,’ and other items. This is contradicted by the fact that smart home technologies represent (often) luxury consumer products that likewise need to be accumulated; however, the visible absence of these technologies within these images does not bring this to the viewers' attention/readers. Smart home environments with hidden technology are furthermore visualized as almost depersonalized, as there are almost no signs of personalization of space across a cross-section of these images

(e.g., **Figures 5.7, 5.8, 5.9, 5.10,** and **others.)**. In his paper, Stevanovic (2013) discusses ideas such as emptiness and simplicity that have been distinctive to minimalism since it first emerged. Clutter is unneeded in a smart, automated, and minimal home where technology is hidden since the space itself is the pinnacle of the efficiency brought about by the "smart" home technologies. In this regard, images semiotically inform imagery of a smart home as a space where technologies can take care of everything and perform tasks without needing personal items. Smart home images signify that not only is smart technology considered 'enough' at home, but it also brings up the main slogan of the architecture of minimum, which is "Less is more." For example, **Figure 5.10** represents a minimalist smart kitchen in which technology is hidden and personal belongings are not visible as in a conventional non-smart home. While the shapes are pristine and simple, there are no signs of residents, and their presence is obscured. In a conventional non-smart home (e.g., **Figure 4.1**), there are multiple signs of lived-in-ness, including a strewn blanket, decorative items, and books on bookshelves that express a private and personal living environment.

6.4 Summary

Overall, smart homes in both categories of images semiotically signify meanings regarding confirmation and trust smart home as a conventional 'home,' and at the same time signify a living space for a new, superior, and effective kind of living which plays into the 'double-bind' dilemma quality. These meanings are transferred through signs of home and smartness identified in previous chapters.

In the first set of smart home images, home is where routine activities like washing, cooking, and leisure may be made more efficient and easier due to positioning foregrounded

smart appliances. Smart home technologies, meant to boost leisure time, need to disregard household work (Hargreaves et al., 2018). However, using smart technology results in introducing new types of housekeeping centred on digital housework. These new forms of digital housekeeping focus on the unseen articulation labour necessary to keep digital media in useable working conditions (Kennedy et al., 2020, Ch. 2 & 4). Secondly, the representations of a smart home where technology is visible build trust by mobilizing semiotic tropes of a non-smart home and confirm to the viewers that it is still a home in which to socialize, work, relax, and be entertained. Furthermore, this set of images presents inhabitants who have control over smart home functions through various smart appliances located in different spots at home.

On the other hand, smart home images with hidden technology express distinctive visual signatures and design aesthetics of a desired and well-planned living space. Smart home images in which technology is not visible are represented as considerably spacious and pristine. They are distinguished by their minimalist design features that make the smart home more aspirational to live in. This visual discourse of smart homes semiotically conveys that all housework, inefficiencies, and messiness in the home are taken care of by hidden smart technologies. This situation results in increasing convenience as well as showing that no labour is required to be implemented within the home. In these smart homes, hidden smart technology takes care of the household and rescinds the need for extra appliances and housework. Subsequently, smart home images where technologies are hidden express a pristine and minimal smart domesticity in which technology not only ministers smart home functions but also eliminates occupants performing menial tasks.

The contributions of this research, the limitations that the researcher has faced in data collection and analysis, and directions for future studies are discussed in the next section (**Chapter 7**), the Conclusion.

Chapter 7: Conclusion

7.1 Introduction

This thesis examines whether there is a shift in the meaning of the 'home' associated with the rise of 'smart' home technologies as expressed in representations (images) of smart homes in architectural trade publications. It does so by mobilizing content, compositional, and semiotic visual analysis as a methodological framework. This chapter summarizes the findings of the research, identifies the limitations of this study, and provides suggestions for future research directions.

A smart home coordinates advanced communication, sensory, and control technologies to form an automated and context-aware domestic environment (Alam et al., 2012) (Vimarlund & Wass, 2014). This study aims to address the research questions specified in **Chapter 1** which are how smart homes are portrayed in architectural trade publications, and how smartness ushered in by smart technologies is reconfiguring a sense of home Further how these changes maybe identified in visual signature of smart home based on architectural design aesthetics in these publications. To achieve the stated research objectives, I collected a sample of 360 images selected from five architectural magazines (ICON[1], Canadian Architect[2], Control4[3], Home & Design[4], Dwell[5]) and a website (ArchDaily website[6]), where the images had been published over a three-year period (2018-2020). To analyze these images, I have utilized a visual methodology approach that has included the mobilization of specific visual analytic techniques, such as visual content, compositional, and semiotic analysis. I coded images based on their content and composition to discover key patterns related to smart home representation, as they compare and contrast against visual representations of a traditional, or conventional (i.e., non-smart) home (**Figure 4.1**).

This approach establishes the importance of mass public consumption towards informing our (societal) evolving understanding of the meaning of the home. Analysing smart home images in architectural trade publications based on the design aesthetics plays an active role in residents' acceptance of living in a smart environment and establishes whether there are connections between the architectural design of the home structure and understanding of smart home spaces by audiences. Architectural magazines and websites frequently reinforce the prevailing stereotype of what a smart home (and, where present in the image frame, its occupants) look like, and how senses of home are created.

The visual analysis of smart home images reported on in this thesis is informed by and contributes to the literature regarding the home, smart home, and aesthetics of architecture elaborated on in **Chapter 2**. It also makes contributions to scholarly fields, including geography, media studies, sociology, and architecture. Specifically, this project addresses a linked gap in these literatures, where little attention has been given to how smart homes are visually presented to viewers, nor how these representations contribute to cultivating new understandings of the meaning of the home. Additionally, how the elements of these images – and their design aesthetics – function as signs of ‘smartness’ and ‘home’ in visual representations of smart homes in architectural trade publications is a missing concept in the current literature.

On the basis of my visual content and compositional analysis, I identified two dominant modes of smart home representation: images where smart home technologies are visible, and those where smart home technologies are hidden. I followed this with a semiotic analysis of the images in my dataset. I used semiology, or the study of signs, to identify how key elements of the selected images functioned to express and visually convey meanings of ‘home’. Specifically,

I found that image elements identified through my content and compositional analysis signified both traditional meanings of home and shifting meanings of home.

This research attempts to address how the two identified modalities of visual representations of smart home spaces (a smart home in which technology is visible and a smart home where the technology is hidden) are doing two kinds of 'work' simultaneously; to *confirm* smart homes as conventional 'homes' and reconfigure the meaning of the home as a space for *new* and superior kind of domesticity. As discussed in **Chapter 6**, analysing the visual representations of 'smart homes' in architectural trade publications shows that smart home representations in which technologies are visible mobilize the semiotic tropes of a typical home and expresses a traditional sense of home as a place where the home's inhabitants can socialize, work, and be entertained. They do so by representing smart homes as spaces that are 'lived in' by visualising housework activities. Moreover, they mirror non-smart ('typical') home interior design aesthetics and mobilize symbolic signs of 'home' such as densely furnished home space(s) littered with personal effects and personalized objects. Examples of this mobilization include the arrangement of comfortable furniture around the TV, messiness and clutter in space, use of neutral colour palettes, the inclusion of several decorative objects, as well as portraying individuals performing daily activities. In this sense, smart home images in which technology is visible offer reassurance to people to trust a smart home as a home, on the basis that it resembles a home in the traditional sense. In a smart home, trust involves cultivating a sense of control in an unpredictable environment and the confidence to move forward into the future (Pink et al., 2018). These images also suggest those (fictitious) occupants of smart homes feel comfortable in these settings and appear to operate and manage smart gadgets with ease. These images

emphasize how smart home surroundings map onto "known" spatial imaginaries and expectations of traditional homes.

Conversely, images of smart homes in which technology is hidden show new and largely depersonalized living spaces characterized by pristineness, sparseness, depersonalization, and simplicity in design aesthetics. These images express a new vision of a home in which messiness, clutter, and personal properties are missing, which works as a direct *contrast* to imaginaries and visual representations of traditional, (non-smart homes) as typified by **Figure 4.1)**. These smart home images in which technologies are purposefully hidden suggest that it is the seamless (invisible) integration of smart technologies that immediately and pre-emptively takes care of the regular, expected chaos and messiness of 'home'. In other words, images of smart homes with concealed technology are establishing a visual narrative of the smart home as a new type of space that inspires novel ways of living: those in which the use of smart technologies eliminates and fixes the limitations of the conventional, non-smart home. Images where technology is invisible are depicted with minimalistic design aesthetics. The natural shapes and emptiness of the interiors represent a rejection of the capitalist need to accumulate things, while also visually 'selling' the integration of smart home tech necessary to achieve the perfected vision of 'home' advanced by this group of images.

7.2 Contributions

My interpretation of smart home images through analysis of the content, composition, and signs in images shows that smart home representations compared to a non-smart, 'typical' home not only corroborate conventional understandings of home as a living space where occupants can work, socialize, and unwind, but also identify the rise of distinctive concepts of

home as a new and superior kind of space to live. Likewise, the architectural design aesthetics of smart home images with hidden and visible smart technology as compared to a 'typical', non-smart home typified in **Chapters 4** (content and compositional analysis) and **5** (semiotic analysis) express the connections and differences in the visual patterns of representations of smart domestic spaces. In summary, the analytical discussion regarding the findings of this analysis not only speaks to theories and concepts regarding smart homes and conventional homes in the key literatures but also leads to new meanings in association with the visual representation of 'home' and 'smart homes'. Furthermore, this research offers a substantive context in terms of the main ideas of smart home architectural design aesthetics and how the design features of a non-smart home are mobilized in smart living spaces. Using semiology as a research tool to analyze imageries of smart living environments based on visual aesthetics is a novel contribution of this research.

This study is relevant to geographers, sociologists, media scholars, and other social scientists, as well as architects, who engage with concepts, meanings, and representations of the home. The findings of this research nuance our understanding of the evolving nature of 'home' visualizations in terms of the aesthetics and cultural significance of the home. Further, the approach taken to interpret smart home images and investigate the shift in the meaning of the nature of the home establishes the importance of mass public consumption towards informing, changing or evolving the meaning of home. In this case, the analysis of smart home images shows how they are active in contributing to this change. Blunt & Varley (2004, p.3) have proposed that "ideas of home" can "invoke a sense of place, belonging or alienation that is intimately tied to a sense of self." This viewpoint is instructive because it permits us to consider

how the home is continuously being both reconstituted and what processes this involves, including the circulation of visual representations.

7.3 Limitations of this research

While conducting this smart home visual analysis research, I faced several challenges in terms of data collection and data analysis. First of all, the issue regarding the collection of smart home images from trade architectural magazines is that many of these publications require paid subscriptions to access, which limited my sample to outlets that provided free and public access to imagery. I also could not reproduce all the images collected as part of my sampling strategy due to copyright. This meant that I could only reproduce images in this thesis that viewers have free access to, do not focus on a specific smart device without showing the home space, are clear without a blurry background, do not include any text in the image, and are not animated images. This also had implications for my semiotic analysis – which involves a detailed discussion of signs in particular images, as well as how image elements work together in a way that requires readers to be able to see the images being discussed – which was limited to the images that I could reproduce. Additionally, the smart home images collected from architectural magazines and a website represent a selective, rather than representative, sample of smart home images appearing in architectural media during the timeframe of data collection (2018-2020).

A second limitation of this research is that there is a gap in the literature regarding how the smart home is envisioned according to socio-cultural implications of the concept of ‘smart home’ and design aesthetics. Therefore, it has been a challenge to back up the ideas, interpretations, and results of this analysis with references to key literature. This is particularly because, as detailed in my literature review (**Chapter 2**), the majority of research on smart

homes emphasizes the technological, energy efficiency, surveillance, and technical aspects of the home rather than its representations and is not visual in nature in terms of the data sources and analytic methods. And third, in terms of smart home image analysis, the approaches I utilized are not without their limitations. Fundamentally, there is always some level of subjectivity associated with the semiotic interpretation of images. What we "see" in an image is filtered through our subject positionalities and life experiences. When we look at an image, we are looking (consciously) at the connections between ourselves and the image such that there can never be a genuine comprehension of what a picture is "saying" (Rose, 2007, p. 10). In semiology, there is no stable point that can provide an entrance into the meaning-making process; all meanings are relational within the image (Rose, 2016). Semiotic analysis of smart home images which involves finding signs of home and smartness in images and communicating what they signify appears to be a compounded work since different people have distinct ideas associated with interpreting specific signs which can be dissimilar to others' opinions. Therefore, to make sense of my visual analysis of smart home images, I employ a recursive emic coding of images to support my interpretations and key findings.

7.4 Directions for future research

This research contributes to current and future research to show how smart home advertisements can play an important role in the public social acceptance or rejection of the smart home concept. In other words, by drawing on this study, social research that involves human participants/subjects can target to evaluate which elements of visual images of smart homes are alienating or appealing to them or what attractive factor in design can turn people off the smart home concept or convince them of the concept. This research suggests calling for more

visual-based research on smart homes by paying attention to the visualizations of the smart home and exploring how smart homes would look in the future of smart housing development in forthcoming studies. Future research could also consider how social differences and inequalities of race, class, and gender are represented and reproduced in smart home imagery in architectural trade publications.

Finally, the aging of the population poses a number of challenges to features of home life and the way the house is tied to society, most notably an increase in the proportion of the population in need of care (Argandoña et al., 2021). Such forecasts emphasize the significance of continuing research on information and communication technologies (ICTs) and housing design for older people and those who care for them, to respond to the needs of aging at home (Medeiros et al., 2012). Homes designed for the needs of the elderly differ significantly from those used by young families or those of several generations (Argandoña et al., 2021).

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